

DOES REGIONAL CURRENCY INTEGRATION  
AMELIORATE GLOBAL MACROECONOMIC  
SHOCKS  
IN SUB-SAHARAN AFRICA?  
THE CASE OF THE 2008 - 2009 GLOBAL  
FINANCIAL CRISIS

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*This paper considers whether regional currency integration in sub-Saharan Africa ameliorates global macroeconomic shocks by considering the impact of the 2008 - 2009 global financial crisis on economic growth. We estimate the parameters of a quantity theory model of economic growth augmented to account for a country's membership in the CFAZ eurocurrency union and the contraction of credit associated with negative macroeconomic shocks. Parameter estimates from Generalized Estimating Equation specifications reveal that the contraction in credit during the financial crisis of 2008 - 2009 had larger adverse growth effects on sub-Saharan African countries who were members of the CFAZ eurocurrency union. We also find that sub-Saharan African countries who were members of the CFAZ eurocurrency union were more likely to experience a contraction in credit. This suggests that CFAZ eurocurrency union membership amplifies the effects of global business cycles in sub-Saharan Africa.*

**JEL Classification:** C23, F15, N17, O11, O47

- For developing sub-Saharan African countries, the increasing integration of their capital markets with world capital markets—one measure of so-called globalization—has costs and benefits (Senbet, 2001).
- The more(less) integrated sub-Saharan capital markets are with that of world capital markets, the more(less) vulnerable are sub-Saharan African economies to global macroeconomic shocks that affect capital inflows.
- In this context, currency union membership in sub-Saharan Africa has a potential trade-off, higher capital inflows that can increase economic growth and raise living standards versus increased vulnerability to adverse global macroeconomic shocks that can lower economic growth and living standards.

- In this paper, we consider whether regional currency integration in sub-Saharan Africa ameliorates global macroeconomic shocks by considering the impact of the 2008 - 2009 global financial crisis on economic growth.
- In particular we consider whether the 13 countries in sub-Saharan Africa that constitute the CFA Franc Zone (CFAZ), relative to those countries in sub-Saharan Africa without functioning regional currency union arrangements, were more or less vulnerable to the adverse macroeconomic shock associated with the 2008 - 2009 global financial crisis.
- As regional eurocurrency integration among countries conditions nominal output on a common currency, we parameterize a parsimonious quantity theory model of economic growth over the period 1960 - 2009 to capture effects of sub-Saharan African country membership in CFAZ.

## A Quantity Theory Model of Economic Growth

Our model of economic growth follows from how output evolves in an economy where owners/managers of profit-maximizing firms can finance with credit the purchasing of capital ( $K$ ) and labor ( $L$ ) services that determines an aggregate production function of the form  $Q = K^\alpha L^{1-\alpha}$ . The typical firm owner/manager sells output at price  $p$ , maximizes the utility of profit, and has a line of credit  $M_c$  which can be used to purchase capital and labor services at cost  $r$  and  $w$  respectively. For a linear utility function with profit  $= \pi = pK^\alpha L^{1-\alpha} - rK - wL$ , the typical firm's optimal input demand is a solution to  $\text{argmax}_{K,L} [ U(\pi) = (pK^\alpha L^{1-\alpha} - rk - wL) \mid M_c = rk + wL ]$ , where  $U(\pi)$  is the utility of profit.

## A Quantity Theory Model of Economic Growth

Suppose the economy has a fractional reserve banking system where a fraction of demand deposits are always lent, for a stock of money  $M$  this establishes:

**Proposition (Optimal Aggregate Output and the Supply of Money).** *In an economy where profit-maximizing firms can borrow from banks to finance the purchase of capital and labor services, optimal aggregate output is increasing in the supply of money.*

A proof of this proposition follows from considering the typical profit-maximizing firm's optimal input demand which are  $K^* = (\alpha M_c)/r$  and  $L^* = [(1 - \alpha)M_c]/w$  respectively. Substituting optimal input demands into the production function yields  $Q^* = [\alpha M_c/r]^\alpha [((1 - \alpha)M_c)/w]^{1-\alpha}$ . If  $M_c \in M$ , then  $M_c \propto M$  and  $\partial Q^*/\partial M = \partial Q^*/\partial M_c = [\alpha/r]^\alpha [((1 - \alpha))/w]^{1-\alpha} > 0$ .

