**Research Paper: Credit and Economic Growth in the ECCU: A Threshold Approach**

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**ECCB Staff Research Paper**

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**Credit and Economic Growth in the ECCU: A Threshold Approach**

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**Abstract**

The macroeconomic role of credit has been continuously deliberated within the realm of finance. The credit growth nexus is of particular importance to the role of the Eastern Caribbean Central Bank which is the monetary authority of the eight member states of the Eastern Caribbean Currency Union (ECCU). Within the financial sector of the ECCU, commercial banks are the main providers of credit and, thus, their behaviour influences the credit-growth relationship that currently exists in the region. Consequently, the authors evaluate within the context the ECCU, the threshold level of real economic growth which spurs changes in credit, given changes in a bank specific interaction term, liquid assets to total assets. This paper examines by means of a fixed effects panel threshold regression, the thresholds which are significant to this credit growth nexus. The authors aim to provide policy makers with a deeper insight into the behaviour of credit in the absence of traditional monetary policy mechanisms such as open market operations in the ECCU.

**JEL Classification: E51, G21**

**Keywords: Credit, growth.**

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## I.  Introduction

The macroeconomic role of credit has been continually deliberated since the evolution of modern finance.  Credit's role in the economy has been expounded on by authors such as former Federal Reserve Chairman, Ben Bernanke.  The traditional framework through which credit flows assumes a smooth transitionary framework for credit creation, one in which funds flow easily from savers to borrowers.  However, within this framework financial firms play no role in the credit creation process (Bernanke, 1992-93).  Alternatives to this IS-LM framework have sought to incorporate the fluctuations in credit among variables such as output, employment and investment.  Therefore, banks can perform a direct role in the economy by sifting asymmetric information to direct credit within the context of macroeconomic performance and in exchange for indirect securities.  This allocation process is replicated in the developing state context and credit is therefore seen as the largest source of finance for firms (Seifallah and Sami, 2014; Gurley and Shaw, 1955).

The literature on credit booms and crises have resurged following the global economic and financial crisis.  Within these various studies is implicitly the question which asks, what is the optimal interaction between credit and macroeconomic developments (Avdjiev & Zeng, 2014).  There are demand and supply-side arguments to these discussions.  In the presence of a demand-side argument, the role for public policy to affect bank behaviour becomes moot.  Under the supply-leading hypothesis, finance is expected to induce economic growth, Patrick (1966) as cited by Atindehou, Gueyie and Amenonve (2005).  The converse holds true for the effect of economic growth on financial intermediation.

In the ECCU, commercial banks in some member states have limited the extension of credit, through changes in credit terms and conditions and a reduction in the stock of credit annually.  Consequently, member states such as Anguilla and Antigua and Barbuda have experienced a credit crunch in the past few years, accompanied by flat economic growth – a creditless recovery (Lugay & Thompson, 2016).  The name *creditless recovery* speaks to extremely low levels of credit (below historical norms), therefore, within the context of such a recovery, economic growth is substantially weaker, and the economy, therefore, becomes more susceptible to exogenous shocks.  In the sub-region, there have been successive annual declines in both domestic credit and private sector credit during the period 2013 to 2016.  This reduction in credit has caused concern as it is perceived to be not conducive for current deliberate policy efforts to generate stronger economic growth.

To spur credit and ultimately economic activity, the Monetary Council (MC) of the ECCB embarked on several recent initiatives. The MC agreed to reduce the minimum savings deposit rate (MSR) from 3.0 per cent to 2.0 per cent from 01 May 2015. More recently, in March 2017, the Monetary Council signed an Agreement for the Establishment of the Eastern Caribbean Partial Credit Guarantee Corporation. The MC also approved, for enactment by member governments, the proposed Credit Reporting Bill and Regulations to develop an ECCU Credit Reporting System and operationalise a credit bureau within the single financial and economic space.

The issues of credit and economic growth are fundamental to the existence of the ECCB, as these variables are central to the purposes of the Bank. It is within the context of the Central Bank's supervisory, regulatory, monetary and developmental roles, that is important to investigate the credit-growth relationship. This paper seeks to evaluate in the ECCU, the threshold level of real economic growth which spurs changes in credit, given changes in a bank specific interaction term, liquid assets to total assets. Our contribution to the literature in this regard evaluates the growth threshold restriction within small island developing states in a currency union with a fixed exchange rate. In so doing, the authors aim to provide policy makers with a deeper insight into the behaviour of credit in the absence of traditional monetary policy mechanisms such as open market operations.

The rest of the paper is as follows. Section II will provide stylized facts on the ECCU and the variables under examination. Section III will review the literature and form the theoretical basis of our analysis. Section IV will review the data and provide the methodology which the authors have used in this paper. Sections V and VI will provide the results and analysis as well as policy implications and recommendations. Finally, Section VII will conclude the piece.

## II. Stylized Facts

The geographical trends indicate that growth in real total credit seems to be positively related to real GDP growth over the historical period in the ECCU (Figure 1). During 1989 to 2016, growth averages for both real credit and real GDP were highest in Anguilla of 11.6 per cent and 3.6 per cent respectively. Conversely, Montserrat registered the lowest growth averages in both real credit (2.2 per cent) and real GDP (-1.6 per cent). This was relative to the ECCU's growth averages for real credit and real GDP of 4.8 per cent and 2.5 per cent respectively.

