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FINANCIAL STABILITY IN THE ECCU:

DEVELOPING EARLY WARNING SYSTEMS AND A FINANCIAL STABILITY INDEX

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ABSTRACT

Periods of vulnerability in the banking system arising from an external shock or induced by policy will likely interrupt the efficient channel of funds to profitable business investments from household savings. Bank regulators and researchers alike have sought to investigate the common strands preceding these events given the destabilizing effects on the economy. This paper examined indicators which can signal an impending crisis at individual banks in the ECCU. The key indicators were then combined in a macro-prudential index to assess system-wide stability. The indicators fell within discreet bands or thresholds which were dependent on the probability of the occurrence of a distress event, defined as a consistent breach of the reserve requirement[1]. The empirical evidence revealed that these thresholds corroborated with the benchmarks used internationally. The model was also able to identify early warning signals prior to actual periods of distress in the financial sector. This analysis provides a guide to events which may precede a financial crisis in the ECCU but are limited at predicting with certainty when such an event would occur in the future.

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[1]The inability of a financial institution to meet the required reserve holdings at the Central Bank indicates poor liquidity management or inadequate provision for claims. However multiple infractions of this requirement over subsequent periods may be a sign of insolvency.

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Introduction

"Achieving financial stability is perhaps the most urgent task facing the world economy at the present time. If the international financial system cannot be made to operate in a more stable way, the prospects for an open and liberal approach to trade and capital flows are poor...the fundamental goals of development and poverty alleviation will be set back." Andrew Crockett (1998)

Financial stability is paramount in a monetary union due to the high degree of interdependence among financial institutions and the cascading effect a crisis can have on economic stability of member countries. The externalities or spill-over effects from a crisis in an individual bank can inhibit economic growth. Conversely economic downturns can adversely affect asset quality, depleting capital adequacy and increasing the risk aversion towards otherwise acceptable business investments. The link between the macro-economy and the financial sector has become more pronounced particularly for developing countries where a stable economic environment is more crucial. The early warning signs of a potential crisis are therefore critical for improved regulation of the financial sector and to provide a stable macroeconomic environment for growth and development. This paper seeks to examine, firstly, the indicators which can signal an impending crisis point in individual banks, incorporating some measure of contagion throughout the banking sector. Secondly the points of transition into a crisis are explored to assess the trigger points of weak banks. Lastly a macro-prudential index is used to assess banking system stability and give a wider analysis of the early signs of a crisis.

The importance of this analysis stems from the growth enhancing effects of financial intermediation which can be easily reversed by the destabilizing effects on the domestic economy of a banking crisis. Loayza and Ranciere (2006) noted the positive long-run impact that financial development can have on economic growth but emphasized that "financial fragility can hurt economic growth". Periods of vulnerability in the banking system stemming from an external shock or induced by policy will likely interrupt the efficient channel of funds to the prospective business investments and households. Conditions can destabilize further if

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there is a loss of confidence in the banking system followed by an inordinate demand for liquid liabilities. The economic consequences are more pronounced as the interconnectivity of the financial system means that a failure at one institution can reduce the liquidity inflows at another institution which is exposed to it, forming a ripple effect of losses within a short space of time. Restoring stability usually results in a transfer of the costs to the central government who are often constrained by limited fiscal space.

The financial sector in Jamaica experienced a period of heightened vulnerability between 1995 and 1998, preluded by the classic warning signs of instability. It was induced by policy measures aimed at liberalizing the financial sector including the removal of foreign exchange controls in 1991. This shift in regime contributed to a significant growth in the financial sector between 1991 and 1995. Building societies and other similar lending institutions quadrupled while commercial banks' assets grew by more than 250 per cent. The increased competition in the sector contributed to volatility in interest rates and the propensity of institutions to form non-regulated entities and benefit from less stringent requirements. This coupled with fluctuations in the exchange rate and rising stock and real estate prices created a serious concern about the viability of the financial sector. These factors are consistent with the signs of distress which were popularized by Goldstein, Kaminsky and Reinhart (2000). In the Eastern Caribbean, the global financial crisis and the collapse of the CL Financial conglomerate in 2009 exacerbated weaknesses at some financial institutions. Liquidity constraints and increased risk aversion within the banking system limited the flow of funds on the interbank market. Interbank rates peaked in July 2010 following a rapid outflow of deposits from individual banks. These stresses to the financial sector can be averted through prudent supervision and regulation. In this paper a thresholds analysis indicating approximately when financial institutions in the ECCU would be in need of enhanced monitoring are examined. The next sub-section provides stylized facts of the ECCU domestic financial sector. Section two gives a purview of the methodologies employed from previous researchers. Though there is no definitive consensus on the factors leading to a financial crisis there are leading indicators which will signal a destabilizing event may occur. The indicators used are identified in section three, data, and the determination of the most useful indicators in

the ECCU is examined in section four, the discussion of the results. Section five provides a succinct conclusion with areas for further research.

Stylised Facts

The ECCU financial sector is comprised of 368 regulated entities, of which 40 are commercial banks. The commercial banks however maintain dominance in the market by holding the major share of total assets, although the non-bank financial institutions have shown a rapid growth in asset size over the last decade. Among the commercial banks there are six systemically important banks (5-10% of the market) by sheer asset size, located in Saint Lucia, Antigua and Barbuda and St Kitts and Nevis. The monopolistic nature of the financial sector with a few dominant players forms the framework upon which the transmission mechanisms and hence the relevant indicators which precede a crisis can be analysed.

A financial crisis in developing countries typically manifests during the transitional stages of financial development or financial liberalization. This thinking is evidenced by research performed by Loayza and Ranciere (2006) where they highlight the link between financial liberalization and financial depth and also financial fragility as there may be negative short run effects of financial intermediation on growth. Indicators of financial depth are therefore important in this analysis to gauge the stage of development. The indicators used followed King and Levine (1993) where various measures of financial intermediation were proposed (see Table 1 and Table 2).

Table 1: Selected Economic Indicators - ECCU

	Inflation		Lending rate		Deposit rate		Measures of financial depth EC$m		
							M2/GDP	PC/GDP	PC/DC
	mean	sd.	mean	sd.	mean	sd.	mean	mean	mean
1990's	0.47	0.70	11.75	0.15	4.24	0.11	70.36	68.20	102.87
2000's	0.65	0.87	10.61	1.17	3.66	0.59	94.21	84.54	101.53
1996-2000	0.34	0.87	11.80	0.16	4.28	0.13	72.17	69.90	103.08
2001-2005	0.58	0.48	11.39	1.04	3.96	0.63	91.05	79.30	102.34
2006-2011	0.86	0.98	9.66	0.23	3.24	0.06	99.76	93.15	100.36

Notes:
1. September 2002 the deposit rate floor was reduced to 3% from 4%
2. Inflation rate (end-of-period)
3. PC - Private Sector Credit, DC - Domestic Credit

Table 2: Selected Economic Indicators - CARICOM

	Barbados		Jamaica		T&T	
	M2/GDP	PC/GDP	M2/GDP	PC/GDP	M2/GDP	PC/GDP
	mean	mean	mean	mean	mean	mean
1990's	69.49	52.74	47.02	22.7	46.59	43.78
2000's	123.11	84.96	55.92	22.13	40.54	37.1
1996-2000	70.51	53.64	46.03	17.5	45.97	43.72
2001-2005	115.43	79.11	60.45	23.3	39.52	38.56
2006-2011	144.85	99.2	53.73	27	41.1	33.68

Note:
1. Data from 1996 to 2009 for Barbados, Jamaica and Trinidad & Tobago
Source: World Bank

The traditional measure of financial depth considers the overall size of the formal financial intermediary system relative to economic activity as measured by the ratio M2 to GDP. This measure of the size of the financial is assumed to be positively related to the provision of financial services. This has grown from 70.3 per cent in the latter half of the 1990's to 94.2 per cent during 2000-2011 in the ECCU. A similar trend is observed in Barbados where this

ratio has increased from 69.5 per cent to 123.1 per cent using the same time reference. The availability of funds to provide financial services from this measure has grown significantly within the last decade. Other major CARICOM markets such as Jamaica and Trinidad and Tobago exhibited a more stable movement with Jamaica showing an 8.9 percentage point difference on average between these two decades while Trinidad and Tobago decelerated by 6.1 percentage points. This measure however does not illustrate the allocation of credit and the sectors to which this credit is allocated.

King and Levine (1993) note that 'a financial system that simply funnels credit to the government or state-owned enterprises may not be evaluating managers, selecting investment projects, pooling risk, and providing financial services to the same degree as financial systems that allocate credit to private sector'. Claims on the private sector in deposit money banks constitute on average 85 per cent of domestic credit in the ECCU from 1996 to 2011. Household mortgages are the main component of these private sector claims. The loan portfolio of these financial intermediaries is therefore adversely affected by increasing unemployment rates. This factor has attributed to the sharp rise in non-performing loans (NPL) since the onset of the global financial crisis. In Barbados and Jamaica the private sector comprised on average 79 and 51 per cent respectively of total domestic credit provided by monetary authorities and financial institutions. The distribution of domestic assets among private sector agents is thus highest in the ECCU but if the credit is mainly allocated within households, then the allocation of credit for business operations, start-ups and SME's are relatively lower, thwarting the benefits to be derived from financial intermediation.

