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Dynamic Panel Analysis of Systemic Banking and Financial Crisis: The Role of Fiscal Policy

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Abstract

Is fiscal indiscipline a threat to systemic banking crises and financial stability? Given the unique challenges faced by the financial sector in developing economies after long periods of unfunded budget deficits, this paper argues that systemic derivatives of fiscal policy inconsistencies can trigger banking crisis. Specifically, the financial risks posed by fiscal indiscipline—a policy regime characterized excessive spending, inadequate revenue collection, persistent budget deficits, and high public debt can instigate instability throughout the economy. The paper showed empirically that in a dynamic binary response model environment, government deficits are more likely to result in a systemic banking crisis. More importantly, the likelihood of systemic banking crisis increases as government deficit begins to rise, reaches a maximum, and then diminishes after a certain threshold. Second, as the GDP default weight of a country increases, the probability of systemic banking crisis falls in both a static and a dynamic environment. Finally, systemic banking crisis spurred by fiscal deficit has domino effect, with exchange rate against the dollar plays negligible role. We conclude that running unfunded fiscal deficit as a long-term policy framework requires prudent financial management to mitigate these risks posed by the deficit overhang.

Keywords

Systemic Banking Crisis, Government Deficit, Dynamic Binary Response Models, Twin Crisis, Financial Stability

1. Introduction

The stability of the banking system and the general economy are inherently tied to robust institutional frameworks and sound macroeconomic policies. In many developing economies, weak regulatory frameworks and expansive informal sec-

tors limit tax revenue collection and other policy tools and make it harder to manage the risks associated with fiscal deficits (Asuako, 2025). This revenue shortfall contributes to persistent structural deficits. Furthermore, underdeveloped capital markets restrict governments' ability to borrow, compelling them to resort to monetary financing-a practice that undermines the traditional money-creating mechanism within the banking system. Additionally, central banks often face political pressure to prioritize deficit financing over controlling inflation. This dynamic creates a state of fiscal dominance, where monetary policy decisions are shaped primarily by fiscal policy needs rather than inflation management. Governments facing large deficits resort to unsustainable measures such as excessive borrowing from domestic banks, which increases systemic risk. If banks become overly exposed to government debt and economic conditions worsen, the chances of a banking crisis rise (Burnside et al., 2001; Mendoza, 2010). To mitigate these risks, developing countries need strong fiscal discipline, sound monetary policies, and well-regulated banking sectors that can withstand economic shocks.

Gonzalez-Hermosillo et al. (1997) demonstrated that fiscal deficit put a strain on the balance of payment position which create systemic banking failures. They contend that the monetization of deficits to finance endless unplanned expenditures on annual basis, expands the money supply, intensifying inflationary pressures and causing unpredictable trade deficits and leading to worsening BOP. This fiscal practice frequently results in persistent inflation, currency depreciation, and rising public debt, which destabilize the economy. The uncertain macroeconomic environment often precipitates sovereign default and corporate bankruptcies, creating systemic risks that undermine banking sector stability (Asuako, 2025). Kaminsky and Reinhart (1999) highlight how banking sector problems can trigger currency crises which compound financial vulnerabilities and introduce new risks that further weaken the banking sector. This feedback loop restricts the banking sector's ability to allocate capital efficiently, limiting business expansion and stifling economic innovation. Given these dynamics, examining the financial stability risks stemming from running unplanned fiscal deficits is essential for understanding how such practices exacerbate financial vulnerabilities, erode long-term financial stability, and sustain macroeconomic imbalances.

Additionally, Burnside et al. (2001) reinforce the importance of fiscal policy in financial stability. They argue that the 1997 Asian financial crisis was significantly influenced by anticipated government bailouts of failing banks, which were expected to be financed by running large deficits. This expectation led to speculative attacks on Asian currencies and the eventual collapse of fixed exchange rate regimes in the region. Similarly, Corsetti and Maćkowiak (2006) show how fiscal imbalances can create conditions conducive to financial crises by sparking speculative attacks and severe currency depreciation. Applying the Fiscal Theory of Price Level, they highlighted the crucial role of fiscal deficit for financial stability, specifically by looking at currency crisis.

Again, fiscal deficits can have a significant impact on banking crises in devel-

oping countries. When governments consistently spend more than they earn, they often rely on borrowing, which can crowd out private sector lending. As public debt rises, banks may be pressured to purchase government bonds rather than lend to businesses and households. This reduces credit availability, slowing economic growth and increasing the risk of financial distress. If the government struggles to repay its debt, banks holding large amounts of government securities may face liquidity shortages, making them vulnerable to crises. While fiscal indiscipline may cause systemic banking crises, such crises in Africa amplifies the interest rates applied to sovereign loans in the international financial market thus exacerbate the problems of sovereign default across the continent (ADB, 2008).

Moreover, fiscal deficits can lead to inflation and currency depreciation, both of which weaken the banking sector. When governments finance their deficits through excessive money printing, inflation erodes the real value of bank assets and deposits, leading to reduced confidence in the financial system. Currency depreciation can further strain banks, especially those with foreign-denominated liabilities. If local banks rely on external funding, a weaker domestic currency increases the cost of repaying foreign debts, raising the likelihood of defaults and financial instability.

While fiscal indiscipline plays a crucial role, systemic crisis in developing economies has been attributed to poor institutional arrangements, imbalances, mismanagement of resources, industrial sector stagnation and many other factors. Mezui et al. (2012) ascribed weak structural (poor governance, high non-performing loans, inadequate regulations) and weak macroeconomic background (current account deficits, negative fiscal balances, high inflation, and interest rates) as the major causes of systemic crisis.

Additionally, many systemic financial crises, especially those in developing countries turn out to be twin crises with inflation and currency depreciation worsening banking sector problems through exposure to the domino effects of the dollar and CFA as superior currencies. In the latter part of the 20th century, several advanced economies and developing countries and economies in transition experienced severe banking crises. Also, the global financial crisis in 2008 started with banking and financial institutions having worthless assets and mortgages on their balance sheet. Such proliferation on large scale banking sector problems has raised widespread concern, as banking crises disrupt the flow of credit to households and enterprises, reducing investment, consumption and possibly forcing viable firms into bankruptcy. Banking crises may also jeopardize the functioning of the payment systems and undermine confidence in financial institutions, they may reduce domestic savings or cause large capital outflow.

Demirgüç-Kunt and Detragiache (1997) determined that low GDP growth, excessively high real interest rates, and high inflation significantly increase the likelihood of systemic problems. Diamond and Dybvig (1983) confirmed that crises do not appear to be solely driven by self-fulfilling expectations. However, Gorton (1988) examining the determinants of bank runs in the U.S. during the nineteenth

century reported that adverse terms of trade shocks also tend to increase the likelihood of banking sector problems, though the evidence is weak. The paper indicated that size of the fiscal deficit and the rate of depreciation of the exchange rate do not seem to have an independent effect on systemic banking crisis. In this study, we revealed the size of the deficit matters for systemic banking crisis, but the effect diminishes after a certain threshold.

Turnell (2003) Banking crises are costly. They damage the integrity of the payments system, distort and disrupt credit, compel the sale of assets and the destruction of asset values, force the liquidation of viable economic enterprises, traduce a country's risk profile, create wealth and output losses, and harm economic stability more broadly. Amit Ghosh (2016) espoused the view that greater banking sector globalization to reduce the occurrence of banking crisis. Moreover, greater bank asset concentration, diversification, credit flows, real interest rates, inflation rates, M2-to-foreign exchange reserves and nominal exchange rate depreciations significantly increase the likelihood of banking crisis, while higher bank profits, real GDP growth, economic development and economic freedom lower such chances. Gills (2010) agrees with this view and further argued that the protracted and severe financial and economic crisis in 2008 is only one aspect of a larger multidimensional set of simultaneous and interacting crises on a global scale. The article constructs an overarching framework of analysis of this unique conjecture of global crises involves the three principal crisis aspects are: an economic crisis of (over) accumulation of capital; a world systemic crisis (which includes a global center-shift in the locus of production, growth and capital accumulation), and a hegemonic transition (which implies long term changes in global governance structures and institutions); and a worldwide civilizational crisis, situated in the sociohistorical structure itself, encompassing a comprehensive environmental crisis and the consequences of a lack of correspondence and coherence in the material and ideational structures of world order. All three main aspects of the global crisis provoke and require commensurate radical social and political responses and self-protective measures, not only to restore systemic stability but to transform the world system.