**Figure 1: Geographic Distribution of Real Growth in Credit and GDP (Averages over 1989-2016)**
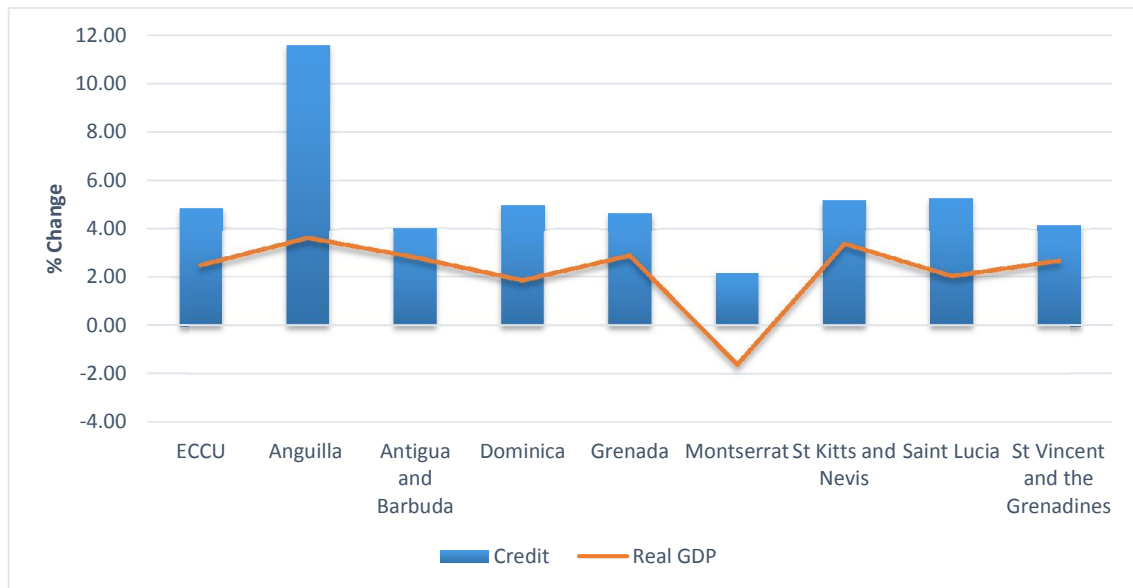


The correlation matrix (Table 1) confirms that the relationship between growth and credit is positive. Notably the correlation between real GDP growth and total credit (as well as business and household credit) is positive but weak.

**Table 1: Correlation Matrix of Real Growth and Credit variables**

| Correlation Probability | Real GDP Growth | Total credit | Business credit | Household credit |
|---|---|---|---|---|
| Real GDP Growth | 1.00 ------ | | | |
| Total credit | 0.21 0.00 | 1.00 ------ | | |
| Business credit | 0.24 0.00 | 0.67 0.00 | 1.00 ------ | |
| Household credit | 0.08 0.26 | 0.05 0.41 | 0.05 0.45 | 1.00 ------ |

Credit has been, more recently in 2016, affected by demand and supply side factors (Summary of the Results of the Commercial Bank Senior Loan Officers' Opinion Surveys on Credit Market Conditions in the ECCU, 2016). On the supply side, the factors which include tighter

overall lending terms for business loans have been influenced by overall economic conditions; instructions from head office; the credit worthiness of customers; growth in the percentage of NPL ratios and liquidity (as defined by the liquid assets to total assets ratio). Demand-side factors relating to increased loans from non-bank financial institutions in the ECCU have influenced the movement of credit contracted from the commercial banking sector which is the subject under investigation in this study.

Examining the liquid assets to GDP ratio reveals that there is a negative relationship between these two variables over the period of analysis (1989 to 2016). This negative relationship implies that as economic growth increases, the level of liquid assets relative to total assets declines (Figure 2). In a similar and expected fashion, the non-performing loans ratio is also negatively correlated with real economic activity (Figure 3). Inspecting these ratios over and against growth in total credit reveals a similar negative correlation in the scatter-plot. Liquid assets relative to growth in total credit is negative while the non-performing loans ratio against total credit growth is negative as well (Figure 4 and 5). These correlations point to the expected signs in the variables.

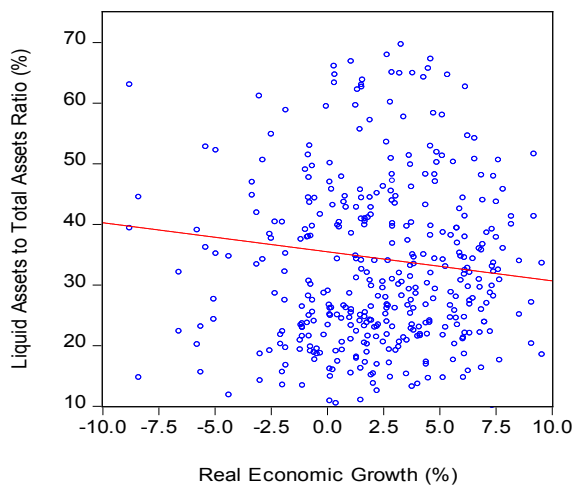**Figure 2: Liquid Assets Ratio (%) to Real Economic Growth (%)**