Figure 1: Percentage Value of Shares Traded on the ECSE
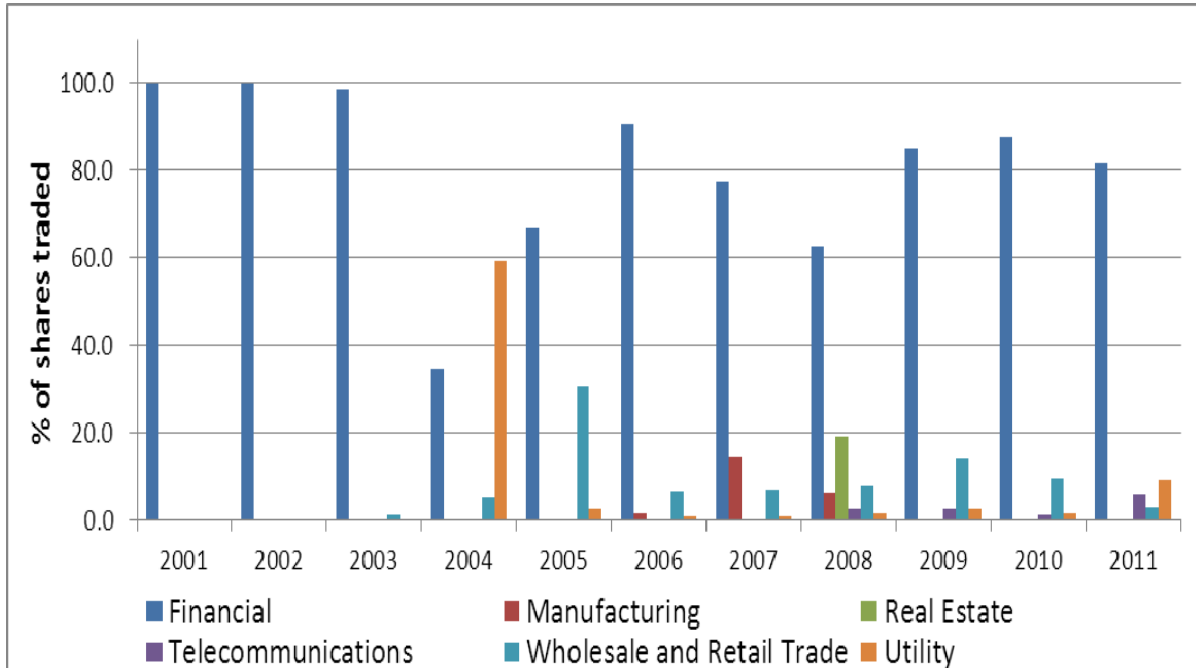
Another component of the financial sector in the ECCU is the Eastern Caribbean Securities Exchange. Equity trades have grown steadily relative to economic activity over the last decade from 0.08 per cent in 2002 to 0.21 per cent in 2010. Figure 1 shows that the financial sector has dominated equity trades, giving further evidence of the importance of commercial banks in the macro-economy and the impact of a stable banking sector. Stock market activity is however still relatively low compared to other forms of financial intermediation in the ECCU.

A Review of the Empirical Literature

Crockett (1997) defines stability in financial institutions as "the absence of stresses that have the potential to cause measurable economic harm ..." Traditionally policy makers would be concerned with sudden changes in market indicators such as the interest rate spread and the changes in the assessment from credit rating agencies. These indicators however have not exhibited warning signs within sufficient time for policy makers to provide the required adjustment. There are various methods employed to examine the early warning signs of

distress in the financial sector. Most studies have looked at non-parametric techniques such as Kaminsky et al (1998) and multivariate logit or probit approaches.

A seminal piece is the signals approach by Kaminsky et al (1998) which identifies indicators, highly correlated with banking crises, that deviate from the 'norm' preceding a crisis. The real exchange rate, stock prices and the M2 multiplier were ranked highest in their analysis. Other indicators such as output and domestic credit to GDP were ranked 5th and 11th respectively based on the percent of crisis which the data accurately predicted. This is a non-parametric technique which has the advantage of assessing the trends prior to impending crisis. It may however be limited in explaining the interdependencies among variables as the regression approach. This is important to garner the transmission of the external shock or policy decision which triggered the crisis through various sects of the economy.

A large number of studies have employed the discriminant analysis or logit approach (Demirguc-Kunt and Detragiache, 1999; Bussiere and Fratzscher, 2002) for investigating the probability of a crisis event at individual banks. Poghosyan et al (2009) notes the advantage over statistical models which do not condition the forecast on assumptions about the future path of any of the variables included in the model. Hardy and Pazarbasioglu (1999) used a multinomial logit approach using macroeconomic and financial variables for the pre-crisis and variants for the severity of the crisis to capture the indicative events leading up to the crisis periods. Based on their analysis, the leading indicators for severe but contained banking crisis were domestic variables; for the Asian crisis proxies for vulnerability in the banking and corporate sector were the best warning signs. Indicators of external developments were best in predicting a full-blown banking crisis. Their findings largely corroborate with Demirguc-Kunt and Detragiache (1999) whose study they sought to build upon.

This study adds to this body of literature by employing a logit approach to assess distress periods in the ECCU banking sector. The outcomes of this investigation were to establish first, a set of indicators most useful for signalling distress in a bank in the ECCU and ultimately the thresholds or the probability range within which a bank may be in distress. In addition, while this tool may not be regarded as a predictor of *future* bank distress, it serves as

a useful guideline for assessing the factors which currently lead to weak banks. The banks with multiple and consecutive distress periods were modeled with other banks with limited to negligent distress serving as a control group.

Data and Methodology

A distress event in this analysis was identified as the period where banks were unable to meet the weekly 6 per cent reserve ratio. These events where summated within a particular quarter. Failure to meet this ratio is usually a sign of insufficient liquidity levels. In the model a positive outcome is classified as the period where banks were in distress and the alternative when they were not in distress. These take the values one and zero respectively.

Figure 2: Frequency of Distress Events
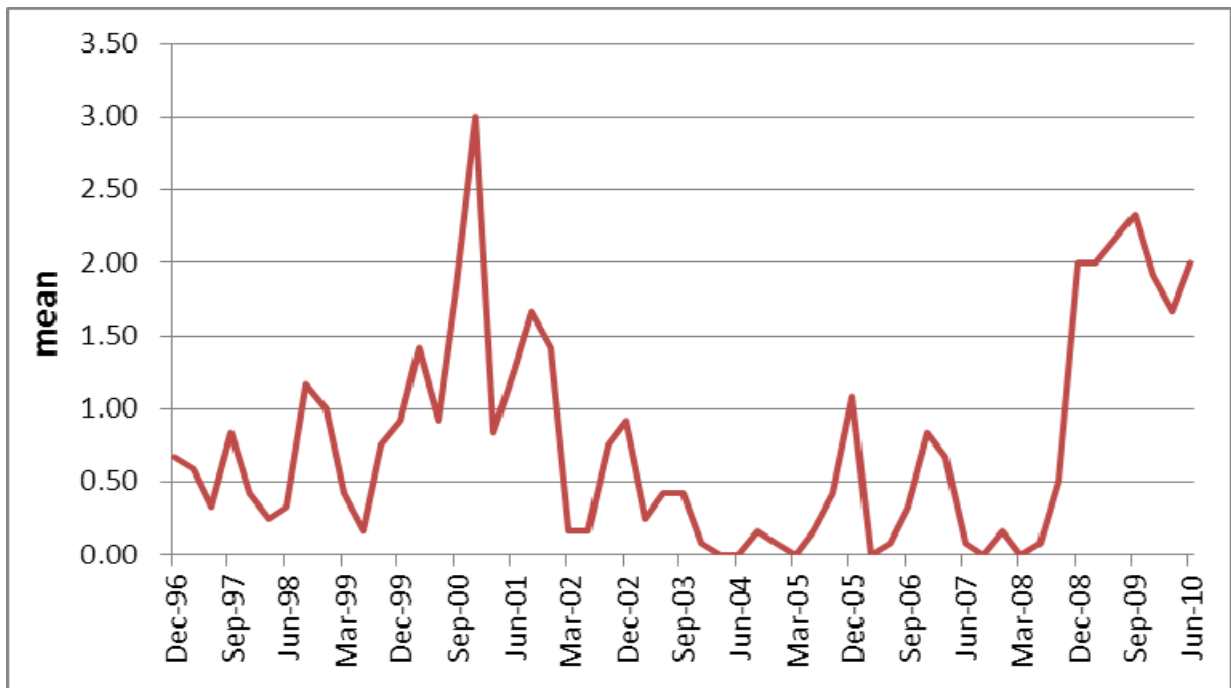
Source: ECCB

The distress events were more frequent during periods of global downturn, 2000-2001 and 2008-2010 and the period of least volatility in 2004 prior to the Cricket World Cup tournament in the Caribbean where investments peaked (see Figure 2). Over the entire time period six

banks incurred the most frequent distress occurrences while the remaining eight were less frequent presenting a counterfactual grouping in the analysis (see Figure 3).

Figure 3: Average Distress Events
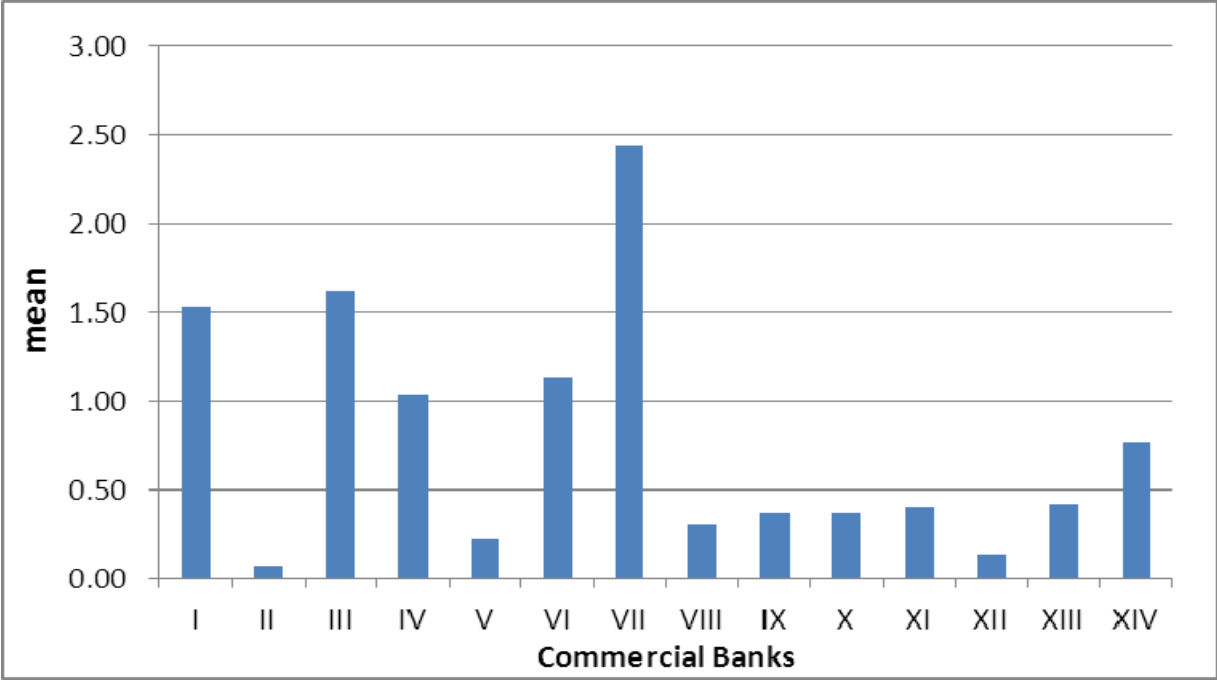
Source: ECCB

The sample included 14 major ECCU indigenous banks for the period 1996Q4 to 2010Q2 which includes the period of the collapse of a key insurance conglomerate and the onset of the global financial and economic crisis. The manifestation of these events in the banking sector lays the foundation for adopting a macro-prudential approach in this analysis. The literature has shown usage of CAMEL indicators and also inclusive of macroeconomic variables. The CAMEL indicators generally are a prudent measure of liquidity and solvency risks in individual banks. However, more recently researchers have utilized a macro-prudential approach given the impact of economic downturns and rapid credit expansion on the financial sector. These two frameworks were employed in this study including region specific indicators which upon observation would have trended unfavourably before a distress event.