Kotz (2008) presented a case that the financial and economic crisis that began in the United States in 2008 creates a systemic crisis of neoliberal capitalism. The same institutional features of neoliberal capitalism that promoted a series of long economic expansions over several decades also created long-run trends that have led to a systemic crisis. Freixas (2009) postulated that monetary policy during the 2008 financial crisis from the perspective of the theory of the lender of last resort create crises, vanish liquidity, and collapse the interbank market, central banks had to inject much more liquidity at low interest rates than predicted by standard monetary policy models. At the same time, as the interbank market does not allow for the redistribution of liquidity among banks, central banks had to design new channels for liquidity injections making monetary policy ineffective in curbing the financial crisis.

Given these dynamics, examining the financial stability risks stemming from the reliance on monetization to address structural deficits is essential for understanding how such practices exacerbate financial vulnerabilities, erode long-term financial stability, and heighten the occurrence of systemic banking crisis. More importantly, the use of asymptomatic variables enshrouds the importance of signals in predicting systemic banking crisis. This analysis tries to bridge the gap in existing literature by drawing inference on evidence from 14 African countries help predict systemic crisis. Also, though many economic events can be predicted with some high probability, predicting or anticipating systemic banking crisis can be challenging. Systemic banking crisis shows both an intellectual and predictive challenge to economists, and thus we try to improve the forecasting model by imposing more realistic assumptions. One way to deal with that is by using symptomatic variables and predictors as signaling measures to predict crisis. Though the occurrence of one indicative predictor may not necessarily give enough information on the surety of a future crisis, it does give a lead to those other factors that must be monitored since most economic crises are interrelated. This analysis employs a logistic and probit regression model, estimates the model with random effect, fixed and dynamic effect. Rather than focusing on the behavior of high-frequency time series around the time of the crisis, we also perform a predictive analysis of the determinants of banking crisis with a binary response model specification.

2. Data

The analysis uses a derivative of Reinhart *et al.*'s Global Financial Stability dataset on Debt, Financial, Inflation and Systemic Crises that occurred, from 1860 to 2014, in 14 African countries, including: Algeria, Angola, Central African Republic, Ivory Coast, Egypt, Kenya, Mauritius, Morocco, Nigeria, South Africa, Tunisia, Zambia and Zimbabwe. The original data collected over many years by Carmen Reinhart (with her coauthors Ken Rogoff, Christoph Trebesch, and Vincent Reinhart). These include Banking Crisis dates for more than 70 countries from 1800-2014, exchange rate crises, stock market crises, sovereign debt growth and default, and many other data series. Data on government deficit and GDP was retrieved from estimates by the International Historical Statistics; Africa, Asia and Oceania 1750-2000 collected by Brian Mitchell (Mitchell, 2003). GDP and government deficit data had intervals, but the missing data was less after 1920. We therefore use the cubic spline method to interpolate for the period with missing data since it ensures smoothness, continuity, and flexibility in the reconstructed data. Also, the method preserves the underlying trend and curvature of macroeconomic variables, especially in historical data where structural shifts and gradual changes are common. Due to data limitation on government deficit and debt service ratio, the analysis used data from 1920 to 2014 instead of the full sample period. Note that data on GDP for the sample period can also be found at the Madison project database. The panel is unbalanced and therefore lag variables and out-

of-sample analysis only considered period where all countries have data available. It's worth mentioning that after World War II, more specifically between the 1950s and 1960s, there was a transition from colonial governments to independent states. Most countries were using their colonial master's currency as medium of exchange. This can be seen from the observed data. Angola was the last country on the list to achieve its independence and Algeria the second to last. South Africa was still battling apartheid for most part of the period though they were independent.

From Figure A1, there is high correlation between banking crisis and systemic crisis, of about 86%. This explains why most African countries that experience banking crisis also experience systemic crisis. Inflation annual CPI explains relates to inflation crisis explaining about 56% of inflation crisis. Independence and exchange rates have about 51% correlation with year, showing that exchange rate increase with years and therefore not stationary overtime. There is a strong negative correlation between exchange rates and systemic crisis.

Currency valuations are determined by the flows of currency in and out of a country. Exchange rates fluctuate depending on several factors including a nation's economic activity and growth prospects, interest rates, inflation rate, balance of payment position, government debt, terms of trade, speculations, etc. When currencies fluctuate wildly, they can create economic uncertainty and instability, affecting capital flows and international trade. The value of the domestic currency in the foreign exchange market is an important instrument in a central bank's toolkit, as well as a key consideration when it sets monetary policy. Directly or indirectly, the exchange rate affects several key economic variables.

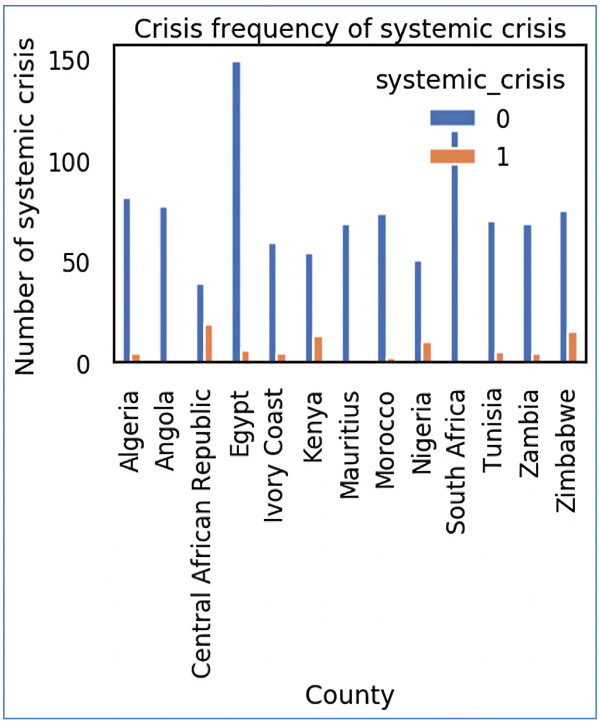

Figure 1. The number of systemic banking crisis by country.

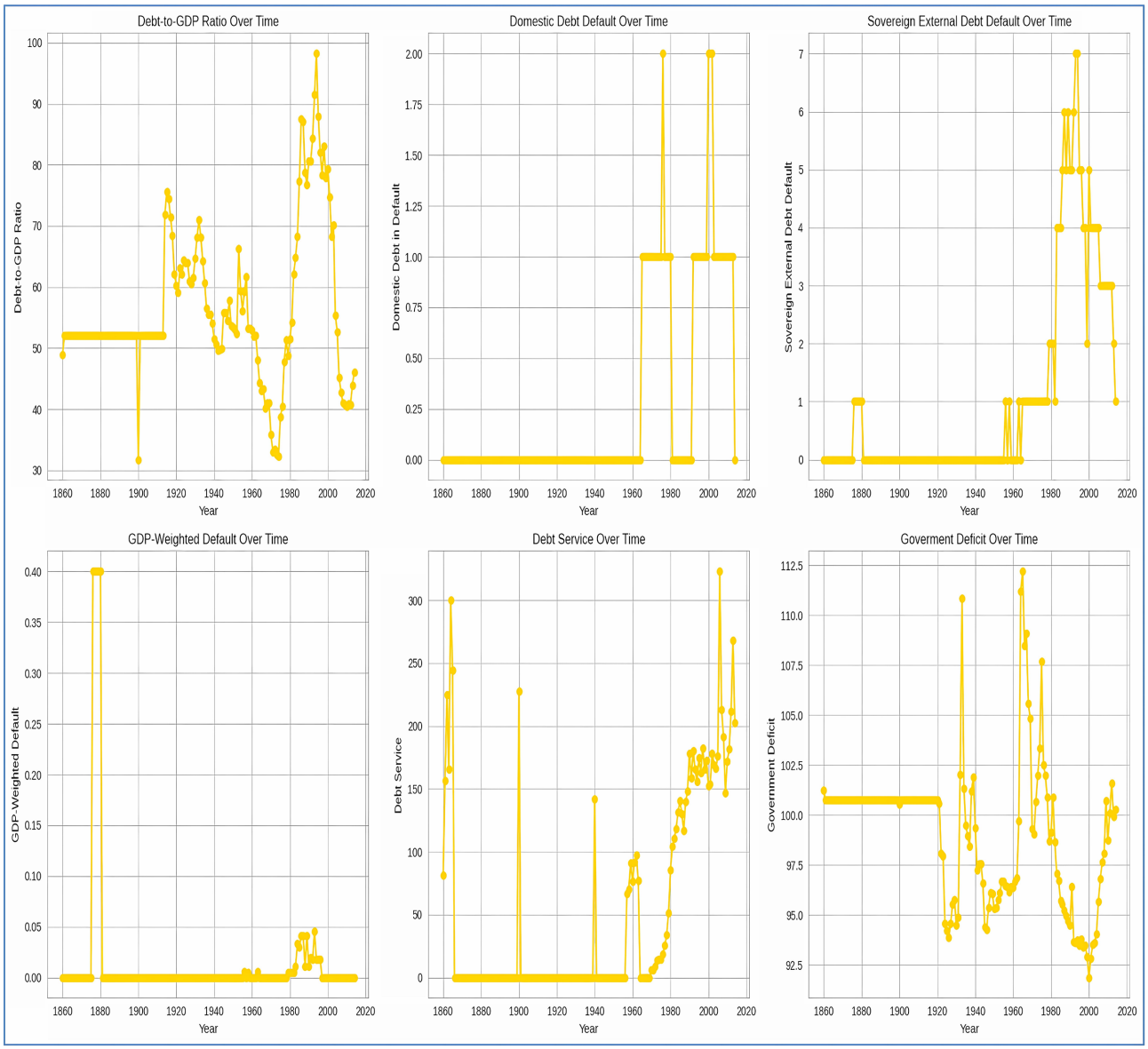

Figure 2. Average levels of selected crises over time..