- We use data from *World Development Indicators 2010* compiled by the International Bank for Reconstruction and Development (World Bank).
- Our sample consists of 48 sub-Saharan African countries over the 1960 - 2009 time period, which is a temporal window that in our view enables identification of long-run steady state economic growth , and how it is possibly perturbed by macroeconomic shocks such as the global financial crisis that began in 2008.
- Our dependent variable from the WDI is nominal Gross Domestic Product (GDP) in current US dollars.

- As a measure of a country's stock of money, we use the current U.S. dollar equivalent value of Liquid liabilities also known as M3—which is the sum of currency and deposits in the central bank, plus transferable deposits and electronic currency, plus time and savings deposits, foreign currency transferable deposits, certificates of deposit, and securities repurchase agreements plus travelers checks, foreign currency time deposits, commercial paper, and shares of mutual funds or market funds held by residents. This definition of money supply is a broad measure of money available to firms and households in an economy available through the financial/banking sector.
- We create several binary variables to capture membership in the CFAZ eurocurrency union, and the 2008 - 2009 global financial crisis.

# Data and Empirical Methodology

- The binary variables for a country's currency union membership indicate whether or not a country is a member of the: (1) Central Africa Franc Zone (CFAZ), (2) West African Economic and Monetary Union (WAEMU), and (3) Economic and Monetary Union of Central Africa (CEMAC).
- Country observations for the years 2008 - 2009 are assigned a dummy variable to capture the commencement of the global financial crisis, and whether or not there was a contraction in credit—which is a measure of the adverse macroeconomic shock associated with the global financial crisis. The measure of credit is from the WDI, and defined as the financial resources provided to the private sector, through loans, purchases of non-equity securities, and trade credits and other accounts receivable, that establish a claim for repayment—measured in current U.S. dollars.

Let  $q_{it}$  and  $q_{it-1}$  be current and previous period nominal GDP respectively for country  $i$  at time  $t$ , we estimate the parameters of our quantity theory model of economic growth based on regression specifications of the form:

$$\begin{aligned} \ln(q_{it}) - \ln(q_{it-1}) &= \beta_0 + \beta_1 [ \ln(m_{it}) - \ln(m_{it-1}) ] + \beta_2 RCU_{it} \\ &+ \beta_3 CRISIS_{it} + \beta_4 (RCU_{it} \times CRISIS_{it}) + \varepsilon_{it} \quad (1) \end{aligned}$$

where  $[ \ln(m_{it}) - \ln(m_{it-1}) ]$  is the growth rate of the money supply,  $RCU_{it}$  is a binary indicator of membership in the CFAZ eurocurrency union,  $CRISIS_{it}$  is a binary indicator for credit contraction during the financial crisis of 2008 - 2009,  $(RCU_{it} \times CRISIS_{it})$  is the interaction between the financial crisis and currency union membership, and  $\varepsilon_{it}$  is a stochastic error.

- As our sample constitutes repeated observations over time, this introduces the possibility that for each country, annual growth rates of nominal GDP are correlated, violating the assumption of independence required for identifying the parameters. Moreover, the temporal nature of the possible correlations can introduce departures from stationarity, further undermining parameter identification.
- Given this, we estimate the parameters of the empirical growth specification in (1) within a Generalized Estimating Equations (GEE) framework (Zeger, Liang, and Albert, 1988) that can accommodate alternative and plausible time dependent correlation structures.