Table 3: Descriptive Statistics

Indicators	Mean	Median	Stdev.
Capital Adequacy Ratio	20.84	17.28	10.94
Non-performing Loan Ratio	15.71	14.13	9.96
Non-interest expense to non-interest income $EC(M)	0.44	0.31	2.29
Return on Assets Ratio	0.44	0.47	0.64
Net Liquid Assets Ratio	37.57	32.08	21.07
Tier 1 Capital to adjusted risk weighted assets	18.05	14.89	10.23
NPL net specific provision to tier 1 capital (%)	88.45	71.62	81.27
Interbank Exposure (% of total loans)	8.34	1.52	16.38
Public Sector Credit (% of total loans)	64.52	39.02	90.37
Z-score	25.63	24.21	9.63

In the baseline model the capital to adjusted risk weighted assets ratio was used to assess the adequacy of bank capital and the exposure of banks to balance sheet shocks. On average the 14 indigenous banks exceeded the benchmark of 8 per cent for the capital adequacy ratio (see Table 3). Individually however some banks would have held capital assets below this benchmark in the initial stage of incorporation, prior to 1998. A typical measure of asset quality is the NPL ratio with the prescribed ratio at least 5 per cent of total non-performing loans. An increasing trend signals deterioration in the quality of credit portfolios and consequently, in financial institutions' cash flows, net income, and solvency[2]. NPL's on average have been relatively high in the ECCU, particularly in the indigenous banking sector. At 15.7 per cent over the sample period, it far exceeds the benchmark of 5 per cent for the NPL ratio. These risks can have adverse effects on private investment in the economy as banks may be more reluctant to lend. With the public sector holding on average 64 per cent of total nominal credit private investment is further curtailed. The vulnerability of these financial institutions may also be heightened by a poor management structure, where the non-interest expense ratio[3] was used as a proxy. While this proxy may not capture the intricacies of a prudent corporate governance structure, it provides a basis for analysing the management of non-interest expenses. On average this ratio has remain fairly stable at $0.4m across

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[2] Evans et al (2000),

[3] Non-interest expense ratio – non-interest expense as a percentage of non-interest income

individual banks. Commercial banks' earnings or profitability was estimated using the return on assets (ROA) ratio where a declining trend in the bank's ROA implies bank losses; however, high profitability may be an indicator of excessive market risk. The health of a financial institution can also be reduced through declining liquidity indicators, proxied by the net liquid assets ratio. The inability to meet short term funding requirements is a crucial measure of bank solvency. The transmission mechanisms among these variables are also important as the risks from a high npl ratio can be moderated by adequate capital assets. Therefore it is not only necessary to examine suitable indicators of a financial crisis but to estimate through a regression framework. These and other macroeconomic variables will therefore be used as distress indicators.

Discussion of Results

The probability of distress based on the indicators used was estimated in a conditional fixed effects logistic regression model. The results of the baseline model are summarised in Table 4.

Table 4: Logit Estimation Results - Baseline

Variables	Coefficient	z-statistic	$P > |z|$
Capital adjusted to risk weighted assets ratio	-0.0003	-0.02	0.984
Non-performing loans ratio	0.0251	2.48	0.013***
Non-interest expense ratio	0.0010	1.64	0.101*
Return on assets	0.5628	2.54	0.011***
Net liquid assets ratio	-0.0312	-2.00	0.045**

Log likelihood   -363.9
Pseudo R-squared   0.051

Notes:
*** denotes the 1 per cent significance level
** denotes the 5 per cent significance level
* denotes the 10 per cent significance level

In this model all the variables were significant, at the 10 per cent level, in explaining the outcome of the banks with the exception of the capital adequacy ratio. The deterioration of the quality of capital may evolve after the decline in some of the other indicators such as the non-performing loans. Therefore, this indicator may not be significant if modelled at the initial stages of distress.

The sign on these coefficients is the most critical issue at this stage as they portray whether there is an inverse or direct relationship with the probability of distress. All of the four variables which were significant exhibit a positive relationship with the dependent variable implying that deterioration in any of these ratios would lead to a distress outcome for the individual banks. It is important to note that for the earnings indicator, ROA, an increase in retained earnings or a reduction in assets was associated with a distress outcome for banks in this sample.

Robustness checks on the baseline model involved looking at other indicators which may add to the determination of a distressed event. Therefore, in the second model core capital was used as the basis for the capitalization and asset quality ratios. Core capital is a measure of a bank's financial strength and is composed of retained earnings and equity capital. Inclusion of this measure, however, did not bear any significant changes to the baseline model. The third model used a macro-prudential analysis to ascertain the effects of the macroeconomic environment on the financial sector. In periods of low economic activity for instance gross domestic income may be curtailed, and borrowers default risk magnified reflecting in higher non-performing loans on a bank's portfolio. These macro indicators were not significant, and thus did not add any additional information to the baseline indicators used. The risks of contagion has become of increased concern given the interdependence of the indigenous banks in the ECCU through the interbank market. The indicator used to measure this risk was however marginally significant in the fourth model of bank fragility. It also showed an indirect relationship as the coefficient bore a negative sign. This was contrary to a priori expectations that increased contagion would impact positively on the probability of distress. The risks may not be sufficiently modelled through this indicator.

Table 5: Robustness Checks on Baseline Model

Models	I	II	III	IV
	Baseline	With	With	With
		Core Capital	Macro Variables	Contagion Risks
Capital to adjusted risk weighted assets	**-0.0003**		**-0.0027**	**-0.0027**
Non-performing Loan Ratio	0.0251***		0.0183[4]	**0.0293***
Non-interest expense to non-interest income	0.0010*	0.0008[8]	0.0009[8]	**0.0008[8]**
Return on Assets	0.5628***	0.5487**	0.5580***	**0.5340***
Net Liquid Asset Ratio	-0.0312**	-0.0300*	-0.0362**	**-0.0246***
Tier 1 capital to adjusted risk weighted assets		0.0080		
NPL net specific provisions to tier 1 capital		0.3553***		
Real GDP (in logs)			-0.2440	
Real credit to GDP (in logs)			-0.5184	
Inflation rate			-0.1466	
Real lending rate			-0.1111	
Interbank Exposure				-0.0516[8]
Number of observations	**734**	**734**	**726**	**734**
Pseudo R-squared	**0.051**	**0.052**	**0.059**	**0.067**
Log likelihood	**-363.9**	**-363.4**	**-357.6**	**-357.8**

[4] This variable was significant at the 15 per cent level

Table 6: Robustness Checks on Baseline Model II

Models	I	V	VI	VII
	Baseline	With Public Sector Share	With z score	Long term Distress[5]
Capital to adjusted risk weighted assets	**-0.0003**	**-0.0014**	**0.0153**	**-0.0538[6]**
Non-performing Loan Ratio	0.0251***	0.0258***	0.0262**	0.0328
Non-interest expense to non-interest income	0.0010*	0.0010*	0.0009[4]	**0.0007***
Return on Assets	0.5628***	0.5654***	0.6082**	**0.2678***
Net Liquid Asset Ratio	-0.0312**	-0.0306**	-0.0337*	**-0.0908***
Public sector share of credit			0.0045	
Z score			-0.0204	
Number of observations	734	734	734	424
Pseudo R-squared	0.051	0.051	0.052	0.192
Log likelihood	-363.9	-363.8	-363.6	-100.6

The public sector share of credit in some indigenous banks differs considerably from the share loaned to the private sector. When included in the analysis this indicator was not significant. One can conclude however that the non-performing segment of public sector may be more relevant and will be captured in the asset quality indicator. In the sixth model, the z score a measure of bank soundness was included. The z-score[7] assesses how well the bank is insured against risk to its equity portfolio. It is regarded as a measure of insolvency as it captures the likelihood of a bank's profitability being too low to cover the volatility of its earnings in a given year. This indicator was insignificant in this analysis which suggests there is no additional information to be gained from the inclusion of this variable. A similar result was identified in Poghosyan et al (2009).

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[5] All variables, with the exception of the net liquid asset ratio, were lagged by two quarters
[6] This variable was significant at the 15 per cent level

[7] $Z \text{ score} = \dfrac{\Sigma ROA + Equity/Assets}{Std\ dev(ROA)}$

The severity of the distress was proxied by an indicator that captures the occurrence of three consecutive reserve requirement infractions in a quarter in the seventh model. The model was re-estimated with this indicator as the dependent variable. The explanatory variables, with the exception of the liquidity indicator, were lagged by two quarters so that the period of severe distress is based on a declining trend in these ratios from the previous two quarters. In this model, NPL ratio was not significant; however, the capital adequacy ratio is now significant at the 15 per cent level. This signals the importance of the capital to assets ratio to the long-term viability of the banks. The sign of the coefficient posits an indirect relationship between the adequacy of the existing capital and the distress outcome for banks in the ECCU. Therefore as this the capital base is eroded the probability of distress increases.

Among these models the baseline model captured the most relevant indicators for predicting the likelihood of a distress outcome. Its predictive power compares fairly well with the other models while using as few parameters as possible. At various cut-off points or thresholds the model can predict banks which were in distress. If the threshold is lowered, the amount of banks deemed to be in distress rises. This, however, also increases the margin of error between the predicted and actual distress outcomes[8]. At the cut-off point 10, with 10 per cent probability of distress there were five predicted distress events. These predicted distress periods occurred in the same period where the bank experienced consecutive reserve infractions per quarter. Table 7 shows this result in four banks which had the most frequent distress periods.

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[8] See Appendix for type I and II errors analysis

Table 7: Actual vs Predicted Distress Periods

Banks[9]	Consecutive Infractions -Actual Distress	Predicted Distress
Bank I	2008 q4 – 2010 q2	**2008 q4**
Bank II	2005 q4 & 2006 q2	**2005 q4**
Bank III	2008 q4 – 2010 q2	**2009 q1 & 2010 q2**
Bank IV	**1999 q3 – 2001 q4**	**1999 q4**

The relationship between the most significant indicators in the baseline model and the probability of distress can be analysed to determine the points at which the indicator falls into a low or high distress region. This is from here-on classified as trigger points. The first trigger point is represented by the low region, 0 to 30 per cent probability of distress, and the second trigger, the high distress region, at the 30 to 50 per cent level.