[1]From **Figure A2**, Central Africa Republic, Ivory coast, and Zimbabwe have the largest default on external debt for about 33, 30 and 29 years, respectively. Most African countries were still experiencing political turmoil within the sample period. This variable affects the creditworthiness of countries. Mauritius has never defaulted on external debt over the period captured. Central Africa Republic, Kenya, and Zimbabwe had the highest number of systemic crises. South Africa, Angola, and Mauritius had never experience systemic crisis. From **Figure A3**, the Central African Republic had the highest median and the highest maximum al-

[1]Maddison Project Database, version 2020. Bolt, Jutta and Jan Luiten van Zanden (2020), "Maddison style estimates of the evolution of the world economy. A new 2020 update. This databased has GDP information for the selected countries. The data from 1900-1965 were curated using historical evidence the Madison project database.

ready registered exchange rate of the country vis-a-vis the USD. Ivory Coast appears with the second-highest maximum already registered. During widespread bank runs, an abnormal number of people try to withdraw their deposits. From Figure 1, Central African Republic, Nigeria, and Zimbabwe have faced the largest banking crises in African countries over long periods. Morocco, South Africa, and Mauritius have faced banking crises for a shorter time span. Angola and Zimbabwe are the only countries with domestic debt in default for about 12 and 30 years respectively (Figure A2). This implies the cost of doing business in both countries probably would increase since the government had to pay higher interest on loans and bonds to compete with businesses. The impact on the economy extends beyond this domain and the potential for banking crisis increases. Figure 2 shows that Most countries started experiencing crises in the 1920s. For most part of the 1800 to 1920, there were not many crises.

From Figure A4, inflation was above target for many countries, especially after independence. Zimbabwe experienced some of the worst inflation levels. Tunisia and South Africa, however, experienced the least fluctuation in inflation levels after independence. Furthermore, Table 1 gives the summary statistics of the data. Systemic crisis has a mean of 0.136, while banking crisis has an average of 0.145. Exchange rate average is 61.04 for the sample period and the average government net expenditure is around 96.290.

Table 1. Descriptive statistics.

Variable	Description	Mean	Std. dev	Min	Max
systemic crisis (SC)	Whether there is systemic crisis occurred in the year (Yes = 1, No = 0)	0.136	0.343	0	1
Domestic debt in default	Measures if there is sovereign domestic debt default occurred in the year (Yes = 1, No = 0)	0.050	0.219	0	1
sovereign_external_debt_default	Measures whether there is sovereign external debt default occurred in the year (Yes = 1, No = 0)	0.244	0.430	0	1
GDP default weight	The total debt in default vis-a-vis the GDP. (Yes = 1, No = 0)	0.008	0.049	0	0.4
Independence	Whether the country is independent from colonial rule. (Yes = 1, No = 0)	0.968	0.174	0	1
Log GDP	The total output of goods and services per year	13.936	4.152	4.094	35.824
Currency crises	Measures that there is currency crisis occurred in the year (Yes = 1, No = 0)	0.618	0.485	0	1
Inflation crises	The inflation crisis occurred in the year (Yes = 1, No = 0)	0.141	0.348	0	1
Exchange rate (USD)	The exchange rate of the country vis-a-vis the USD	61.045	135.241	0	744.306
Banking crisis	The country experiences a banking crisis occurred in the year (Yes = 1, No = 0)	0.145	0.352	0	1
Government Deficit	Government Expenditure in excess of revenue percentage	96.29	17.807	40.492	197.133
Debt Service Ratio	The debt servicing ratio of country	125.733	189.308	0	1342.478
Inflation	The general price level in a country	38,508	918,631	−8.823	2,198,969

3. Econometric Methodology

Following Dumitrescu et al. (2012), Eric (2012), Arestis et al. (2010), we adopt a dynamic binary response model, leveraging logistic and probit regression techniques, to estimate the probability of systemic banking crises occurrence based on fiscal deficit and key macroeconomic indicators. The dependent variable of the binary model is;

$$y_{it} = \begin{cases} 1, \text{ if the country } i \text{ experienced systemic banking crisis at time } t \\ 0, \text{ if the country } i \text{ experienced no systemic banking crisis at time } t \end{cases}$$

To examine the role of fiscal deficit and other fundamental variables in predicting systemic banking crises, we specify the following general dynamic binary response model:

$$P\left(y_{it}=1 \mid X_{it,yit-1}\right)=\Phi\left(\alpha+x_{it}'\beta+\delta_1 y_{it-1}+\varepsilon_{it}\right) \tag{1}$$

x_{it} is a vector of macroeconomic predictors, α is a constant term, β is the coefficient vector for explanatory variables, ε_t represents the error term. To assess the presence of dynamic effects, we introduce lagged dependent variables and macro-financial indicators as explanatory variables. We are interested in forecasting crisis using different explanatory variables and models. Therefore, we specify the information set as

$$\left(y_{it} \mid \Omega_{it-1}\right) \sim \beta\left(p_{it}\right) \tag{2}$$

Based on the information set, the conditional probability according to the Bernoulli distribution can be specified as:

$$p_{it}=E_{it-1}\left(y_{it}\right)=P_{t-1}\left(y_{it}=1\right)=\Phi\left(\pi_{it}\right) \tag{3}$$

E and P in Equation (3) signify the conditional expectation and conditional probability given the information set Ω_{t-1}, whereas $\Phi(\cdot)$ is the cumulative distribution function (CDF) of the logistic or normal distribution. The former assumption leads to a probit model, whereas the latter leads to a logit model. π_{it} is a linear function of explanatory variables included in the information set Ω_{it-1}. In a dynamic binary response model, the π_{it} is specified following Nissilä (2020):

$$\pi_{it}=\alpha+X_{it-k}'\beta+\delta_1 y_{it-1} \tag{4}$$

The binary response model above can be modified to include any number of include any number of lags of the dependent variable. We extend the equation to include lag of explanatory variables as;

$$\pi_{it}=\alpha+X_{it-k}'\beta+\delta_1 y_{it-1}+\alpha_1\pi_{it-1} \tag{5}$$

From the above, the forecasting procedure of systemic banking crisis in a mean square sense, is an optimal h-period forecast of y_t based on information at a time $t-h$ is given by the conditional expectation $E_{t-h}(y_t) = P_{t-h}(y_t = 1)$. By the law of iterated conditional expectations $E_{t-h}(y_t) = E_{t-h}(\Phi(\pi_{it}))$, where π_{it} is given by the binary response model specification from Equation (3)-(5).

For simplicity, let's consider the dynamic probit model. The optimal one-period forecast at time $t-1$ in the mean square sense is obtained directly from an

equation:

$$p_t = P_{t-h}\left(y_{it}=1 \mid X_{t,yt-1}\right) = \Phi\left(\alpha + X'_{t-k}\beta + \delta_1 y_{t-1}\right) \tag{6}$$

where P signifies again the conditional probability. The multiperiod forecasts can be constructed either directly or in an iterative way. In a direct approach, an optimal h-period ahead forecast at time $t-h$ is obtained by an equation:

$$p_{it} = P_{it-h}\left(y_{it}=1 \mid X_{it,yit-1}\right) = \Phi\left(\alpha + X'_{it-k}\beta + \delta_1 y_{it-1}\right) \tag{7}$$

Assuming that $k, l \geq h$ so that the lagged values are known at time $t-h$. It has been common to choose the lag orders k and l in a way, that the most recent values of the explanatory values and the crisis indicator are employed. For example, Dueker (1997) applied the above model with selection $k = l = h$ and Estrella and Mishkin (1998) applied the static probit models with a choice $k = h$. However, Kauppi and Saikkonen (2008) have argued that the most recent values may not be the most optimal and instead, the lag orders should be selected by statistical procedures.