GEE parameter estimation is a semiparametric approach where for  $k$  explanatory variables and  $j = 1, 2, \dots, C$  possibly correlated clusters of observations on the dependent variable  $Y_j$  parameter estimates follow from solutions to a quasi-score function of the form:

$$U_k(\beta) = \sum_{j=1}^C \mathbf{G}'_j \mathbf{V}_j^{-1} (\mathbf{Y}_j - \lambda_j) = 0$$

where  $\mathbf{G}_j = \lambda_j / \beta$ , and for scale parameter  $\phi = 1$ ,  $\mathbf{V}_j = [(A_j)^{1/2} R_j(\alpha) (A_j)^{1/2}] / \phi$ . The  $\mathbf{A}_j$  are  $T \times T$  diagonal matrices with  $g(\mu_{it})$  as the  $t^{\text{th}}$  diagonal element,  $\alpha$  is a vector of unknown parameters, and  $R_j(\alpha)$  is the working correlation matrix.

- GEE parameter estimates provide measures of a population response to changing covariates.
- To the extent that assumptions about the source of individual country heterogeneity under standard fixed effects estimation is limited to what's available in the data, GEE parameter estimates provide population average responses to covariates that are much closer to the data than parameter estimates based on specifying the source of individual heterogeneity (Zeger, Liang, and Albert, 1988).
- In this context GEE parameter estimates will inform the extent to which the average growth rates change when more multi-country currency unions form in sub-Saharan Africa—or the marginal average treatment effect.

- Table 1 summarizes the covariates of our empirical specification of the quantity theory model of economic growth.
- The number of observations reflects the number of sub-Saharan African countries in the sample that had nonmissing values of all the covariates under consideration over the 1960 - 2009 time period.
- Approximately 37 percent of the country observations are countries with membership in the CFAZ eurocurrency union. Of these member countries, approximately three tenths of 1 percent experienced a contraction of credit during the 2008 - 2009 global financial crisis.
- While this variation may seem too small to identify an effect, our GEE parameter estimates can indeed exploit this variation to identify. As a GEE specification models the average response to an independent covariate over a subpopulation that shares common values of the covariate, parameter estimates account for responses to particular independent covariates for the entire population—some of which need not have the same matchings of the dependent and independent covariate.

# Table 1

Covariate	Description	Mean	Standard Deviation	Observations
$\ln(q_{it}) - \ln(q_{it-1})$	Log difference in nominal Gross Domestic Product: (Growth rate of Nominal GDP)	.062	.144	693
$\ln(m_{it}) - \ln(m_{it-1})$	Log difference in Money Supply: (Growth rate of money supply)	.082	.176	693
$RCU_{it}$	Currency Union Membership: Binary variable equal to one If member of currency union	.365	.482	693
$CRISIS_{it}$	Binary variable equal to one If there was a contraction of Credit during global financial crisis	.003	.054	693

- GEE parameter estimates are estimated across seven different correlation structures for the error term, are reported in Table 2.
- We allow for the correlation  $\rho$  between growth rates to be exchangeable, independent, autoregressive of order 1 (AR1) and 2 (AR2), and stationary of order 1 (STA1) and 2 (STA2).
- The explanatory adequacy of each regression is assessed with a Wald chi-square distributed test for the null hypothesis that exogenous explanatory variables have parameters that are jointly insignificant.
- Given that GEE parameter estimates are not likelihood-based, both relative and absolute goodness-of-fit measures based on likelihoods are not appropriate. We report instead as an overall goodness-of-fit measure the Spearman's rank correlation coefficient ( $\rho^s$ )—a nonparametric measure of the monotonic relationship between two variates—between the growth rate predicted from the GEE parameter estimates and the actual observed growth rate.

- Collectively, the GEE parameter estimates reported in Table 2 suggest a robust effect of eurocurrency union membership on how sub-Saharan African economies responded to the global macroeconomic shock associated with the 2008 - 2009 financial crisis.
- In every GEE error specification, the sign on  $CRISIS_{it}$  and  $RCU_{it} \times CRISIS_{it}$  is negative and significant. This suggests that the 2008 - 2009 financial crisis significantly lowered economic growth for sub-Saharan African countries in general, and for CFAZ eurocurrency union members, economic growth was further reduced. The independent effects of CFAZ eurocurrency membership is always insignificant.
- As for explanatory power, the parameters are always jointly significant, and the quantity theory model of growth appears to explain the data well, as the estimated  $\rho^s$  of .7050 implies a high concordance between actual observed growth and the growth predicted by the estimated growth model. In this context, the quantity theory model explains economic growth in sub-Saharan Africa reasonably well.