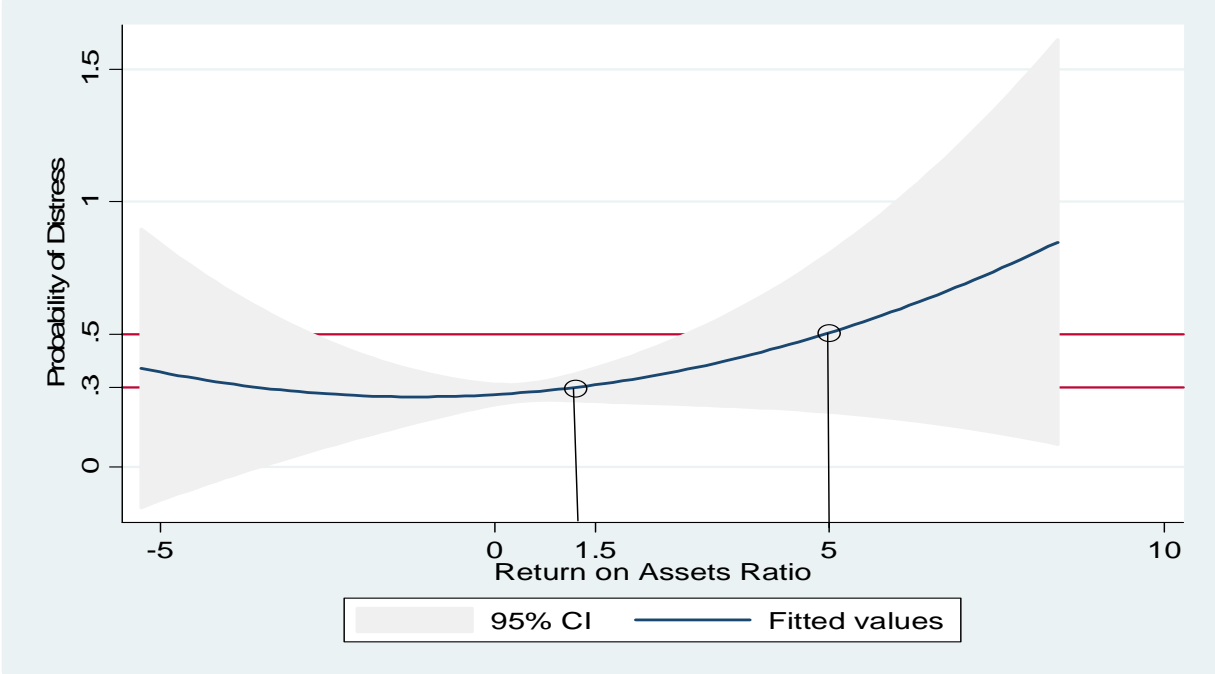**Figure 4: Threshold Analysis - Non-Performing Loan Ratio**

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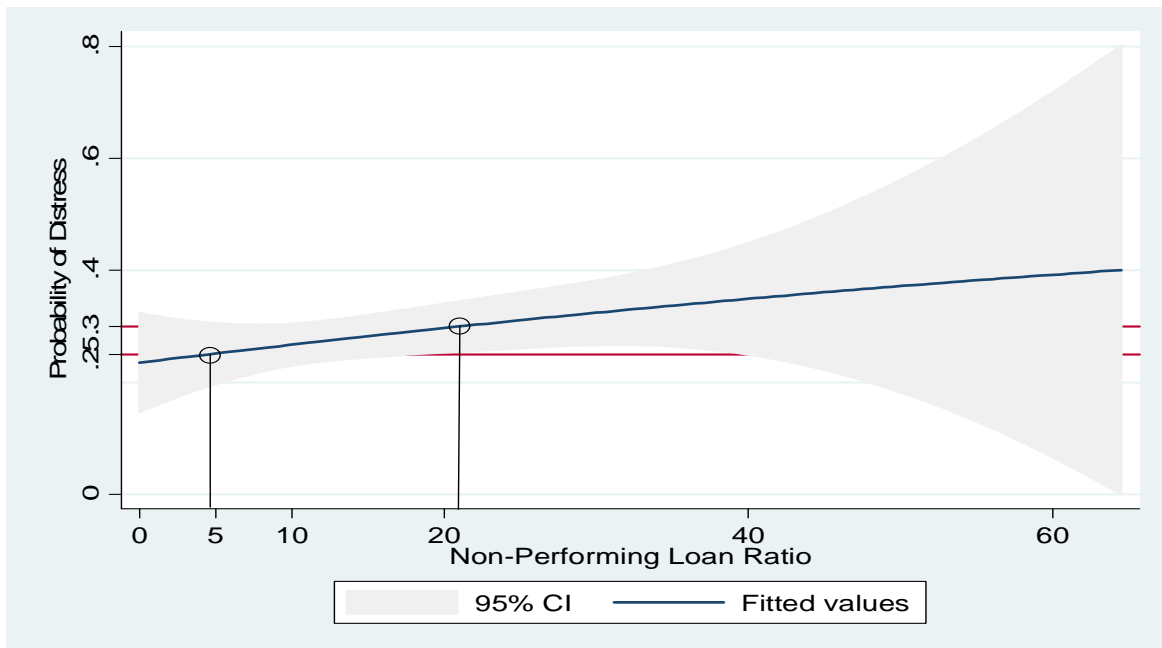
[9] Bank VII was not predicted as a bank in distress in this analysis despite consecutive infractions in the latter half of the period.

This indicator crossed the low threshold at 5 per cent, in tandem with the current[10] benchmark which prescribes that the non-performing loans be less that 5 per cent of total loans. For the high distress region, the non-performing loan ratio should be at a maximum limit of 20 per cent.

In Figure 5, the return on asset ratio has also maintained a similar limit to the current benchmark of 2 per cent. However based on this analysis the risks to bank soundness are realised if this ratio exceeds 1.5 per cent. The return on asset ratio should also not exceed 5 per cent as this indicates periods of high distress. The rationale for this may be that the banks may show signs of vulnerability where there are excess returns on assets. Figure 6 shows that a sustainable position for ECCU banks would be to hold 50 to 80 per cent of liquid assets to liquid liabilities. Outside of this range would trigger a greater than 20 per cent probability of distress.

Figure 5: Threshold Analysis - Return on Asset Ratio

Figure 6: Threshold Analysis - Net Liquid Asset Ratio
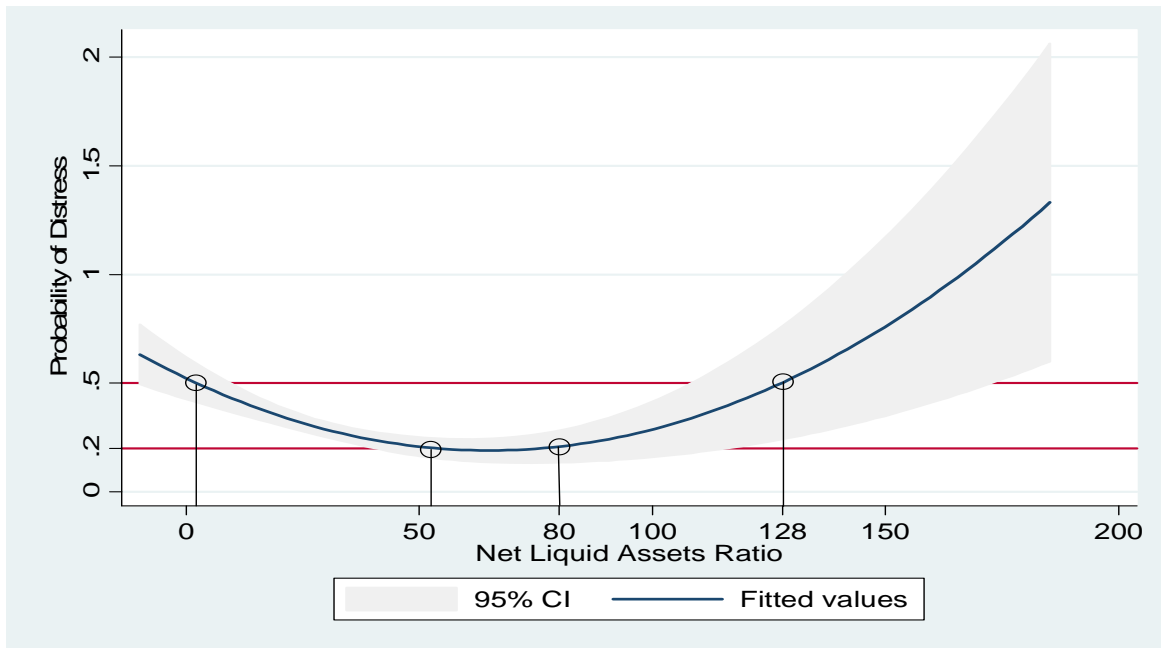
Table 8: Summary of Trigger Points

Indicators	First Trigger (0–30% PD[11])	Second Trigger (30–50% PD)
Non-Performing Loan ratio	if greater than 5%	**if greater than 20**
Return on Assets ratio	if greater than 1.5%	**if greater than 5**
Net Liquid Assets ratio	**if greater than 80% or if less than 50%**	**if greater than 128%**

Non-parametric approach – Financial Stability Index

A banking sector vulnerability index shows the current trend of leading indicators in the ECCU banking sector. It provides another diagnostic apparatus for informed policy making of a sector. Kaminsky and Reinhart (1998) have looked at a non-parametric analysis observing the behavior of indicators on the eve of a financial crisis. Their research used a signal approach for indicating the onset of a crisis.

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[11] PD – Probability of Distress

This index examines periods of volatility in the banking sector using the key indicators estimated in the previous analysis with a key macroeconomic indicator, credit growth (see Figure 7). The interest rate spread, though a commonly used as a crisis predictor, has been noted by Grenade (2007) as being highly leveraged in the ECCU even through periods of stability. Other researchers such as Craigwell and Moore (2000) have noted the monopoly which banks exert in this sector as one of the main reason for the large interest rate spreads. Thus use of this indicator may be misleading. Goldstein et al also note the 'late reaction' of interest rate spreads and question the usefulness of this indicator as a prime early warning tool. The construction of the index involved the determination of a 'tranquil'[12] period mean for each indicator. This was the average of the least volatile consecutive eight quarters[13] of the sample of data from 1997q4 to 2010q4. Scores for each indicator were denoted as deviations from this period of stability is recorded and weighted by the standard deviation for the previous eight quarters. The greater the divergence from stability the higher the score placed on each indicator. Prolonged periods of departure from tranquility will also result in higher scores in this analysis[14]. The scores of the indicators were aggregated to form a macro-prudential index of the banking sector. This index should present an early warning of forthcoming incidences of instability as marked by increasing trends away from the mean.

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[12] The tranquil period mean all fell within or very close to the internationally accepted benchmarks for the financial soundness indicators.

[13] The least volatile period for most indicators was between 2001 and 2003.

[14] The standard deviation would be smaller.