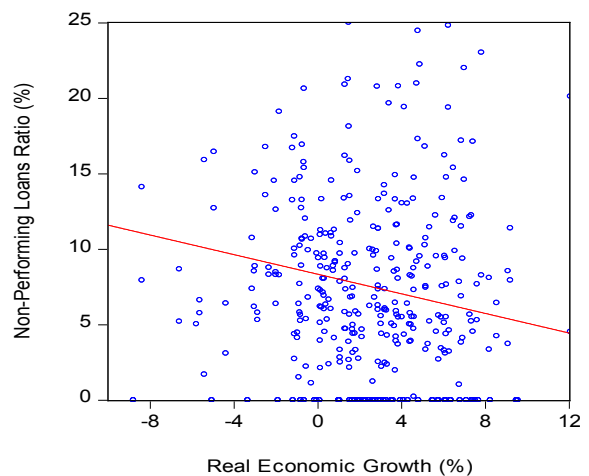**Figure 3: Non-Performing Loans Ratio (%) to Real Economic Growth (%)**

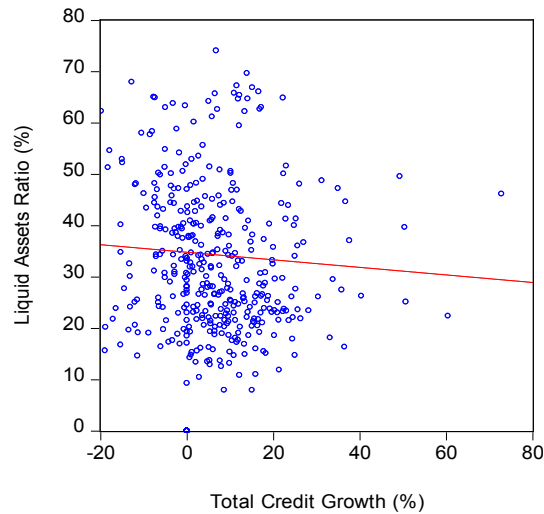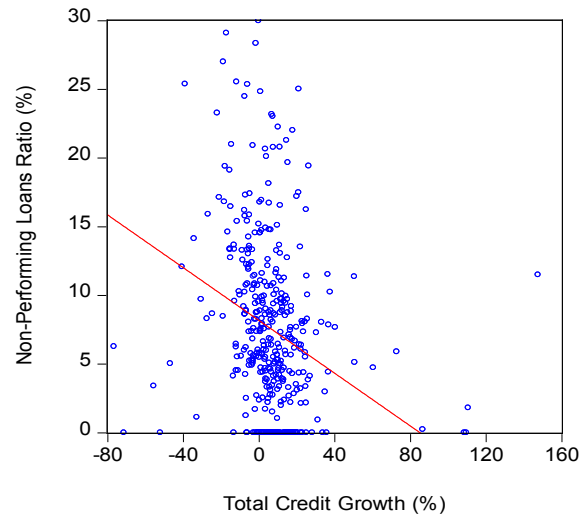**Figure 4: Liquid Assets Ratio (%) and Total Credit Growth (%)**



**Figure 5:Non-Performing Loans Ratio (%) and Total Credit Growth (%)**



Meanwhile, economic growth in the ECCU has been constrained by both structural (e.g. issues relating to geography, size and volatility) as well as non-structural factors (e.g. issues relating to debt, the financial sector and crime and violence) at the regional level, further compounded by global challenges including the slow US recovery after the global financial and economic crisis (Report of the ECCU Task Force on Debt, Growth and Development, 2013).

In further analysing the variables in the ECCU, the authors examined data during the periods prior to and after the global economic and financial crisis. Prior to the global economic and financial crisis in 2008/2009, the performance of credit in the ECCU was connected in part to the many projects associated with foreign direct investment, investment in infrastructure in anticipation of cricket world cup, the growing tourism industry and the rising incomes of households. Credit rose rapidly in the member states, and several institutions entered into syndicated loan arrangements within the tourism industry. Consequently, with the financing available for consumers and investors, growth increased, as savings were reallocated accordingly.

After the financial crisis, credit to the economy contracted rapidly and the stark difference can be seen below (**Error! Reference source not found.**). Examining credit growth between 2006 and 2016, we note that most sectors grew by at least 5.0 per cent in 2006 when compared with contractions of a minimum of 2.4 per cent and a maximum of 21.0 per cent in 2016.

**Error! Reference source not found.**The correlation expected between the growth in total credit and real economic output during the period 2000 to 2016 was positive as anticipated (**Error! Reference source not found.**).  The relationship remained positive over the time series.  With the onset of the global financial crisis, many consumers and businesses defaulted on their debt and the level of non-performing loans in the sub-region rose above the prudential minimum established by the ECCB.  A closer look at major sectors such as tourism reveals that growth in credit to the industry was recorded at 36.4 per cent as at the end of 2006, while at the end of 2016, credit contracted to 15.2 per cent (**Error! Reference source not found.**).