In direct approach, the optimal h-period ahead forecasts can be obtained for one value of h at a time. In iterative approach, the lag order of the recession indicator does not need to be related to forecast horizon. Let us consider, for simplicity, again the dynamic probit model and the case $h = 2$. By using the one-period model iteratively and assuming $k \geq 2$ one obtains

$$E_{t-2}\left(y_{it}\right) = \sum_{P_{t-1}\in 0,1} P_{it-h}\left(y_{it}=1 \mid X_{it,yit-1}\right)\Phi\left(\alpha + x'_{it-k}\beta + \delta_1 y_{it-1}\right), \tag{8}$$

where the conditional probability P is given by:

$$\begin{aligned} &P_{t-2}\left(y_{it-1}=1 \mid X_{it,yit-1}\right) \\ &= \Phi\left(\alpha + x'_{t-k-1}\beta + \delta_1 y_{it-1}\right)^{y_{it-1}} * \left[1-\Phi\left(\alpha + x'_{it-k-1}\beta + \delta_1 y_{it-2}\right)^{1-y_{it-1}}\right] \end{aligned} \tag{9}$$

Thus, the iterative forecast takes into account the two possible paths through which the economy can enter systemic banking crisis in two period's time. We estimate both logit and probit model using maximum likelihood estimation (MLE). It is noteworthy that one way to deal with symptomatic variables and predictors as signaling measures to predict crisis is to use dynamic approach. Though the occurrence of one indicative predictor may not necessarily give enough information on the surety of a future crisis, it does give a lead to those other factors that must be monitored since most economic crises are interrelated. A dynamic model incorporating lagged dependent variables is theoretically more appropriate for analyzing banking crises because crisis risk is inherently persistent and path dependent. The occurrence of a crisis in one period often influences the probability of subsequent crises through channels such as financial fragility, investor confidence, and policy responses. By including lagged crisis indicators, we capture temporal dependencies, feedback effects, and adjustment processes that static models ignore, leading to more realistic and robust estimates of crisis determinants

4. Results

Table 2 presents the results for the model with random and fixed effect. From the logistic and probit regression results, there is a positive association between systemic banking crisis and government deficit. The probability of systemic banking crisis increases as the government deficit increases. Specifically, periods characterized by high government deficit have higher associated probability of experiencing systemic banking crisis. GDP weighted default is less likely to cause systemic banking crisis. Sovereign external debt default, currency crises, and annual inflation have no significant association with banking. The exchange rate has mixed effects that are not significant when the probability is negative.

Table 2. Fixed effects models (Country and Time Effects): Control for country-specific and time-specific fixed effects.

	Probit Model			Logit Model		
Government Deficit	0.032*	0.103	0.034*	0.096***	0.032	0.067**
	(0.019)	(0.036)	(0.018)	(0.035)	(0.021)	(0.035)
GDP	−0.002***	0.399	−10.561***	−0.152	−9.634***	−21.042***
	(0.006)	(7.250)	(4.568)	(7.335)	(6.089)	(8.626)
Inflation	0.013	0.01	0.005	0.009	0.007	0.011
	(0.014)	(0.012)	(0.01)	(0.012)	(0.012)	(0.018)
Exchange (USD)	0.004*	−0.002	0.010**	−0.001	0.001**	0.001**
	(0.002)	(0.003)	(0.001)	(0.003)	(0.003)	(0.002)
Sovereign External Default	0.038	0.888	2.009	0.268*	2.285	4.237
	(0.029)	(0.582)	(0.613)	(0.482)	(0.863)	(1.283)
Constant	−8.507	−2.53	−6.804	−11.323	−8.528	−13.288
	(6.241)	(0.011)	(2.691)	(6.263)	(2.526)	(5.514)
Country Fixed	NO	YES	NO	NO	YES	NO
Time Fixed	NO	NO	YES	NO	NO	YES
Number of Obs.	762	557	449	762	557	449
Log likelihood	−231.718	−55.655	−26.1758	−231.718	−39.747	−55.09
Adjusted Pseudo R^2	0.702	0.753	0.806	0.703	0.756	0.808

Note: The dependent variable is the dummy variable systemic banking crisis. The estimation used the logit and probit model with data covering 12 African countries between 1800 and 2014. The standard errors are in parentheses and the significance levels are ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

To diagnose the probability of systemic banking crisis as deficit increase, we employed a quantile-based classification to analyze the probability of crisis over deficit range. The quantile-based approach is widely used in economic research and social sciences to classify continuous economic variables into meaningful groups. OECD & IMF reports often categorize economic indicators (like expenditure, debt levels) into percentile groups for comparative analysis. Bai & Ng (2008) discuss quantile classification as an effective tool in econometric modeling.

Government deficit as percentage of revenue is a continuous variable, we classified it into four bins using quantile-based discretization to ensure that each category contains an approximately equal number of observations, making it a balanced approach to categorize continuous data. This is particularly useful when the distribution of net government expenditure is skewed (i.e., has extreme values). The bins are low (0% - 25% percentile), medium (25% - 50% percentile), high (50% - 75% percentile), and Very High (75% - 100% percentile). Only **Figure 3** for the probit is presented because the predicted logit model distribution over the debt category is similar. The probability of having systemic crisis is about 11.96% when the country has low government deficit, 13.18% when the country has medium deficit level, 28.51% when the country has high debt level, and 14.61% when the country has very high deficit. Thus, the probability of having systemic banking crisis is concave over deficit range.

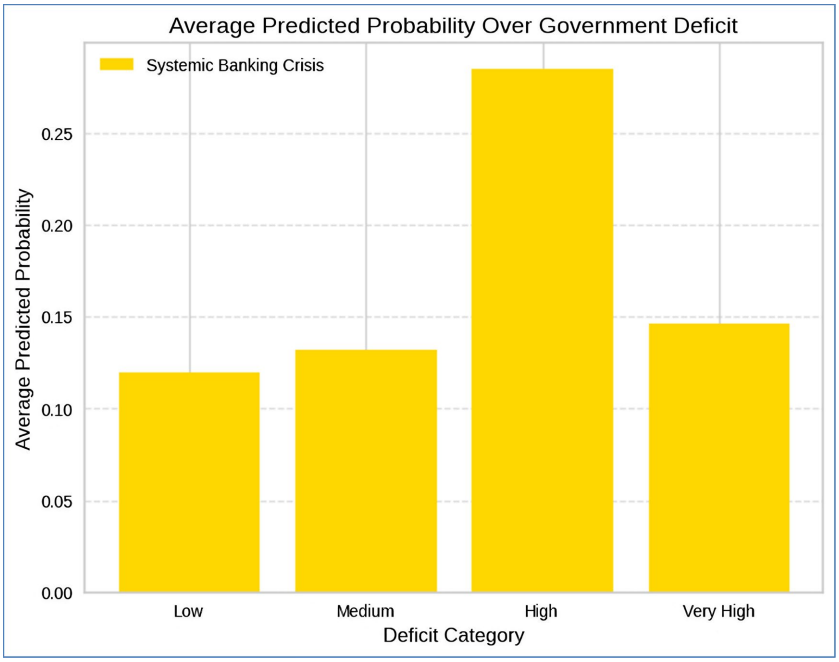

Figure 3. The predicted average probability of systemic banking crisis by deficit groups.

The observed concave relationship, where very high fiscal deficits are associated with a lower probability of crisis, may reflect endogenous policy responses and external interventions triggered at extreme deficit levels. When deficits reach unusually high thresholds, they often serve as a clear warning signal, prompting preemptive fiscal consolidation, monetary tightening, or structural reforms. Additionally, international financial institutions such as the IMF or World Bank are more likely to intervene at extreme deficit levels through bailouts, standby arrangements, or debt restructuring, thereby stabilizing investor expectations and reducing immediate crisis risk. Concurrently, crisis anticipation effects may be the reason for this non-linearity. When markets expect decisive action at very high deficit levels, risk premia may stabilize or even decline in the short term. Moreo-

ver, some countries with very high deficits may already be in crisis-like conditions where the probability of a *new* crisis is mechanically lower due to crisis truncation bias in empirical models. This finding is consistent with Baldacci et al. (2011) and Reinhart and Rogoff (2010) which noted that extreme fiscal imbalances often coincide with external support and policy shifts, potentially delaying or mitigating crisis onset in the short run.

Table 3 presents the results for the dynamic model. To incorporate fixed effects into the dynamic logit and probit model, we need to handle country fixed effects and time fixed effects separately. The dynamic logit and probit results show that there is a positive association between systemic banking crisis and government deficit, the lag of deficit, and sovereign default. The probability of systemic banking crisis increases as the government deficit increases. Also, the lag of systemic crisis is most significant cause of crisis. Thus, years of crisis is likely to be followed by crisis.

Table 3. Dynamic logit and probit models: Introduce lagged crisis occurrence to capture persistence.