Figure 7: Financial Stability Index
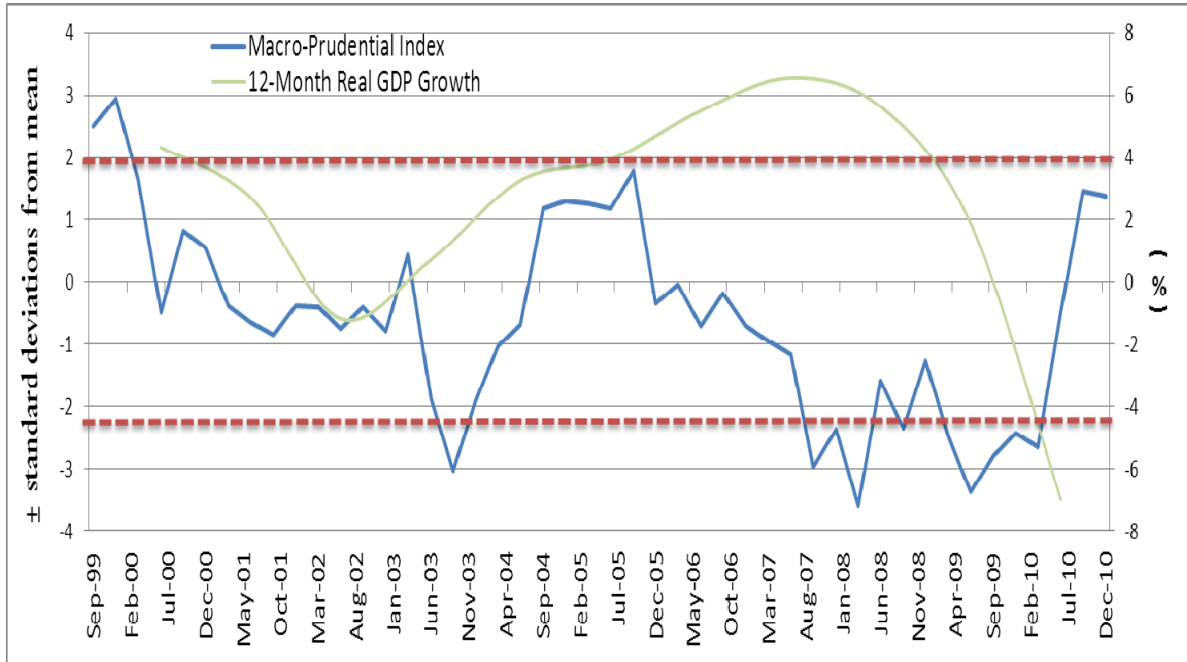
Source: Author's estimates

The most stable[15] periods lay between 2000q3 and 2003q2 as the index revolved around the standardized zero- mean. The index rose towards the upper bands, as the ECCU economies experienced a credit boom and relatively rapid growth in GDP in the years preceding the 2007 ICC world cup held in the Caribbean. Following this period, the credit bubble burst and the banking sector showed signs of increasing vulnerability as the index fell below the lower bound for a protracted period. A similar break of the lower bound was seen during the global financial crisis[16] where the ECCU underwent a 7 per cent decline in real GDP. Recovery from the crisis has been soft and though the index towards the end of 2010 has fallen within the specified bands, the banking sector remains vulnerable as it hovers near the upper bound.

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[15] ± 1 sd

[16] There was a lagged impact of the global financial crisis on the ECCU economies.

Conclusion

An unsound banking system can have a perverse impact on the macro-economy and similarly an unfavourable macro-economy can inhibit the key functions of the banking system. In developing countries the impact is ever more important given the financial intermediary role which the financial sector plays in private sector development, curtailing the multiplier effect of savings on output growth. In the ECCU, a fully-fledged financial crisis has not occurred, though events in particular sects of the financial system have posed severe challenges and the need for enhanced supervision. The global economic and financial crisis has also permeated the region's banking sector, through increased credit risks, subdued consumer confidence and increased risk aversion by lenders. The macroeconomic consequences have thus spurred renewed interest in early warning systems and more prudent regulation.

This study examined through a logistic regression model, the prime indicators of a forthcoming distress event in fourteen indigenous banks in the ECCU. The results proved that the CAMEL variables were most indicative of adverse these events. The main strength of the model was the ability to identify a greater likelihood of the occurrence of a distress event prior to. However, out-of-sample, these models have generally not performed well. Further extensions of the analysis to include the wider Caribbean or other developing countries with a similar macro environment will provide a wider control group, enhancing the robustness of the results. This paper though provides an insight into the characteristics of the ECCU financial sector. It complements the regulatory tools utilized in bank supervision as it reflects an objective assessment of the soundness of the banking sector. These models cannot be used in isolation however and must be collaborated with other qualitative audits such as onsite examinations.

A corollary to this paper is the impact on the exchange rate regime from a banking crisis in the ECCU, following similar episodes in developing countries. In the existing framework, significant reductions in foreign reserves held at the central bank can spur devaluation; however this is less likely given its legal remit to maintain at least 60 per cent of domestic currency in foreign reserves. Private capital inflows are not sufficiently large to exacerbate a

currency crisis from a sudden reversal in these flows as in the East Asian economies. Further research in this area would shed some light on the possible links between a banking crisis and a currency crisis in the ECCU.

The strengthening of the financial sector is thus paramount in our developing economies as the fiscal and economic costs of a banking crisis are insurmountable. The analysis of key indicators is the continuation of significant strides made to reduce the discretionary bias in decision making. However at the forefront of policy making is the rationalization and continued development of the sector through financial safety-net measures and an enhanced supervisory framework.

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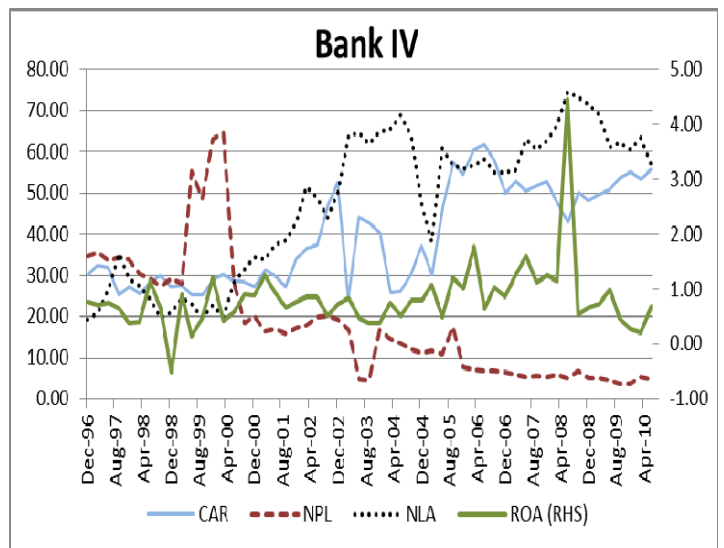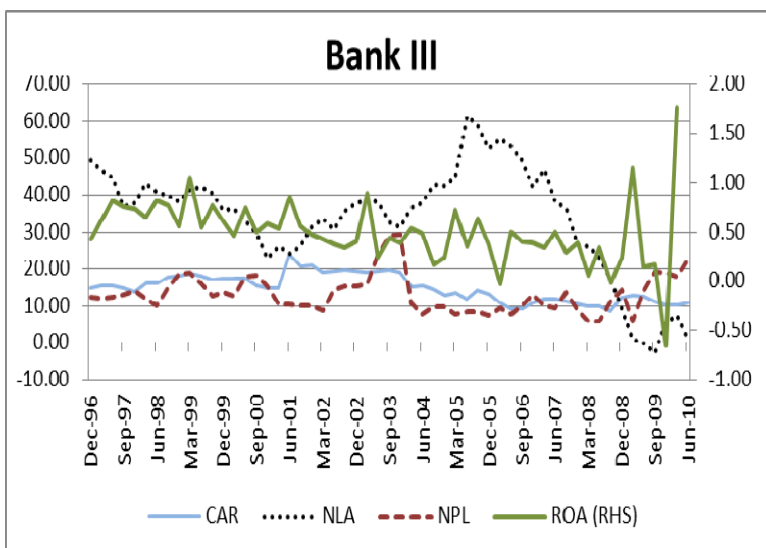
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Appendix

The trends in selected indicators in individual banks show the sudden change in the variables at particular periods. In Bank 1, for instance, the volatility in the return on assets ratio was significant during 2008, during the period of acute liquidity risks within this bank. Similar trends were noticed in the following banks during periods of heightened vulnerability.

Figure 8: Trends in CAMEL Indicators by Bank

Bank V

Bank VI

Bank VII

Bank VIII

Bank IX

Bank X

Bank XI

CAR NPL NLA ROA (RHS)

Bank XII

CAR NPL NLA ROA (RHS)

Bank XIII

CAR NPL NLA ROA (RHS)

Bank XIV

CAR NPL NLA ROA (RHS)