**Figure 6: Growth in Real Credit by Selected Sectors, 2006 & 2016 in the ECCU**
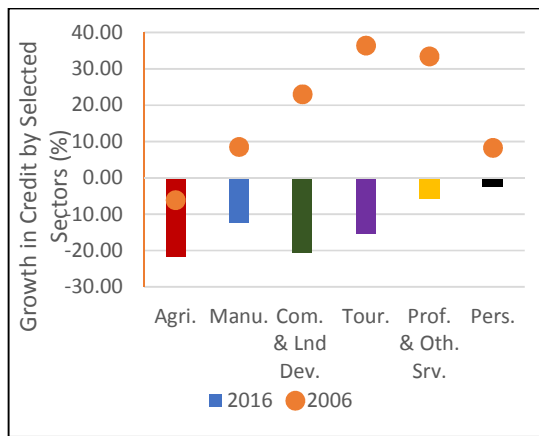
**Figure 7: Growth in Real Total Credit & Real GDP Growth, 2000 - 2016, in the ECCU**
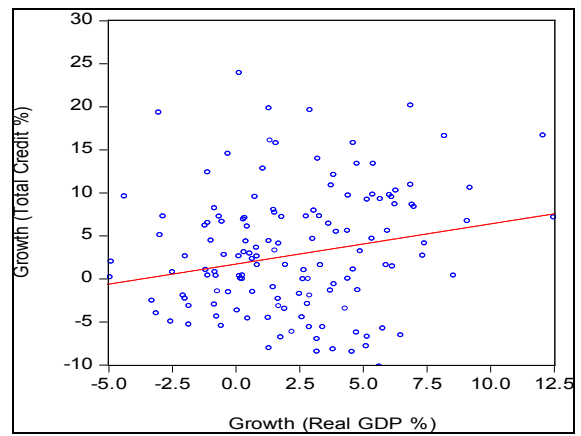
## III.  Literature Review

### Credit and Economic Growth

The contentious debate on the underpinnings of economic growth have been long espoused by many researchers.  The topic however, has not fallen short in the minds of academicians and policy makers and continues to be discussed at length.  "Solow's theory which focused on exogenous growth has been the base for much empirical work in the area" (Seifallah & Sami, 2014).  There have also been other facets and theories surrounding growth and development generally.  Schumpeter, for example, focused on the production technology for innovations, Howitt and Aghion (1988) as cited by Seifallah and Sami, (2014).  Others such as Mankiw, et

al., (1992) and Schultz, (1980) have focused on merging the accumulation of human and physical capital into existing growth paradigms (Seifallah & Sami, 2014). These arguments lead to the inevitable question of causality. Is the contribution between credit/finance and growth unidirectional or bi-directional and is it featured in the short-run or long-run (Patrick, 1966)?

The inclusion of credit into the economic growth arguments were originated by Gurley and Shaw (1955). The author's outline the role of banks in allocating in an efficient manner, excess funds which exist within the economy. By borrowing these surpluses, banks are then able to redistribute these resources to new areas for profit while issuing indirect securities to the lenders of these resources. By assessing these interactions between intermediaries and other economic agents, the authors were then able to extend the parameters into economic growth theory. From this, the credit-growth nexus has since taken root in the literature. Consequently, arguments have been postulated for its interaction in both developing and developed countries (Seifallah & Sami, 2014).

Though the aforementioned theoretical postulations are in the affirmative, there have been arguments contrary to the above mentioned. Hayek (1941) as cited by Seifallah and Sami (2014) posits that "credit does not have any stimulating effect on growth and production." Other authors, argues Seifallah and Sami (2014), also share this point of view; noting that credit is more demand following than supply leading[2]. These authors include Robert Lucas, Joan Robinson and Fu-Sheng Hung. In these instances of dissension, the authors also give consideration to other factors such as the process of development and the role which the financial system plays during the stages of development. Other postulations on the negative effects of credit and economic growth were expatiated on in Patrick (1966). Further, Gantman and Dabos (2013) argue that in a weakened macroeconomic state, injections of liquidity in the form of credit or any other can lead to potentially damaging effects on the economy.

The final perspective considered by the literature is the *Feedback Hypothesis* which suggests that the relationship between financial sector development and inevitably credit is complementary and reinforcing in nature (Pradhan, et al., 2014). Thus, bidirectional causality

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[2] An expository on the demand following or supply leading approach can be found in Patrick (1966). The author states that, "the demand following approach implies that finance is essentially passive…" while the supply leading approach suggests that; "financial institutions are created in advance of the demand for [these institutions].

exists. Alternatively, theses have offered that there is indeed no statistically significant relationship between financial development, the financial sector and economic growth.

In pairing the positive relationship between credit and growth away from contrarian views, Beck (2012) analysed the channels through which credit flows – those most likely to influence economic growth. This linkage between these two variables (credit and economic growth) may also be examined using the closed economy approach as articulated by Biggs, et al., (2009). Biggs, et al., (2009) scrutinized the role of households and firms in the economy, relative to the role of banks. This simple two-sector approach shows that without credit flowing through the economy, the production of goods and services and the value which is added (economic growth) becomes limited. Credit, therefore, as a contributing factor to economic expansion plays a greater role when channelled to non-bank financial firms initially, however, crises are sometimes initiated by the default on loans by households – which may use credit for the purpose of consumption smoothing rather than the acquisition of capital stock or inputs.

The additive effect which supply-side credit plays in the economy was also captured adequately by Minsky (1992) and Bernanke, et al., (1999). These authors show that bank behaviour in combination with the fuelling effects of credit is likely to lead to economic crises. Conversely, in the ECCU, the low supply of credit (credit rationing) is expected to act as a constraint to economic growth in regions often contributing to credit-less recoveries, Lugay and Thompson (2016). In the presence of negative external shocks, credit is also expected to have alternative effects on the economy, affecting various sectors of economy based on the overall structure of the macro-economy (Beaton, et al., 2016).

With the relationship between credit and growth established, we consider the variables used in these relationships. Angeles (2015) establishes, private sector credit as the critical factor affecting output per capita. The author separates for analytical purposes, credit extended to households and those extended to firms (Angeles, *op.cit*). The authors of this piece, also extend the variables to include the inflation rate, net exports and the restriction on credit. Finally, a dummy is added to capture the effect of natural disasters on economic output.