	Dynamic Probit		Dynamic Logit	
Government Deficit	0.032***	0.0004	0.007	0.046**
	(0.019)	(0.001)	(0.011)	(0.021)
GDP (default)	0.013	−0.441*	−9.040**	−12.700**
	(0.253)	(0.207)	(4.039)	(6.396)
Inflation	0.013	0.0322	0.659	0.1604
	(0.014)	(0.021)	(0.409)	(0.818)
Exchange (USD)	−0.003***	−0.000***	−0.0011***	−0.001*
	(0.001)	(0.000)	(0.001)	(0.002)
Sovereign External Default	0.038	0.072	1.474***	3.305***
	(0.029)	(0.026)	(0.460)	(1.016)
Lag systemic Crisis	5.313***	6.587**	4.422***	20.587***
	(0.413)	(0.000)	(4.403)	(3.622)
Lag Government Deficit	1.267**		3.953**	
	(0.468)		(0.421)	
Lag of Inflation	0.193*	1.066*	2.175	3.270*
	(0.036)	(1.911)	(0.000)	(9.403)
Constant	−85.507	−6.61E	−2.4658	−94.8876
	(60.240)	(−0.805)	(0.000)	(3.62E)
Number of Obs.	458	458	458	458
Log likelihood	−58.454	−42.647	0.89	0.902
Adjusted Pseudo R^2	0.782	0.764	0.743	0.734

Note: The dependent variable is the dummy variable systemic banking crisis. The estimation used the logit and probit model with data covering 12 African countries between 1800 and 2014. The standard errors are in parentheses and the significance levels are ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

Inflation above target level in prior year has the positive likelihood of causing systemic banking crisis. GDP weighted default is less likely to cause systemic banking crisis. Sovereign external debt default, currency crises, and inflation annual CPI have no significant association with banking. The lag of systemic crisis, deficit and inflation are more likely to cause systemic banking crisis

We perform single variable analysis and show the results above. **Figure 4** above shows that the average predicted probability of systemic crisis is increasing over debt to GDP ratio, domestic debt in default and sovereign external default. The average effect increases as the GDP default weight, debt service and government deficit increased initially, reaches a maximum and begin to decrease after a certain threshold

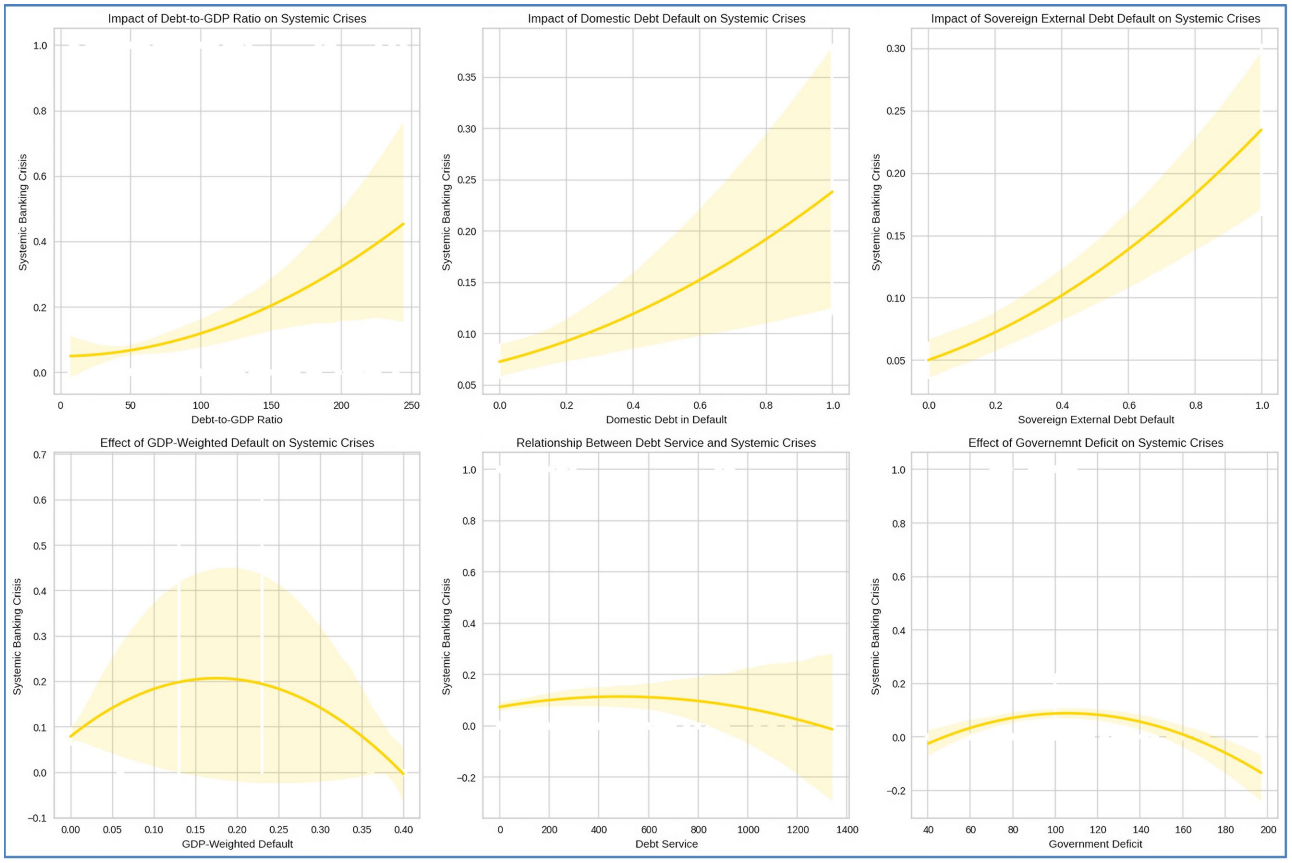

Figure 4. Average probability of experiencing a systemic banking crisis.

Dumitrescu et al. (2012) also suggests that banking crisis are often followed by sovereign external debt default. Erer and Erer (2024) suggest systemic crisis has domino effect in which a financial trouble spreads between institutions and markets until it affects the whole monetary base and financial system with dire global economic consequences. Also, due to the strong association between currency crisis, banking, systemic and sovereign external default, we perform a multivariate analysis to investigate the domino effect of systemic crisis. We report the multivariate probit results below. The bivariate and trivariate results show that there is

an association between systemic banking crisis and inflation and the exchange rate with respect to the US dollar. This indicates that countries with higher inflation crisis and higher exchange rates against the dollar are more likely to experience systemic banking crisis. GDP weighted default, currency crises, and debt to GDP ratio and currency crisis have no significant association with banking crisis. The debt to GDP ratio is also statistically significant when systemic crisis is added to the regressors. The correlation coefficient between the bivariate outcomes is not statistically significant considering the value of rho(p). Therefore, we proceed to estimate a logit model instead of a bivariate logit model. The results from the separate logit model are also almost identical to those of the bivariate model and hence, there is no need for the bivariate logit model. The latter part of the bivariate regression shows that there is a strong and positively significant relationship between currency crises, debt to GDP ratio, the exchange rate against the dollar and debt service ratio. Fiscal policy shows significant impact on sovereign default but not systemic banking crisis. The analysis shows that systemic crisis significantly predicts banking crisis but was dropped due to the high correlation between the variables.

The results show that the systemic banking crises, currency crisis and debt crises are persistent. Nevertheless, it seems the bivariate model is mis-specified, since it cannot capture the impact of the various crises on each other (see Table 4). Moreover, the bivariate and trivariate model turns out to be more parsimonious in terms of parameters to be estimated since the lag variable of deficit, inflation, and has a positive effect of the probability of occurrence of both currency and debt crises. Therefore, it supports the implementation of a multivariate crisis model whenever it is feasible.

Table 4. Bivariate and trivariate models to test the dunomis efffect of systemic banking crisis.