27
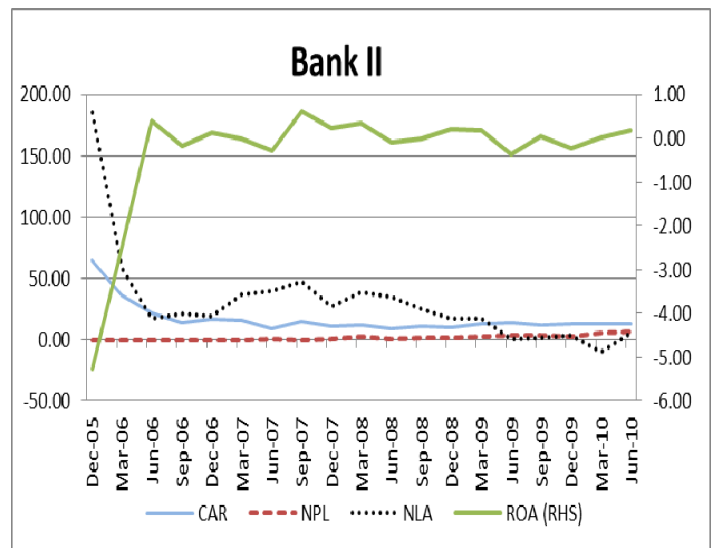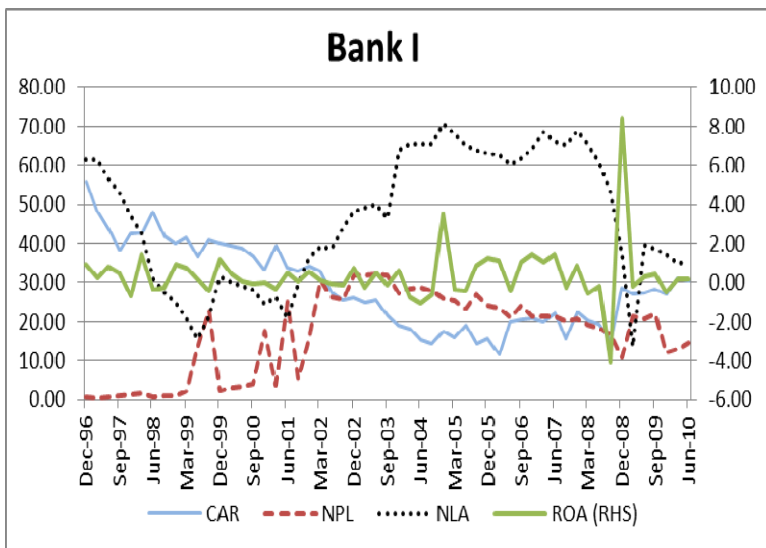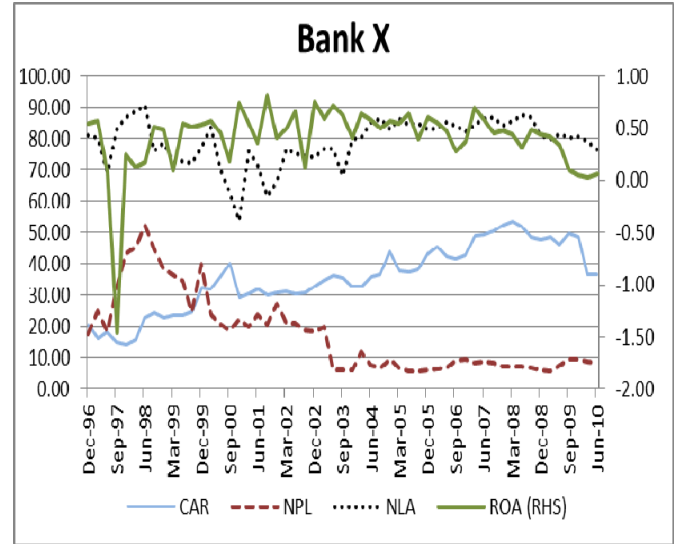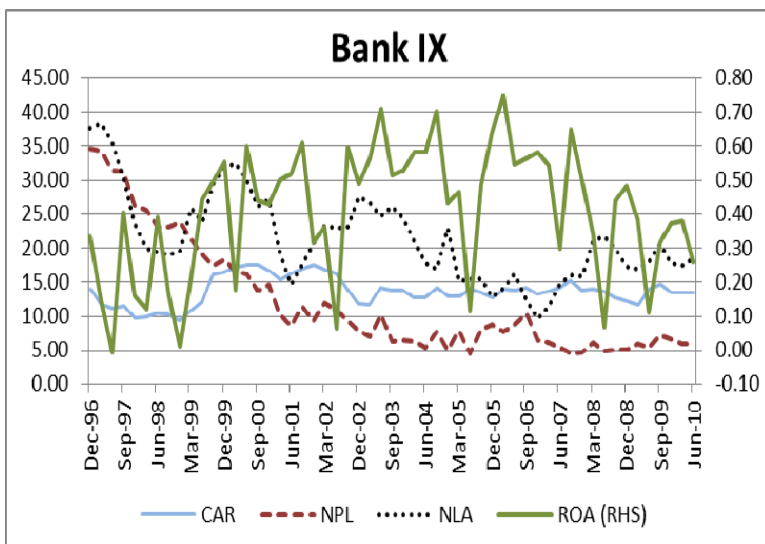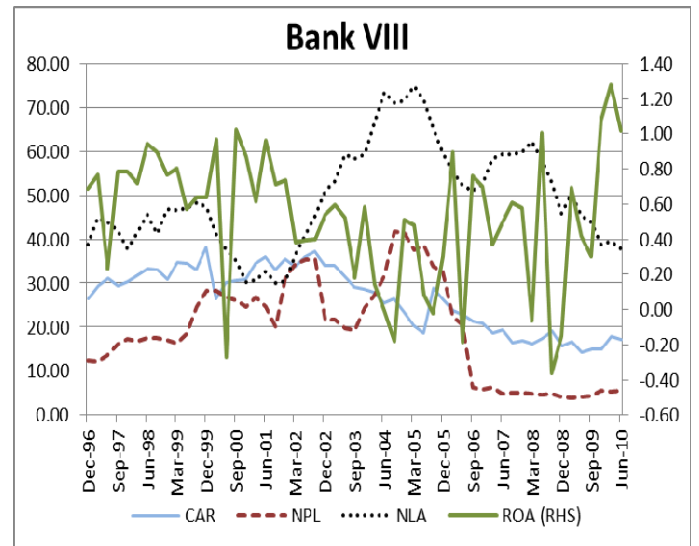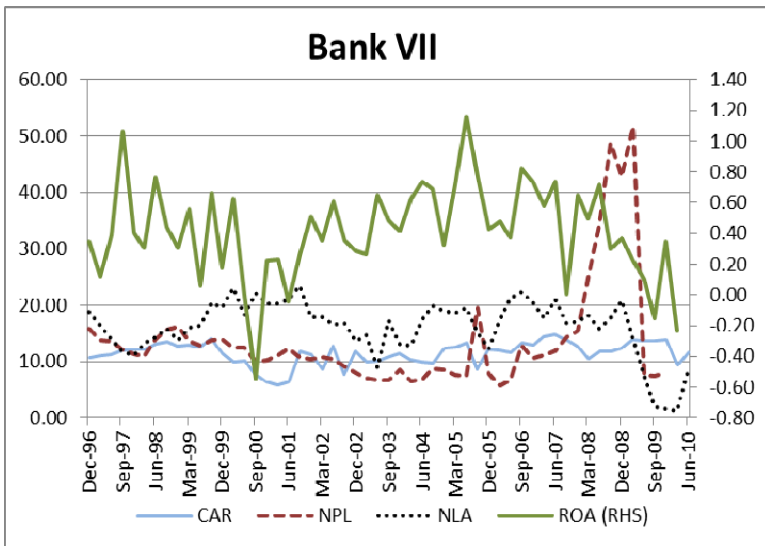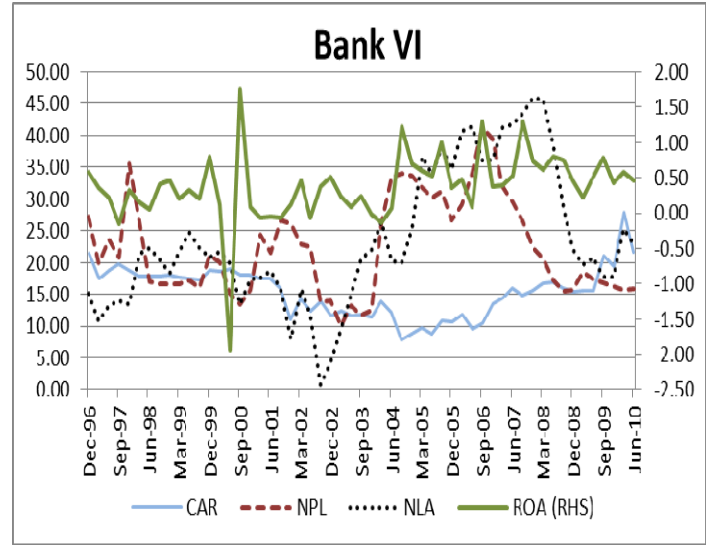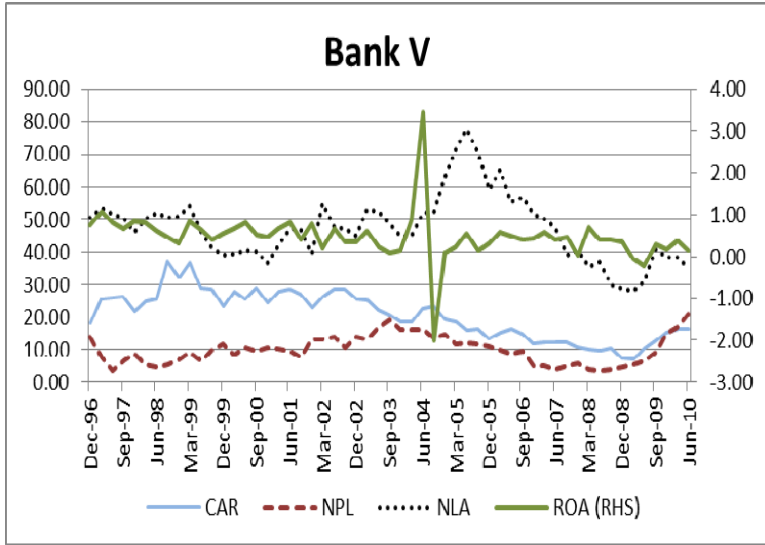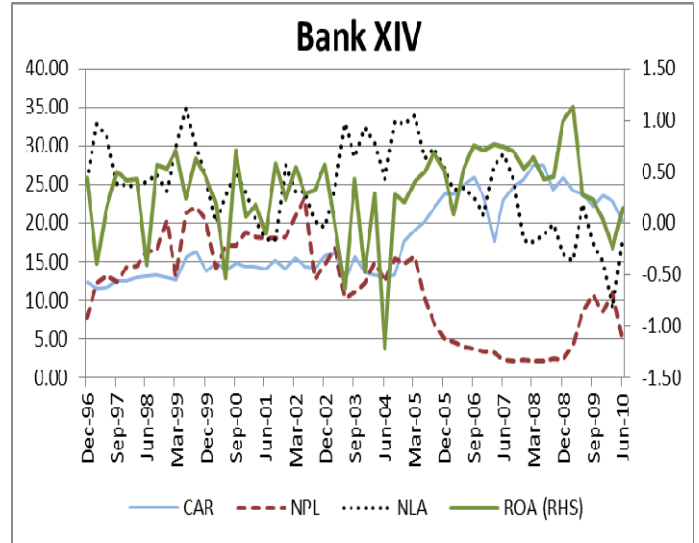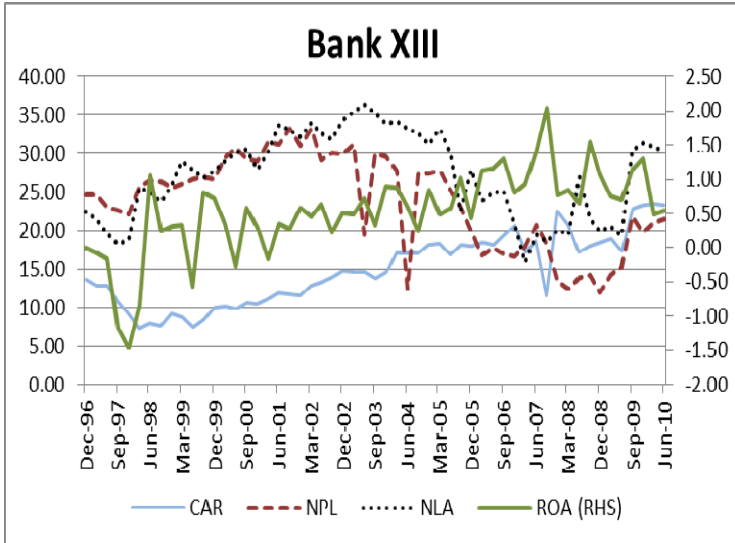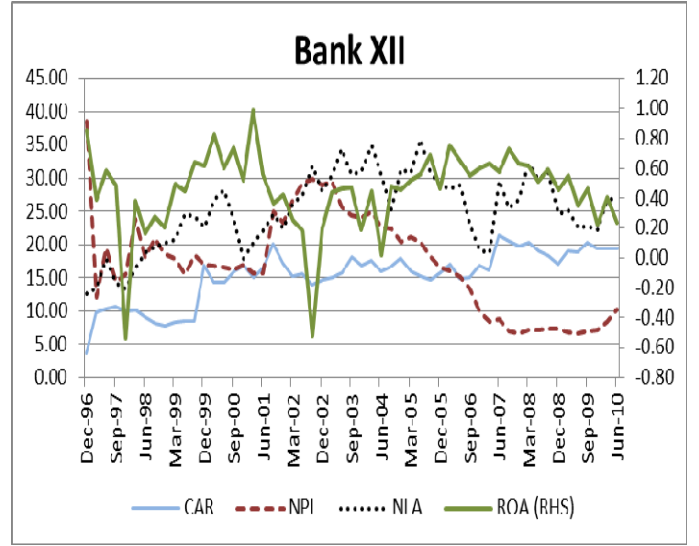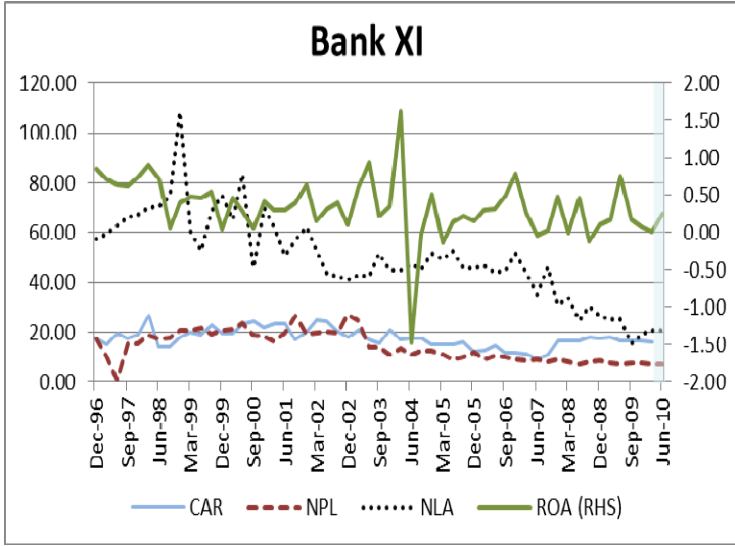
Table 9: Type I and II Errors