**Threshold Models**

Threshold models "assume that regime shifts are triggered by the level of observed variables in relation to an unobserved threshold" (Piger, 2007). Although these models are simple to

estimate and perform inferences (Gonzalo and Pitarakis, 2012) and they have been used in macroeconomics and financial research (Wang, 2015), they are not yet fully developed. Hansen (1999) and Gonzalo and Pitarakis (2012) highlighted that econometric techniques associated with threshold regression models are either not well advanced or are still in their infant stages. Also, Wang (2015) noted that the application of those models to panel data had been scarce, a point which was also raised by Chudik et al (2015).

There have been challenges associated with the use of these models. Hansen (2000) acknowledged that their underlying statistical theory was not fully formed, so he developed the asymptotic distribution theory which underpins estimations of the regression threshold and slopes. Notably, Gonzalo and Pitarakis (2012) stated that there were two main econometric issues that would have to be faced in utilising them. One dealt with conducting tests to determine whether threshold effects were present; and the other related to estimating the underpinning parameters for the model, if there were threshold effects. Furthermore, Wang (2015) noted that nuisance parameters can affect the estimation and inference technique, thus Hansen (1999) developed the fixed-effect panel threshold model to deal with these parameters. Additionally, Chudik et al highlighted the difficulty in analysing a multiple threshold model relative to a single threshold one.

Amid the available literature, pioneering work on threshold models seem to have been undertaken by Hansen (1996, 1999, 2000). Hansen (1999) examined whether financial constraints impacted the investment decisions of firms by undertaking threshold regressions on panel data. He specified the threshold regression model which had individual-specific effects, and made least squares estimates of the threshold and the regression slopes by utilizing a fixed-effects transformation. This researcher also carried out a bootstrap technique to evaluate the existence and significance of the threshold effect, and he used asymptotic distribution theory to obtain the threshold estimate.

A number of researchers built on the work of Hansen. Khan and Senhadgi (2001), re-investigated whether inflation threshold effects existed on growth, with techniques for estimation and inference, partly based on Hansen's work. Gonzalez and Terasvirta (2005) applied a new technique which they described as a generalisation of Hansen's model. Rather than assuming a heterogeneous panel with individual effects and regression coefficients that do not vary, they built a model which permitted heterogeneity with regression coefficients that change across individuals and over time. They constructed a non-dynamic panel smooth

transition regression model, with fixed effects and exogenous regressors, which was used to analyse the investment decisions of firms where there are capital market failures. Craigwell, et al., (2012) adapted the threshold estimation technique by Hansen (1996,2000) to study the threshold effects among public debt and real GDP growth in the Caribbean. Chudik et al (2015) noted that Hansen's work could not be applied to dynamic panels nor those with heterogeneous slopes, so they dealt with a panel with large time and cross section dimensions, in order to work with issues such as heterogeneity and concurrent homogenous threshold parameters. Wang (2015), who utilised work of Hansen (1996, 1997, 1999), highlighted how to estimate a fixed-effect panel threshold model in the econometric software, STATA, and also highlighted single and multiple threshold models.

More recently, Mohaddes et al. (2017) estimated a dynamic panel-threshold model to identify the real growth threshold effects on NPL ratios in Italy. Their work was based on similar research undertaken by Chudik et al (2015) who investigated whether there were threshold effects between debt and growth on a panel of forty countries.

## IV.     Data, Model and Econometric Methodology

The data used in this study is drawn from the databases of the Eastern Caribbean Central Bank (ECCB) and encompasses total credit by economic activity, which includes both resident and non-resident credit extension (non-performing loans have been excluded) and domestic credit categories of household and business credit. Additionally, the authors incorporate banking sector variables in the form of liquid assets to total asset and the non-performing loans ratio. Finally, real sector activity and openness to trade are captured through private consumption to GDP and net exports to GDP. Through this approach, the authors will delineate the behaviour of credit with economic growth, according to residence and area of economic activity. The data set also includes real economic output and as such, the credit variables are deflated before being entered in the regression. The data is drawn across the eight (8) member states of the ECCU and annually over the period 1989 to 2016. Within this dataset, variables are captured in the following way. Total credit, business credit and household credit are all computed as ratios to GDP. Real Economic growth is kept at levels (growth rates), Net Exports are computed as a ratio to GDP, liquid assets to total assets and non-performing loans to total loans are kept at levels (ratio). Additional transformations to the variables came in the form of natural

logs - the variables affected included, total credit, household credit and liquid assets to total assets.

The authors first established the relationship between economic growth and credit in the ECCU through the granger causality approach (Granger, 1969). "Causal relationships can be assessed through either a short-run or long-run approach amongst variables," (Pradhan, et al., 2014). "Short run relationships are established through F-Statistics, while long-run relationships are established through the significance of t-tests of lagged Error Correction Terms or ECTs – derived from a cointegrating equation" (Pradhan, et al., 2014). In this instance, the authors seek not to establish a long-run cointegrating relationship but the short-run.

The establishment of causality follows a path which is less winding and more direct. The authors first choose to examine only the short run relationship between economic output and credit. Second, the authors test for the order of integration of the variables and third, the authors establish whether a long-run relationship exists between variables. This latter approach is taken only if the variables are integrated to the order one (1). Finally, the authors perform the Panel Granger Causality test using the F-Statistics. Therefore, the authors do not consider the longer-run relationship but only the short-run. The tests will examine the causal relationship between economic growth and each credit variable. To establish the order of integration, the authors perform a panel unit root test for use both in Granger Causality and the fixed effects model.