# Results: (Table 2) GEE Parameter Estimates

Error Specification:	Exchangeable	Independent	AR1	AR2	STA1	STA2
<i>Regressors:</i>						
$\beta_o$	.013 (.005) <sup>b</sup>	.013 (.005) <sup>b</sup>	.013 (.005) <sup>b</sup>	.012 (.005) <sup>a</sup>	.012 (.005) <sup>b</sup>	.012 (.005) <sup>b</sup>
$\ln(m_{it}) - \ln(m_{it-1})$	.619 (.033) <sup>a</sup>	.618 (.033) <sup>a</sup>	.627 (.032) <sup>a</sup>	.634 (.031) <sup>a</sup>	.627 (.032) <sup>a</sup>	.635 (.031) <sup>a</sup>
$RCU_{it}$	-.005 (.006)	-.006 (.006)	-.006 (.006)	-.004 (.006)	-.006 (.006)	-.004 (.006)
$CRISIS_{it}$	-.022 (.008) <sup>b</sup>	-.032 (.006) <sup>a</sup>	-.032 (.006) <sup>a</sup>	-.031 (.006) <sup>a</sup>	-.032 (.006) <sup>a</sup>	-.031 (.006) <sup>a</sup>
$CRISIS_{it} \times RCU_{it}$	-.066 (.013) <sup>a</sup>	-.055 (.009) <sup>a</sup>	-.052 (.010) <sup>a</sup>	-.054 (.009) <sup>a</sup>	-.052 (.010) <sup>a</sup>	-.054 (.009) <sup>a</sup>
<i>Diagnostics:</i>						
Number of Observations	693	693	693	689	693	689
$\chi^2_{k-1}$ : ( $H_o: \beta_1 = \dots = \beta_k = 0$ )	449.25 <sup>a</sup>	555.47 <sup>a</sup>	618.42 <sup>a</sup>	646.06 <sup>a</sup>	619.83 <sup>a</sup>	646.86 <sup>a</sup>
$\rho^s$	.7050	.7050	.7050	.7050	.7050	.7050
Quasi-Likelihood Information Criterion Statistic	14.56	14.50	14.09	13.79	14.09	13.79

# Results (Table 2) GEE Parameter Estimates

The practical significance of the GEE parameter estimates can be assessed with a consideration of the minimum *QIC* GEE parameter estimates—the AR(2) and STA(2) error structure specifications. Assume the average growth rate reported in Table 1 is an approximation of the steady state growth rate for the period under consideration. Evaluating the elasticity of growth with respect to the financial crisis reveals that the financial crisis caused a reduction in economic growth relative to the steady growth equal to approximately 50 and 135 percent respectively for non-CFAZ and CFAZ eurocurrency union members.

This computation follows from simply estimating point elasticities based on:

$$\partial(\ln(q_{it}) - \ln(q_{it-1}))/\partial CRISIS_{it} \times 1/\Sigma(\ln(q_{it}) - \ln(q_{it-1}))T^{-1}$$

where *T* is sample size, and 1 is the equilibrium value of the financial crisis as it is dichotomous. This suggests that at least in the case of the 2008 - 2009 financial crisis, currency unions in sub-Saharan Africa have no benefits with respect to ameliorating global macroeconomic shocks.