	Bivariate Probit		Trivariate Probit Model		
	Banking Crisis	Debt Crisis	Currency Crisis	Banking Crisis	Debt Crisis
Government Deficit	0.000*	3.380	0.072*	0.032*	4.237**
	(0.003)	(0.215)	(0.026)	(0.003)	(1.283)
GDP	−0.629	−11.696	−0.441	−0.131*	−21.042
	(0.070)	(5.499)	(0.207)	(0.397)	(8.626)
Inflation	0.825	0.167	0.215	0.029*	0.011***
	(0.208)	(0.237)	(0.084)	(0.386)	(0.018)
Exchange Rate (USD)	0.002	0.005	0.029	4.459*	1.95
	(0.000)	(0.001)	(0.019)	(0.396)	(0.450)
Sovereign External Default	0.072		0.032	1.654	
	(0.202)		(0.020)	(0.400)	
Lag Government Deficit	0.416	0.000	0.192*	−0.372	9.839***
	(1.232)	(0.000)	(0.036)	(0.398)	(1.592)

Continued

Lag of Inflation	−0.324		0.000	4.725**	
	(0.468)		(0.000)	(0.398)	
Banking crisis		0.004			0.000
		(0.026)			(0.000)
Currency crisis	−2.064				
	(1.863)				
Debt crisis			0.000		
			(0.000)		
Constant	−1.432	−1.584	−1.201***	−1.808***	−13.288
	(0.146)	(0.155)	(0.441)	(0.396)	(5.514)
Number of Obs.	558	558	558	558	558
Log likelihood	−253.686	−253.686	−248.568	−248.568	−248.568
Rho	0.978	0.968	0.963	00.963	0.964

Note: The dependent variable is the dummy variable systemic crisis, currency crisis and debt crisis. Hereafter the analysis used only the probit model since the results for the probit model statistically similar. The estimation used the probit model with data covering 12 African countries between 1960 and 2014. The standard errors are in parentheses and the significance levels are ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

5. Robustness

The out-of-sample prediction evaluation period runs from 1980 to 1990 and 1999 to 2014. The results in Table 5 show the out-of-sample prediction performance of the various models analyzed. First, we can observe that the indicator of systemic banking crisis performs similar to the full sample analysis.

Table 5. Out-of-sample forecasting: Conduct 15-year and 10-year predictions to assess model performance.

	Static Probit		Dynamic Probit	
	10-Year	15-Year	10-Year	15-Year
Government Deficit	0.033***	0.029***	0.003***	0.102***
	(0.019)	(0.081)	(0.053)	(0.039)
GDP	−0.188**	−0.009*	−0.078**	−0.131**
	(0.222)	(0.006)	(0.385)	(0.397)
Inflation	0.010**	0.009***	0.026***	0.029*
	(0.385)	(0.518)	(0.387)	(0.386)
Exchange (USD)	0.537	−2.677	3.193	4.459*
	(0.447)	(0.390)	(0.401)	(0.396)
Sovereign External Default	1.424**	1.512	0.089**	1.654
	0.406	0.65	0.409	0.4

Continued

Lag Government Deficit			1.267	−0.372
			0.468	0.398
Lag systemic Crisis	5.313***		7.747***	
	0.413		0.453	
Lag of Inflation			0.059	4.725
			0.408	0.398
Constant	−3.101***	−5.131**	−1.179***	−1.808***
	0.398	0.418	0.393	0.396
Log likelihood	−55.655	−55.655	−54.356	−48.635
Adjusted Pseudo R^2	(0.782)	(0.794)	(0.763)	(0.791)

Note: The dependent variable is the dummy variable systemic banking crisis. The estimation used the probit model with data covering 12 African countries between 1800 and 2014. The standard errors are in parentheses and the significance levels are ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

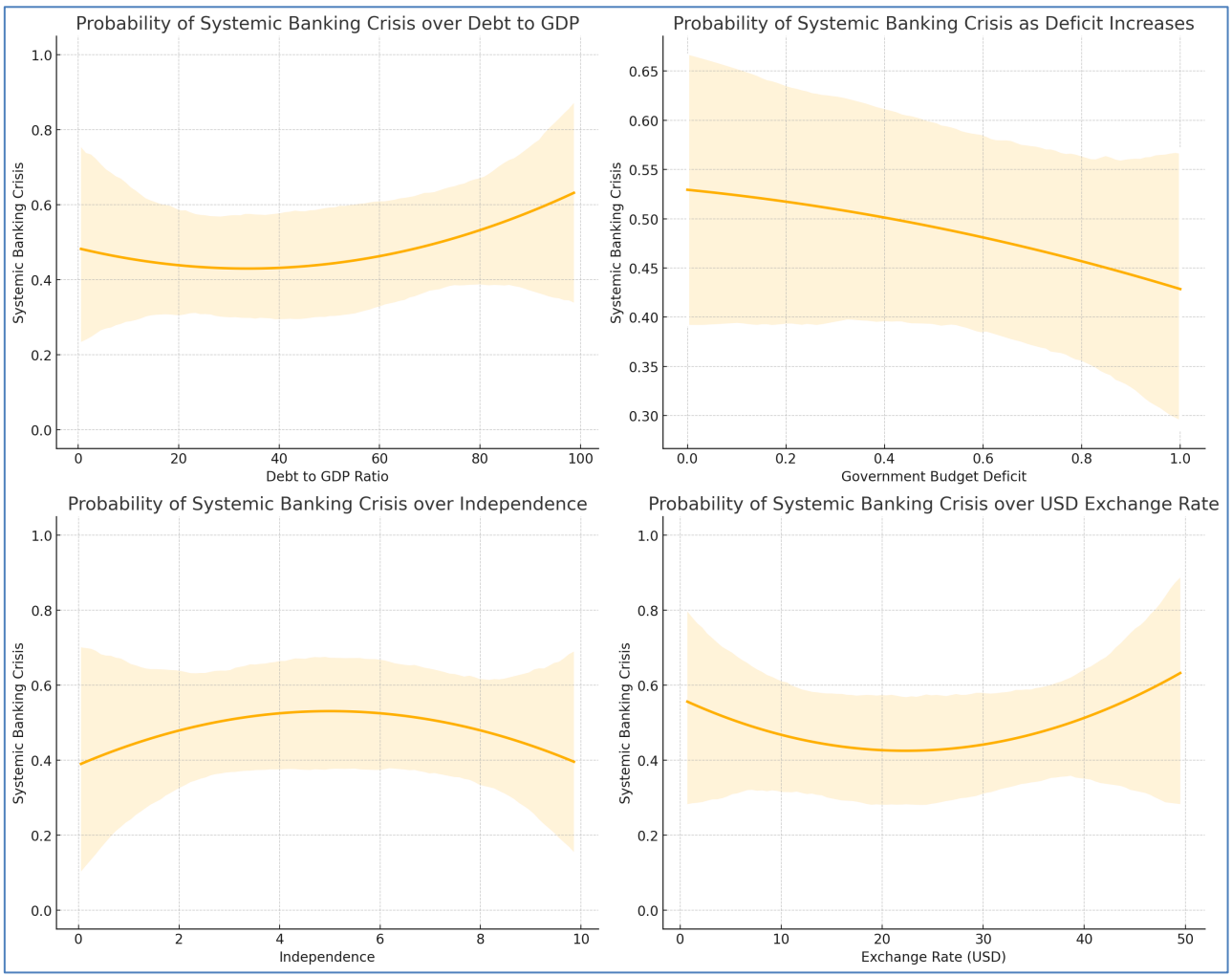

Figure 5. The average probability of systemic banking crisis for the out-of-sample analysis using just four variables.

We also performed a sample analysis using only a subset of 4 variables. We use dummy variable 1 when the country has a deficit and 0 otherwise. We randomly selected 50 observations and performed the analysis using the probit model. The results are presented in **Figure 5** below. The analysis suggests a decreasing likelihood of experiencing systemic banking crisis over the deficit though positive. Debt to GDP ratio, independence, exchange rate shows convex effect.

It is worth noting that to ensure the validity of our results, we conduct the following tests: multicollinearity diagnosis using Variance Inflation Factor (VIF). Apart from the lag variables which have VIF between 2 and 3, the results show no major concern of multicollinearity.

6. Conclusion

This paper investigated the financial stability risk associated with fiscal indiscipline -a policy regime characterized by government's failure to manage its public finances responsibly, excessive budget deficits, rising public debt thereby triggering macroeconomic instability and systemic banking crisis. The analysis showed that systemic banking crises in Africa are significantly related to three factors: fiscal deficit, exchange rate against the dollar, and the lag of crisis. Specifically, the paper showed empirically that in a dynamic binary response model environment, government deficits are more likely to result in a systemic banking crisis. More importantly, the likelihood of a systemic banking crisis increases as the government deficit begins to rise, reaches a maximum and diminishes after a certain threshold. We ascribed the behavior of fiscal deficit as due to the systemic derivative of fiscal policy inconsistency, a scenario with broad and persistent economic consequences arising from government failure to maintain a stable and coherent fiscal policy over time. These effects emerge from repeated fiscal mismanagement, such as erratic spending, unpredictable taxation, and unsustainable debt accumulation. This finding is consistent with the theoretic and empirical literature that fiscal deficit can increase systemic banking crisis by necessitating monetization and domestic government defaults (Gonzalez-Hermosillo et al., 1997; ADB, 2008). Similarly, this finding is consistent with the work of Burnside et al. (2001), who argue that large fiscal deficits often create expectations of government bailouts, leading to speculative attacks and financial instability.