Finally, the authors make use of the Panel Fixed Effects Threshold model established by Wang (2015) – which though being applied in STATA14 – was built on from Hansen (1999). The model used by this econometric software encompasses both single and multiple threshold assumptions. Consequently, a single threshold model can be constructed as such:

$$y_{it} = \mu + X_{it}(q_{it} < \tau )B_1 + X_{it}(q_{it} \geq \tau )B_2 + u_i + e_{it} \tag{1}$$

The variable $q_{it}$ is the threshold variable in equation 1, while $\tau$ is the threshold parameter which separates the equation into two separate regimes, with their respective coefficients. To capture the individual effects within the equation, the parameter $u_i$ is used while the parameter $e_{it}$ is the disturbance. To estimate the threshold parameter, the authors could have opted to search over the entire variable or only over specific portions of the variable (a restricted search). Thus, the threshold variable is one which minimizes the Residual Sum of Squares (RSS). Within the context of this threshold approach, if *tau* is known, then the threshold estimates

become no different than an ordinary least squares equation. Else, if unknown, the consistent estimation of *tau* will be conducted using a likelihood ratio statistic.  Therefore, the authors used the F-Statistic, combined with the relevant critical values and a confidence interval of 95.0 per cent to select the respective thresholds.

Where multiple thresholds (or regimes) exists, the model is estimated in a sequential manner, generating the following:

$$y_{it} = \mu + X_{it}(q_{it} < \tau_1)B_1 + X_{it}(\tau_1 \le q_{it} < \tau_2)B_2 + X_{it}(q_{it} \ge \tau_2)B_3 + u_i + e_{it} \qquad (2)$$

The threshold variable, *tau,* separates the model into three (3) regimes with their respective coefficients (equations 3, 4 and 5).  In each scenario (single, double or triple thresholds), the assumptions are as follows:

$$\begin{cases} H_0 & = \text{ The linear model is a sufficient explanation} \\ H_a & = \text{ A single threshold exists} \end{cases} \qquad (3)$$

**or**

$$\begin{cases} H_0 & = \text{ A single threshold exists} \\ H_a & = \text{ A double Threshold exists} \end{cases} \qquad (4)$$

**or**

$$\begin{cases} H_0 & = \text{ A double threshold exists} \\ H_a & = \text{ A triple threshold exists} \end{cases} \qquad (5)$$

The fixed effects threshold model is finally estimated and outliers trimmed at the 1.0 per cent level.  The trimming of the variables allows for the removal of major outliers which may otherwise impact the results.  Additionally, the process is iterated over 300 times and the program can search a grid pattern of approximately 400.  In each threshold or regime case, the iteration/bootstrapping process is repeated.

In order to specifically examine the threshold effects of economic activity within the ECCU, the authors constructed a fixed effects model containing the variables real economic activity, non-performing loans, liquid assets to total assets, private consumption and net exports. Additionally, an interaction term which linked the liquid assets ratio to moments in real GDP was generated.  The models were generated in three (3) stages.  First, the authors computed a

standard fixed effects model using the variables and finally the threshold regression was estimated.

## V. Results and Analysis

**Table 2: Granger Causality Results**

| $H_0$ | p-value |
|---|---|
| Real GDP Growth $\nRightarrow$ Total Credit | 0.00* |
| Total Credit $\nRightarrow$ Real GDP Growth | 0.64 |
| Real GDP Growth $\nRightarrow$ Business Credit | 0.00* |
| Business Credit $\nRightarrow$ Real GDP Growth | 0.18 |
| Real GDP Growth $\nRightarrow$ Household Credit | 0.00* |
| Household Credit $\nRightarrow$ Real GDP Growth | 0.41 |

(*) indicates $H_0$ is rejected

The results in Table 2 indicated that real GDP growth caused credit (total, business and household credit). The converse did not hold true.

This section also examines the results of the fixed effects regression used to determine the thresholds associated with real economic activity in the ECCU. In the fixed effects model, real GDP, non-performing loans, liquid assets to total assets and net exports were all deemed to be significant to the specification. Consistent with the Granger Causality estimates, it is noted that real economic activity has a positive and significant impact on credit while variables such as non-performing loans, liquid assets ratio and net exports have a negative and significant impact on total credit. Private consumption, though negative is insignificant in this specification of the model. The standard errors are noticeably small and within acceptable ranges for the study.

Application of the fixed effects framework to the threshold regression constituted by Hansen (1999) and further developed by Wang (2015) for STATA14 gives similar results. In the threshold formulation, the authors argue that liquid assets are expected to have a negative

impact on total credit to GDP given low levels of economic activity. The negative impact is counter intuitive towards the analysis. Traditional banking analysis says that higher levels of liquidity are expected to have positive impacts on credit growth. In the ECCU however, commercial banks seem to be accumulating higher levels of liquidity and reducing their stock of credit. The liquid assets ratio is therefore shifted from the main specification, as it acts as the regime variable while real economic activity acts as the threshold variable. Thus, the threshold construct for total credit suggests that the liquid assets ratio is expected to negatively impact the ratio of total credit to GDP (residents and non-residents included) by 0.09 per cent when economic growth is between 0.13 per cent and 0.19 per cent.