- Our growth model leaves unanswered any insight on causal pathways—what is particular about the CFAZ eurocurrency union that render its members exposed, relative to non-members, to macroeconomic shocks?
- We speculate as a possibility that currency unions such as CFAZ are more prone to credit contraction cycles. This is likely if banks in countries with a common currency are more leveraged relative to banks in countries that don't belong to currency unions.
- Bris and Koskinen (2002) find that common currency unions have a tendency to induce leverage reductions among firms. To the extent that over time, banks in currency union countries are also prone to leverage reductions, this de-leveraging can cause credit contraction cycles which impact adversely on economic growth.
- Table 3 reports GEE Probit parameter estimates, where the dependent variable is whether or not a country had a contraction in credit in a given year. The independent variable are membership in the CFAZ eurocurrency union, and the liquid reserves to bank asset ratio of banks.

- We estimate the GEE Probit specifications with the identical error structures utilized in the growth model parameter estimates, and report the same diagnostics.
- Across all error specifications in the GEE Probit parameter estimates in Table 3 reveal that as the bank liquid reserves to asset ratio increases—bank de-leveraging—the probability of credit contraction increases in all sub-Saharan countries.
- Being a member of the CFAZ eurocurrency union has a positive and significant effect on the probability of credit contraction.
- This suggests that banks in CFAZ eurocurrency member countries are more prone to de-leveraging and credit contraction cycles across time, and that the relatively high vulnerability of CFAZ countries to the macroeconomic shock of the 2008 - 2008 global financial crisis is at least partially explained by the relatively high propensity of banks in CFAZ eurocurrency union countries to contract credit.

# Results: (Table 3) GEE Probit Parameter Estimates

Error Specification:	Exchangeable	Independent	AR1	AR2	STA1	STA2
<i>Regressors:</i>						
Constant	-.682 (.081) <sup>a</sup>	-.681 (.080) <sup>a</sup>	-.684 (.082) <sup>a</sup>	-.674 (.083) <sup>a</sup>	-.687 (.082) <sup>a</sup>	-.675 (.082) <sup>a</sup>
$RCU_{it}$	.178 (.092) <sup>c</sup>	.179 (.091) <sup>c</sup>	.177 (.093) <sup>c</sup>	.171 (.092) <sup>c</sup>	.178 (.093) <sup>c</sup>	.172 (.092) <sup>c</sup>
Bank Liquid Reserves To Asset Ratio	.809 (.213) <sup>a</sup>	.821 (.218) <sup>a</sup>	.898 (.216) <sup>a</sup>	.871 (.232) <sup>a</sup>	.907 (.216) <sup>a</sup>	.868 (.227) <sup>a</sup>
<i>Diagnostics:</i>						
Number of Observations	757	757	757	757	757	757
$\chi^2_{k-1}$ : ( $H_0: \beta_1 = \dots = \beta_k = 0$ )	16.11 <sup>a</sup>	16.15 <sup>a</sup>	18.21 <sup>a</sup>	15.80 <sup>a</sup>	18.88 <sup>a</sup>	16.25 <sup>a</sup>
Quasi-Likelihood Information Criterion Statistic	934.83	934.89	935.06	935.23	935.05	935.14

- Our GEE parameter estimates reveal that the contraction in credit during the financial crisis of 2008 - 2009 had larger adverse growth effects on sub-Saharan African countries who were members of the CFAZ eurocurrency union.
- We also find that sub-Saharan African countries who were members of the CFA eurocurrency union were more likely to experience a contraction in credit.
- The relatively high vulnerability of CFAZ countries to the macroeconomic shock of the 2008 - 2008 global financial crisis is at least partially explained by the relatively high propensity of banks in CFAZ eurocurrency union countries to contract credit.

- Brownbridge and Kirkpatrick (2000) note that partly due to a colonial legacy, inherited banking regulatory regimes in sub-Saharan Africa reflect a colonial area banking environment in which there was little or no oversight by a regulatory body.
- To the extent that this influences bank regulatory prerogatives and credible oversight of risk in the banking system, our results suggest some scope for better bank regulatory policy in CFAZ countries.
- As de-leveraging is a likely corrective response to excessive leveraging which is correlated with risk, our results suggest that bank regulatory policies that constrain bank leverage (e.g. more stringent capital requirements) could reduce the vulnerability of CFAZ countries to adverse macroeconomic shocks.