Second, as the GDP default weight of a country increases, the probability of systemic banking crisis falls in both a static and a dynamic environment. Finally, systemic banking crisis spurred by fiscal deficit has domino effect, with exchange rate against the dollar playing negligible role. If country faces systemic crisis, then it's probable that currency crisis will also happen shortly, and this is followed by a sovereign debt default. The analysis shows that the years which experienced systemic crisis also experienced banking crisis. This confirms the hypothesis that the two variables are correlated. In summary, periods of systemic crisis are likely to see exchange rates and debt default crisis. Moreover, the evidence suggests that systemic banking crisis are dynamic. These results are mostly in line with António

Antunes et al. (2018) who find a statistically significant and positive relationship between inflation and climate change (quantified by temperature, precipitation and carbon emissions) in the long run and a statistically insignificant relation in the short run. They contend that banking crises are rare events, but when they occur their consequences are often dramatic. Their results which align with our findings show that adding dynamic components and exuberance indicators to the models substantially improves the ability to forecast banking crises.

Most economic crises are interrelated since one crisis can lead to the other. We show that there is interconnectedness between various classes of crises. We show that expected periods of systemic crisis overlap banking or currency crisis and debt crisis. Banking crisis, systemic crisis, exchange rate, and inflation crisis will lead to sovereign default in either domestic debt or sovereign external debt. Finally, fiscal indiscipline leads to systemic banking crisis. The findings have broader implication, particularly in economies where fiscal indiscipline has become a dominant economic management tool. While governments are increasingly tempted to use monetary financing to manage deficits and stimulate recovery, this study demonstrates the inherent risks of such policies as it can trigger systemic banking crisis.

7. Policy Implications

The findings of this study have several important policy implications, particularly for economies where fiscal indiscipline is a recurring issue. First, governments must recognize the significant role fiscal deficits play in triggering systemic banking crises. This study demonstrates that while government deficits initially increase the likelihood of banking crises, but the effect diminishes after reaching a certain threshold. This finding is consistent with the work of Burnside et al. (2001), who argue that large fiscal deficits often create expectations of government bailouts, leading to speculative attacks and financial instability. Similarly, Gonzalez-Hermosillo et al. (1997) emphasize that chronic fiscal deficits weaken a country's balance of payments and exacerbate systemic financial crises. Therefore, policymakers should adopt a balanced approach to fiscal management—ensuring that deficit spending does not spiral out of control while also maintaining flexibility for necessary counter-cyclical fiscal policies. Implementing fiscal rules, such as expenditure limits or debt ceilings, could help mitigate the risks posed by excessive public debt and ensure long-term financial stability (Demirgüç-Kunt & Detragiache, 1997).

Second, the study underscores the importance of institutional reforms to strengthen macroeconomic stability. Developing economies with weak regulatory frameworks and underdeveloped financial markets are particularly vulnerable to the adverse effects of fiscal indiscipline. Mezui et al. (2012) identify poor governance, high non-performing loans, and weak macroeconomic policies as major causes of financial instability in Africa. Strengthening financial sector oversight, improving tax collection mechanisms, and reducing reliance on monetary financ-

ing of deficits can help create a more resilient banking system (Kaminsky & Reinhart, 1999). Additionally, governments should prioritize structural reforms that enhance economic diversification and reduce dependence on external borrowing, thereby minimizing the risk of sovereign debt default and its spillover effects on the banking sector (ADB, 2008).

Finally, the research highlights the interconnected nature of financial crises, demonstrating that systemic banking crises often coincide with currency and sovereign debt crises. This is consistent with the findings of Kaminsky and Reinhart (1999), who show that banking sector problems can trigger currency crises, compounding financial vulnerabilities. Similarly, Erer and Erer (2024) discuss how systemic financial crises exhibit a domino effect, spreading across institutions and markets until they destabilize the entire economy. This suggests that policymakers should adopt a holistic approach to crisis management, recognizing that instability in one area of the economy can quickly spread to others. Establishing early warning systems that monitor key fiscal and financial indicators—such as government deficit levels, exchange rate movements, and inflation trends—can help policymakers intervene proactively before crises escalate (Schinasi, 2004). Furthermore, international financial institutions and regional economic blocs should work together to provide financial assistance and policy guidance to countries facing fiscal distress, helping them avoid the domino effects of systemic crises (Turnell, 2003).

Data Availability Statement

The data used in this study is publicly available. The curated data and codes for the analysis can be obtained upon reasonable required.

Originality

To the best of our knowledge, this is the original idea and empirical evidence of the author. All literature and ideas of others are properly cited in text and in reference.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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Appendix A

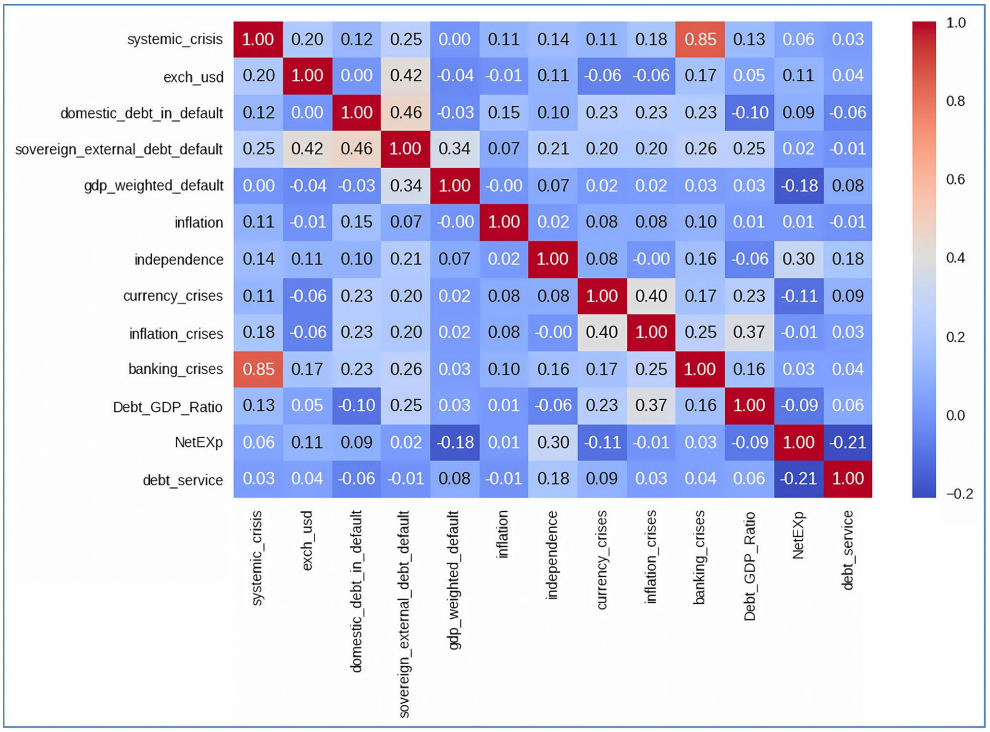

Figure A1. Correlation matrix.

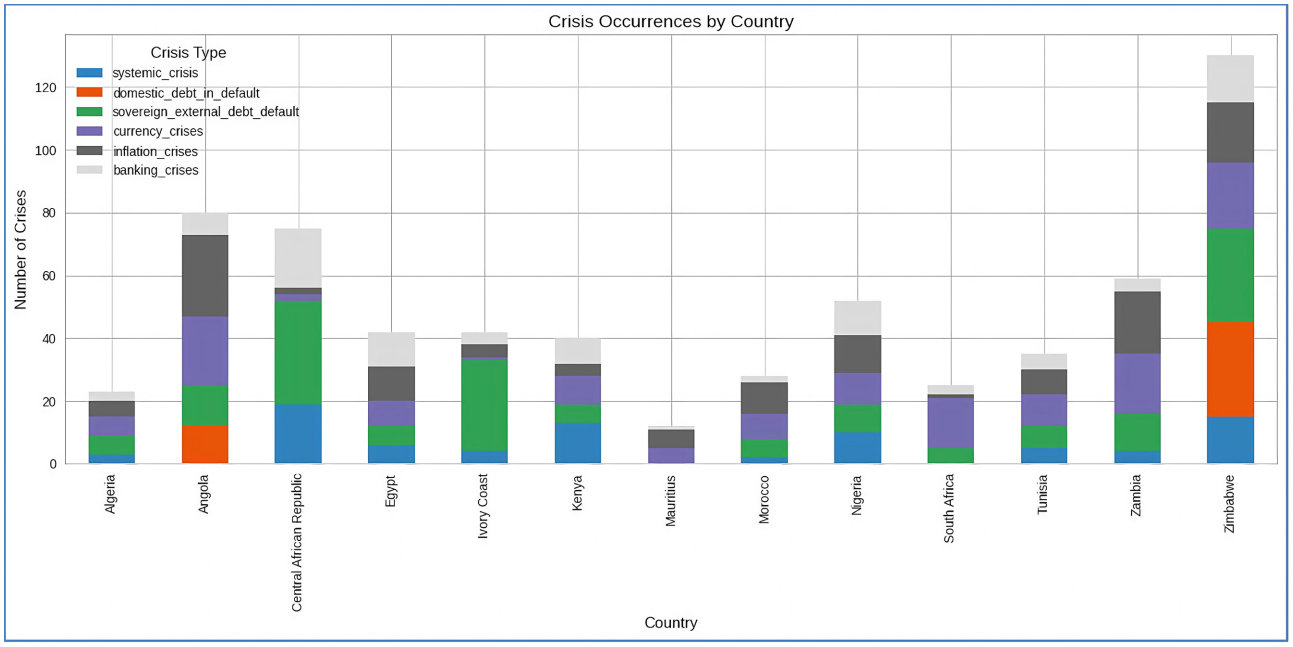

Figure A2. Data exploration by country.