The threshold for economic growth is also estimated for business credit with a similar specification. The results in this instance suggests that as economic activity rose over the period, liquid assets had a larger but negative impact on real credit growth, while non-performing loans, private consumption and net exports had negative and significant impacts on credit activity. Within this liquid asset regime, the real growth threshold rose to 7.41 per cent, with the impact on domestic credit (residents only) being minus 0.34 per cent. Finally, testing the threshold against household credit reveals that up to 1.91 per cent, the liquid assets ratio is expected to have a minus 0.01 per cent impact on household credit to GDP (residents only). Similarly, non-performing loans, private consumption and net exports maintain their negative relationship with household credit to GDP.

**Table 3: Results of Various Models Tested**

| Variables | Fixed Effects | Fixed Effects Threshold (Liquid Assets Regime/Real GDP Threshold) | | |
|---|---|---|---|---|
| **Dependent Variables** | *Total Credit* | *Total Credit* | *Business Credit* | *Household Credit* |
| Real Economic GDP | 0.0642*** [.01629] | | | |
| Non-performing Loans (1 Lag) | -0.04017*** [0.0097] | -0.0388*** [0.0104] | -0.5725*** [0.1188] | -0.0131*** [0.0023] |
| Liquid Assets to Total Assets (1 Lag) | -0.0006*** [0.0080] | | | |
| Private Consumption | -0.0056 [0.0050] | -0.0028 [0.0048] | -0.1176** [0.0534] | -0.0035** [0.0011] |
| Net Exports | -0.0074*** [0.0074] | -0.0011 [0.0086] | -0.0194** [0.0928] | -0.0077*** [0.0019] |
| *Constant* | 1.2705*** [0.2126] | 1.4908*** [0.2733] | 11.6397*** [3.033] | 3.3977*** [0.0614] |
| **Regime Variable** | | | | |
| Liquid Assets to Total Assets (Interaction Term) | | -0.0906** [0.0171] | -0.3395*** [0.1025] | -0.0073*** [0.0039] |
| **Threshold Variable** | | | | |
| Real Economic GDP | | 0.1900** ‡0.1300** | 6.5600** ‡7.4100*** | -10.8700 ‡1.9100** |

Source: Author's Calculations
* p < 0.10, **p < 0.05, ***p < 0.01
†- Single threshold, ‡ - Double threshold, †‡ - Triple threshold

## VI.    Policy Implications and Recommendations

Having established the direction of causality at the beginning of the study as leading from growth to credit, the authors conclude that the relationship is demand driven rather than supply leading in the short run.  However, in the long-run this conclusion is expected to reverse.  Thus, maintaining the bi-directional relationship as seen in some studies.  Further to the analysis, is the existence of thresholds using total credit to GDP (resident and non-resident credit), as well as domestic credit sub-categories of household credit to GDP and business credit to GDP.  These variables in combination with private consumption to GDP, net exports to GDP, non-performing loans ratio and liquid assets to total assets suggest that financial intermediaries are greatly impacting growth and its prospects within the monetary union.

The ECCU, is a quasi-currency board and as such monetary policy tools in a traditional sense are not executed.  The negative impact of liquid assets to total assets confirms the effect which this economic construct will have on credit going forward.  The negative relationship reflected in the interaction term reveals that as growth progresses through to higher levels (separate regimes), banks in the ECCU will maintain or continue to accumulate liquid assets relative to total assets.  This hoarding is not being conducted within a vacuum, rather the presence of higher NPLs (in the form of the NPL ratio) and its continued negative impact on the extension of credit is in line with previous research conducted in the area and specifically for the ECCU.  The negative impact of higher liquid assets suggests that the extension of liquidity or lowering of discount rates (if such a move is considered) may have a limited impact on credit growth.

Because of these higher NPLs and high liquidity, credit conditions have tightened and credit rationing exists.   In so far as the economic growth continues at its current pace (low), commercial banks in the ECCU will maintain low levels of credit extension.  This result also points to the effect of NPLs and need for regulators to work with banks in the reduction of their non-performing loans.  Higher NPLs in this regard, may act as de facto monetary policy for commercial banks.  In so far as they remain above unacceptable levels, commercial banks may opt to restrict the extension of credit through various means until NPLs are reduced to more acceptable levels.  This 'wait and see' approach only occurs in the absence of monetary policy.  Changes to policy rates would have typically led to banks being persuaded – where possible- to extend more credit.

Net exports, though significant, is expected to have a minimal impact on total credit and domestic credit subcomponents. Private consumption as a ratio of GDP is significant and highly impactful in our analysis of the thresholds related to business credit but relatively inconsequential in household credit and total credit. This relationship may be because of the construct of private consumption which may suggests the presence of some endogeneity within the model.

## VII.    Conclusion

The literature surrounding the credit growth nexus has grown over the years. There have been many approaches to examining the relationship in developing countries. However, since the global financial crisis, the relationship has been altered and as such, the economies may be defined as demand following rather than supply leading. This paper sought to further develop the credit-growth analysis by considering separate regimes which may exist within the economic growth framework. The model designed by the authors considers several sides to the analysis including the open economy framework – an addition which may be considered as relatively new to the literature on the ECCU. Most importantly, however, the study captures the effect of growth through the interaction of banking variables – namely liquid assets on credit growth while considering separate thresholds of real economic growth.