Infractions per quarter (Actual Distress)	Predicted Distress (threshold level – 10%)		
	0	1	Total
0	526	0	**526**
1	203	5	**208**
Total	**729**	**5**	734

The type one and two errors measure the accuracy of the prediction to the actual distress outcomes (in this study the liquidity infractions). The type one error is realized if a distress outcome is predicted when in fact there was none. The type two errors occur when a bank is predicted to be healthy when in fact it was in distress. Table 9 shows that the type one error is null while the type two error is incurred in 203 instances. However, this may be primarily due to the actual data set which counts every reserve infraction per quarter while the model predicts a distress outcome if the reserve infractions occurs at a higher frequency.

ECCB Staff Research Paper

COMMERCIAL LENDING RATES IN THE ECCU

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ABSTRACT

This paper examines the degree to which lending rates of commercial banks in ECCU member countries are 'persistent' and as such are mark-up rates which take into account interest demand elasticity, non-performing loans, return on risk free international assets and lending cost in line with Khermaj 2003. The paper finds that in three countries no significant differences existed between calibrated lending rates and nominal rates providing some evidence in support of our main hypothesis. This finding was further strengthened by the evidence from liquidity preference curves constructed using a Lowess technique.

Key Words:

Lending Rates, Interest Elasticity, Commercial Banks

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Executive Summary

This paper aims to explore the degree and strength of the relationship between liquidity (excess reserves) and lending rates in the ECCU. More specifically we seek to determine reasons for the apparent persistence of lending rates in the ECCU. We study lending rates of the commercial banking sector in each of the eight islands in the ECCU on an aggregated and disaggregated basis i.e. studying the entire country's banking system and then differentiating between indigenous and foreign branch banks. By structuring the study in this manner we examine the nature and significance of any differences which may exist between indigenous and foreign branch banks in the ECCU. Our overall goal is to test the hypothesis that lending rates in the ECCU serve as mark up rates on foreign interest rates and bank identified risk and cost in line with Khermaj (2003). This theory falls in line with the credit rationing school of thought and thus the persistence of interest rates. Understanding the determining factors of lending rates within the ECCU is of significant importance as it will allow us to better understand banks functioning and therefore tailor policies with a view to stimulating lending and fuelling growth in the ECCU.

For this study we use quarterly bank specific and macroeconomic data on commercial banks in the ECCU for the period January 1995 to December 2008. To test our hypothesis a loan demand equation was estimated to obtain lending rate elasticities on an aggregate and disaggregated basis using two stage least squares. Lending rates were then calibrated based on the markup theory put forward by Khemraj (2003). These calibrates rates were used to construct liquidity preference curves using the Lowess technique.

Our results show that on average nominal commercial lending rates in the ECCU declined over the period studied whiles excess reserves increased becoming exceedingly volatile towards the end of the study period. Lending rates and other bank specific characteristics varied significantly between indigenous and foreign branch banks with low interest demand elasticities being found. Within some islands no significant difference was found between

calibrated and actual average lending rates and the requisite flattening of the lending curve was observed lending some credence in favor of our main hypothesis.

Introduction

The beginning of the decade has seen significant increases in excess liquidity among the member countries in the ECCU[17]. Anecdotal evidence suggests that commercial bank lending rates however have not declined in a manner commensurate with the magnitude of this increase as suggested by economic theory. The Caribbean Center for Money and Finance[18] (CCMF) notes that ECCU lending rates have remained relatively flat despite the severity of the economic contraction which the region is currently experiencing, alluding therefore to the persistence of ECCU lending rates. Furthermore the share of excess liquidity in the ECCU has become skewed towards foreign branch banks at the expense of the indigenous banks.

Prior work on banking in the ECCU, see Polius and Samuel (2000), Grenade (2007) and Randall (1998), have focused on studying the reasons for the purportedly persistently high interest rates spreads in the region and the efficiency of our banking system. More specifically these and other relevant works have considered the small size of national markets, the oligopolistic structure of the commercial banking industry, the inadequate competitiveness of non-bank financial intermediaries and/or poor fiscal management[19]. In the absence therefore of works with an emphasis on examining excess reserve growth and its effects in the ECCU, this paper seeks to contribute to this literature and by extension better understanding of the commercial bank role in the ECCU financial system particularly as it relates to the setting of lending rates.

Analyzing this relationship will provide insights to policy makers as they seek ways to stimulate growth in 2012 and beyond as articulated in the Eight Point Stabilisation Plan. The Monetary Council notes that growing the ECCU economies is a priority as it will enable the

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[17] ECCB Data Analysis
[18] CCMF Vol. 3 No. 3 March 2010
[19] As seen in "Interest rate determination in the Caribbean", Patrick Kendall (2000)

absorption of an increasingly high degree of unemployed persons and facilitate increased government revenue necessary to provide the public with the increasingly high level of service mandated by them. The channels through which bank's intermediation fosters growth in developed countries is well documented in the literature (see Levine 1997 and Loungani and Rush 1995). Research has shown, however, that banks in developing countries, often hold large amounts of non- remunerated excess reserves and have high interest rates (see Khemraj 2007). It can be argued that by holding large non- remunerated excess reserves potential growth opportunities are stifled as marginal borrowers are rationed out of the market, curtailing private domestic investment. Additionally a more liquid bank would reduce the prices (interest rates) on loans to consumers due to the bank's reduced need to price liquidity risk into the lending rate. It is important however to highlight that there are a myriad of other factors which can influence bank lending rates such as the cost of operations, the elasticity of loan demand, levels of competition, the incidence of non- performing loans and the rate of return on foreign financial instruments such as US treasury bills to name a few.

Cognizant of these factors we use the methodology of Khemraj 2007 who argued that banks exhibit a form of credit rationing as they set fairly high minimum lending rates. As a result their liquidity preference curves are flat at high rates of interest. This paper tests the validity of this argument in the ECCU. The paper also aims to estimate the elasticity of demand for loans with the ECCU banking sector. This would give an insight into the responsiveness of consumers to changes in the loan rates in the ECCU. Throughout this paper we shall examine these hypotheses on an aggregated and disaggregation basis i.e. country wide and by indigenous and foreign bank. In doing so the nature of the differences if any between foreign-branch and the indigenous banks can be observed.

The paper is organized as follows; section 2 gives a brief look at the relevant literature in this field, section 3 explores the methodology applied and an analysis of the data employed, while section 4 discusses the results and then the paper concludes with a critical analysis of shortcomings and avenues for further research.

Review of Literature

The literature governing the determination of interest rates is characterised by two main hypotheses; the financial liberalization model and the credit rationing model[20]. Credit rationing models imply an excess of demand for loanable funds in the market, and consequently marginal borrowers are rationed out of the market at high interest rates. These interest rates are thought to be set at a predetermined rate which is at most times "sticky". These models were popularized by Stiglitz and Weiss, 1981 who focused on credit rationing in markets with imperfect information. The perceived riskiness of borrowers is factored into interest rate set by banks. This may adversely sort potential borrowers (adverse selection effect) and/or affect the action of borrowers (incentive effect) as increasing the interest rate to reflect the default risk of borrowers may induce borrowers to take further risks. As Stiglitz and Weiss noted "higher interest rates induce firms to undertake projects with lower probabilities of success but higher payoffs when successful". Given these effects from imperfect information in the loan market, the price or interest rate will not adjust quickly creating excess demand equilibria in the credit market.