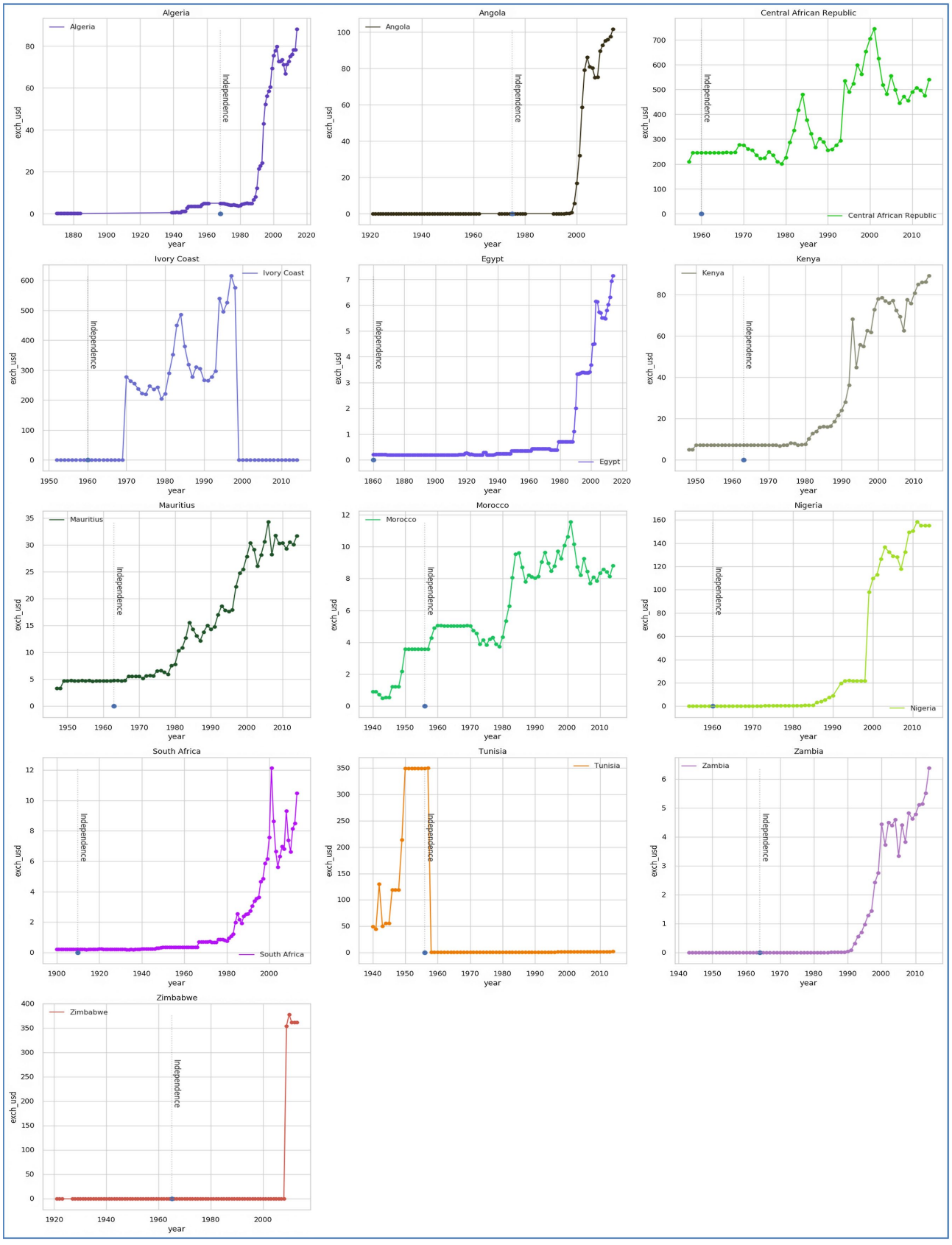

Figure A3. Trend plot of exchange rate before and after independence.

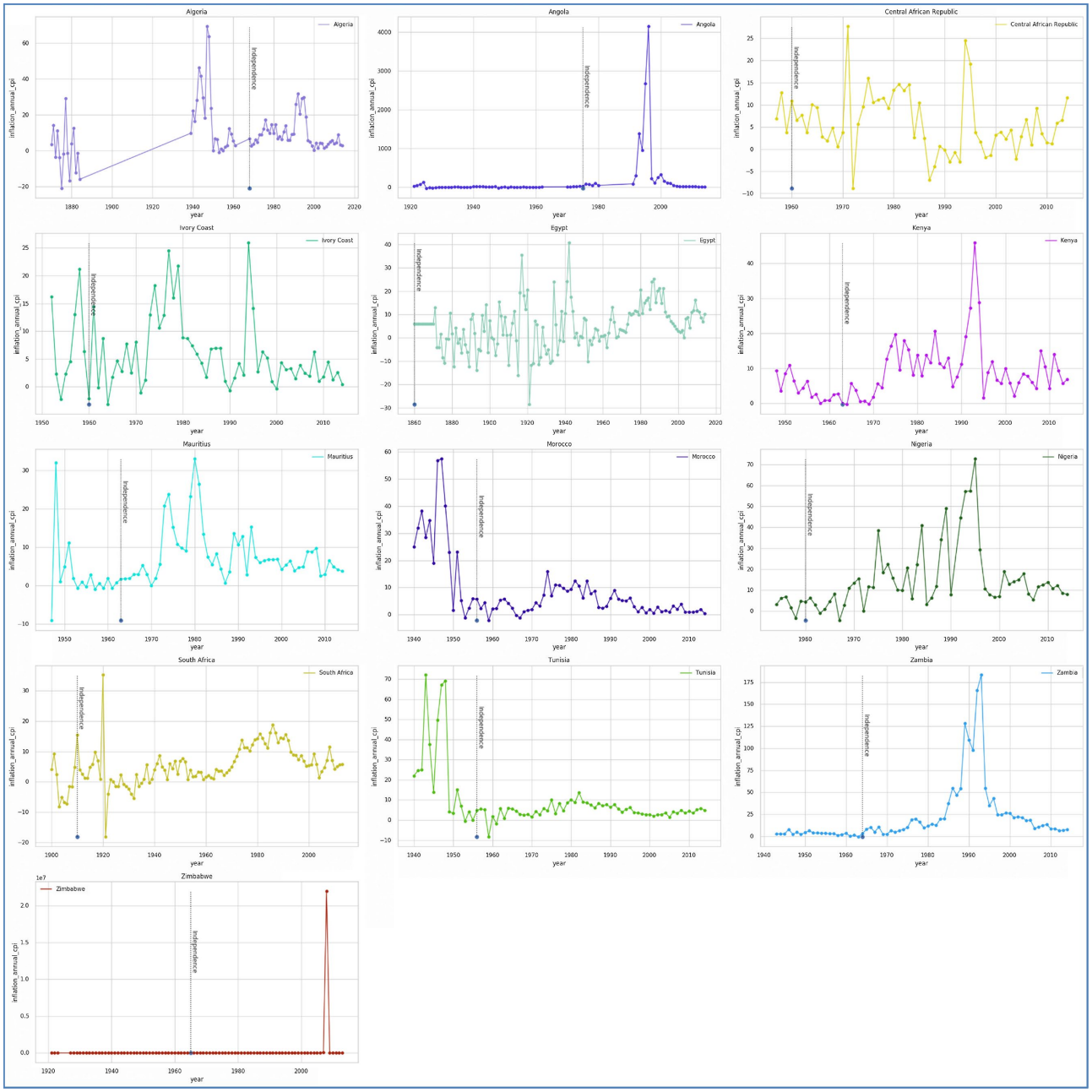

Figure A4. Trend plot of inflation by country before and after independence.