The results of the paper point to a strongly negative and significant impact of liquidity on credit growth – given the current threshold levels of real GDP. The paper shows that within the context of higher NPLs, liquidity will have a negative impact on credit growth as economic growth progresses higher. This negative impact of liquidity is on account of the hoarding behaviour exhibited by commercial banks since the financial crisis which impacted the ECCU. These impacts also speak to the need for the continued need for commercial banks to further reduce their NPLs so as to be able to extend credit.

# References

Angeles, L., 2015. Credit Expansion and the Economy. *Applied Economic Letters,* 22(13).

Atindehou, R. B., Gueyie, J. P. & Amenounve, E. K., 2005. Financial Intermediation and Economic Growth: Evidence from Western Africa. *Applied Financial Economics,* 15(11), pp. 777-790.

Avdjiev, S. & Zeng, Z., 2014. Credit Growth, Monetary Policy and Economic Activity in a Three-Regime TVAR Model. *Applied Economics,* 46(24), pp. 2936-2951.

Balke, N. S., 2000. Credit and Economic Activity: Credit Regimes and Nonlinear Propagation of Shocks. *The MIT Press,* 82(2), pp. 344-349.

Beaton, K., Myrvoda, A. & Thompson, S., 2016. Non-Performing Loans in the ECCU: Determinants and Macroeconomic Impact. *IMF Working Paper,* November, 2016(229), pp. 01-33.

Bernanke, B. S., 1992-93. Credit in the Macroeconomy. *FRBNY Quarterly Review/Spring,* pp. 50-70.

Chudik, A., Mohaddes, K., M, P. H. & Raissi, M., 2015. *Is There a Debt-threshold Effect on Output Growth?,* Washington DC : IMF Working Paper.

Craigwell, R., Drakes, L., Greenidge, K., & Thomas, C., 2012. Threshold Effects of Sovereign Debt: Evidence from the Caribbean. *IMF Working Papers,* 2012(157), pp. 01-23.

Duggins, C. R., 2016. The Implementation of a Partial Credit Guarantee Scheme in the ECCU. What to look for. *ECCB Policy Brief,* pp. 01-10.

Eastern Caribbean Central Bank. (2016). *Summary of the Results of the Commercial Bank Senior Loan Officers' Opinion Survey on Credit Market Conditions in the ECCU – January to June 2016.* Basseterre.

Eastern Caribbean Central Bank. (2017). *Summary of the Results of the Commercial Bank Senior Loan Officers' Opinion Survey on Credit Market Conditions in the ECCU – July to December 2016.* Basseterre.

ECCU Task Force on Debt, Growth and Development. (2013). *Combined Report of the ECCU Task Force on Debt, Growth and Development.* Basseterre: Eastern Caribbean Central Bank.

Gantman, E. R. & Dabos, M. P., 2013. Finance and Economic Growth: New Evidence from Time Series Analysis. *Applied Economic Letters,* 20(9), pp. 893-896.

Gonzalez, A., Terasvirta, T. & van Dijk, D., 2005. *Panel Smooth Transition Regression Models,* Sydney: Quantitative Finance Research Center.

Gonzalo, J. & Pitarakis, J.-Y., 2012. Estimation and Inference in Threshold Type Regime Switching Models. In: *Handbook of Research Methods and Applications in Empirical Macroeconomics.* s.l.:s.n., pp. 189-204.

Granger, C. W. J., 1969. Investigating Causal Relations by Econometric Models and Cross-Spectral Methods. *Econometrica,* 37(3), pp. 424-438.

Hansen, B. E., 1999. Threshold effects in non-dynamic panels: Estimation, testing, and inference. *Journal of Econometrics,* 1 April.pp. 345-368.

Hansen, B. E., 2000. Sample Splitting and Threshold estimation. *Econometrica ,* May, 68(3), pp. 575-603.

Khan, M. S. & SSnhadji, A. S., 2001. Threshold Effects in the Relationship between Inflation and Growth. *Palgrave Macmillan Journals on behalf of the International Monetary Fund,* 48(1), pp. 1-21.

Lee, S., Park, H., Seo, M. H. & Shin, Y., 2017. Testing for a Debt-threshold Effect on Output Growth. *Fiscal Studies,* p. na.

Lugay, B. & Thompson, S. J., 2016. *Determinants of Credit-less Recoveries in the Eastern Caribbean Currency Union.* Nassau, The Central Bank of Bahamas, pp. 01-33.

Mohaddes, K., Raissi, M. & Weber, A., 2017. Can Italy Grow Out of Its NPL Overhang? A Panel Threshold Analysis. *IMF Working Paper,* March , Issue WP/17/66, pp. 01-17.

Patrick, H. T., 1966. Financial Development and Economic Growth in Underdeveloped Countries. *Economic Development and Cultural Change,* 14(2), pp. 174-189.

Piger, J., 2007. *Econometrics: Models of Regime Changes,* Eugene: University of Oregon.

Pradhan, R. P., Arvin, B. M., Norman, N. R. & Nishigaki, Y., 2014. Does Banking Sector Development Affect Economic Growth and Inflation? A Panel Cointegration and Causality Approach. *Applied Financial Economics,* 24(7), pp. 465-480.

Seifallah, S. & Sami, B. A. M., 2014. The Credit-Growth Nexus: New Evidence from Developing and Developed Countries. *Economic Notes by Banca Monte dei Paschi di Siena SpA,* 43(2), pp. 115-135.

Wang, Q., 2015. Fixed-effect panel threshold model using Stata. *The Stata Journal,* 15(1), pp. 121-134.