In the financial intermediation hypothesis on the other hand prices (interest rates) adjust quickly to resolve the disequilibrium between supply and demand. Slovin and Sushka (1983) posit that banks explicitly set interest rates based on a model of financial intermediary behaviour where there is no rationing. They follow a profit maximization function for banks constrained by the minimum amount of liquid assets needed for the adequate functioning of the bank. They also assume there are no excess or borrowed reserves and as such open market securities are a close substitute of loans. Banks are assumed to compete based on the price (interest rate). Based on these assumptions, Slovin and Sushka found that when the liquidity constraint is binding banks are not able to invest in open market securities and the loan rate becomes a mark-up function of the deposit rate. This implies that shocks to the deposit market will have a direct impact on the loan market. When the liquidity constraint is not binding however, the loan rate is primarily a function of the interest rates set in the bond markets

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[20] The interest rate parity theory and the Fisher equation or variations thereof are also noteworthy factors in determining domestic lending rates

(open market securities).   Empirical examination performed using a time-series model confirmed the theoretical formulations.

Khemraj (2010) emphasizes the role of holding excess reserves in the banking system and its effects on interest rate determination in developing countries including Barbados, Jamaica and Guyana.   He assumes banks operate in a Cournot Oligopoly where they compete strategically on quantity of loans, treasury bills and deposits.   The banks' profit function includes an element of default risk, on the part of government and private borrowers, and transaction costs, constrained by a binding liquidity equation.   The lending rate derived is a minimum mark-up rate over an exogenous foreign interest rate, marginal transaction costs and a risk premium.   Borrowers risk marginalisation, if they are not able to pay the minimum loan rate. Credit not extended therefore to these marginalized borrowers is accumulated as non-remunerated excess liquidity.   In this sense holding excess reserves is seen as a substitute for loans with the loan rate being the opportunity cost of holding excess reserves.

In the region, previous work on the determination of the loan rate has been conducted by various researchers, inclusive of, Thomas (1974), Kendall (2000) and Worrell (1994). Thomas (1974) showed that domestic interest rates are determined solely on the foreign interest rates given the lack of a domestic capital market under the British Caribbean Currency Board. Kendall (2000) assumes that Commercial banks in the Caribbean operate in a perfectly competitive market; contrary to Khemraj (2010) and Greenwich and McClean (1997) but similar to Slovin and Sushka (1983).   Khemraj notes that excess liquidity and bank loans should become substitutes at a zero loan rate if the market is perfectly competitive. This is not the case in the region as excess liquidity occurs at very high interest rates hence signaling the likelihood of a non-competitive environment.

Worrell (1994) modeled monetary autonomy within a fixed exchange rate mechanism. He showed the difference between domestic and the foreign interest rates is a cost variable which is inclusive of currency conversion costs, brokerage cost, information costs, and adverse

selection[21]. Following this model he notes the impact of monetary policy actions in an imperfect capital market. Worrell (1994) posits that the sensitivity of private sector borrowers to changes in interest rates is of prime importance for the success of monetary policy by the authorities. He also notes the high levels of excess cash in small developing countries, particularly in times of low domestic credit demand. He claims "in effect, the cost of reducing cash balances is greater than the expected return from shifting the portfolio". Further sale of open market securities by the monetary authority in exchange for this excess cash will be expansionary and significantly moreso at high rates of interest.

Most literary accounts of the region have looked at interpreting persistently high spreads between the loan rate and the deposit rate. These spreads in the ECCU is characteristic of financially developing countries and signify that commercial banks have significant market power (Moore and Craigwell, 2002). Grenade (2007) notes the excess liquidity in the banking system and its contribution to narrower spreads. The excess creates a buffer against liquidity risks for these banks and thus the negative relationship with the interest rate spreads is theoretically sound. However the relationship between the loan rate and the excess liquidity in the banking system can be better analyzed through a framework purported by Khemraj, 2010, and thus the rest of the paper follows his methodology.

Model Construction

On an individual country basis the data was modeled using the following framework and quarterly ECCB bank data from 1995 to 2009.

The following price equation was derived[22] following the theoretical formulation conducted by Khemraj (2010).

$$r_L \left(1 + 1/N\epsilon_L\right) = [r_F + c_i{'} (L)] / (1 - p) \qquad \textbf{Equ 1}$$

Here the lending rate, r_L, is a function of the external rate of interest, r_F, the marginal cost of transaction, $c_i'(L)$, the interest elasticity of loans demanded, ϵ_L, N, the number of banks as a measure of market size and *p* the rate of non-performing loans. This is similar to Worrell (1994) which included the foreign interest rate and a cost component in his analysis of the domestic interest rates and monetary policy in a fixed exchange rate regime. Obtaining interest elasticities is paramount to the model as it shows with decreases in the interest elasticity the markup rate rises. The lower the elasticity or the more insensitive borrowers are to changes in the price of loans, the greater the incentive banks have to raise the markup interest rate. Similarly the smaller the number of banks in the market, the greater is the case for a monopoly and the markup will be higher.

In order to determine the elasticity of loan rates for the ECCU a loan demand function in line with Ikhide (2003) was estimated. Ikhide (2003) used a semi-log[23] function of the real lending rate, expected income, inflation both expected and unexpected, the output gap and with the coefficient of the real lending rate being the interest elasticity of demand. However in this form it will be difficult to distinguish whether the coefficient of the real lending rate is a reflection of the responsiveness to loan supply or loan demand. Within the academic literature see Angrist and Krueger (2001) this is referred to this as the identification problem or as Lin (2004) notes the simultaneity problem. Lin (2004) notes that in such situations separate estimation by OLS of demand and supply would lead to inconsistent and inefficient coefficient estimates which would not address the identification issue. To counter this problem researchers often use the instrumental variable approach which involves imposing exclusion restrictions on both the supply and demand equations see Lin (2004).

Variables which are correlated with the endogenous variables but vary autonomously and independently of the other variables in the model are deemed appropriate instruments. For the purposes of this paper demand 'shifters[24]' are, income whiles supply 'shifters' are excess reserves, the herfindahl index, and the ratio of non-performing loans. Common to both supply and demand therefore will be price i.e. the real lending rate, inflation expected and unexpected

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[23]The real lending rate remained in levels
[24] Variables which affect demand and not supply and vice versa

and the output gap. Wooldridge (2001) notes that where supply and demand equations are being defined it is imperative that these equations be 'identified'. A necessary condition for ensuring identification is that the order condition for our equation holds whiles a necessary and sufficient condition for identification is that of the rank condition holds. The rank condition will provide us with information regarding whether our equation is over or just 'identified'.

Letting equation two be the demand for loans and equation three the supply. Reduced form equations for the quantity and price of loans can be defined from these equations.

$$Q_d = \beta_1 + \beta_2\,Rl + \beta_3\,Inf + \beta_4\,Unexpinf + \beta_5\,Expinc + \beta_6\,Gap + \varepsilon_d \qquad \textbf{Equ (2)}$$

$$Q_s = \gamma_1 + \gamma_2\,Herf + \gamma_3\,Liq + \gamma_4\,Npl + \gamma_5\,Gap + \gamma_6\,Cost + \gamma_7\,Unexpinf + \gamma_8\,Inf + \gamma_9\,Rl + \varepsilon_s \quad \textbf{Equ (3)}$$

Where *rl* is the real lending rate, *Inf* inflation, *unexpinf* unexpected inflation, *gap* the output gap, *expinc* expected income, *herf* the herfindahl index, *liq* liquidity, *npl* non performing loans and *cost* cost of operations.

Table 10: Variables used for Elasticity Derivation

Variable	Defined	Expected Sign
Demand		
Real Lending	Weighted Lending Rate - Inflation Rate	*Negative*
Expected Income	Fitted Obtained by regressing on past values	*Positive*
Output Gap	Hodrick-Prescott Filter	*Positive*
Expected Inflation	Fitted Obtained by regressing on past values	*Negative*
Unexpected Inflation	Residual Obtained by regressing on past values	*Negative*
Supply		
Herfindahl	Herfindahl Index	*Positive*
Liquidity	Excess reserves	*Negative*
NPL ratio	NPL/total loans and advances	*Negative*
Real Deposit Rate	Rate of Deposit Growth	*Positive*

Source: Author's estimates

Variable Analysis (A Priori Expectations)

The real lending rate serves as the price economic agents can acquire loans and as such is expected to be inversely related to demand. Expected income[25] is assumed to positively influence demand and for the purpose of this paper is defined as the fitted[26] values obtained by regressing past values of Gross National Income[27] on itself. Inflation which corrodes the purchasing power of money is expected to be negatively related to demand, agents expectations and any shocks to these [expectations] are expected to impact demand. Ghosh and Ghosh (1999) cited in Ikhide note that agents will associate high inflation with macro instability and choose therefore to reduce their credit demand. Unexpected inflation is defined as actual less expected inflation. Where expected inflation was defined as the fitted value of a regression on inflation on its past values. The output gap which measures the difference between actual and potential GDP indicates instances where aggregate demands exceeds aggregate supply and vice versa. In cases for e.g. where actual exceeds potential GDP for instance $AD > AS$. To the extent that this demand is fuelled by credit, demand for loans is expected to increase.

One would assume that as the market size increases, more competition will drive commercial banks to use the interest rate as a bargaining tool to lure consumers away from its competitors. Thus changes in the herfindahl index, a measure of market size[28] are expected to play a positive role in credit extended in the ECCU. For the purposes of this paper market share (which is necessary to compute the herfindahl index) is define as the country's share of loan deposits. Using loans extended as typically done in other papers would have led to multicollinearity issues. Liquidity defined as the level of excess reserves (above the 6 per cent reserve requirement) of the country intuitively affects loan supply as higher levels of liquidity should signal a greater capacity to grant loans. The non-performing loan ratio indicates the

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[25] The issue of endogeneity between GDP and credit was addressed as the regression considered expected income (GDP regressed on its past) rather than GDP as the regressor.
[26] AR (1) model is used
[27] Gross Domestic Product was used as a proxy of Gross National Income as the flows between them are negligible. Quarterly figures for GDP was accumulated as per research performed by Sahely et al (2007)
[28] Measured using the individual country share of total loans and advances in the ECCU

asset quality of a bank's loan portfolio and as such is likely to reduce the amount of loans extended if this ratio is unfavourable.

Once the elasticity had been obtained the research proceeded with the estimation of the model purported by Khemraj (2010) for domestic interest rate. Similarly a calibration technique was used to investigate the mark-up function. Cooley (1997) describes this technique as using "economic theory extensively as the basis for restricting a general framework and mapping that framework into the measured data." With this technique, relationships are not fashioned upon the assumptions needed for econometric analysis rather the model is derived based on observations in the economy. Estimates of variables are, however, acquired from previous econometric studies to calibrate the results of the model. Cooley (1997) notes that calibration techniques were meant to complement and not substitute econometric techniques.

Elasticity Variable Descriptive Statistics

This section reviews observed lending rates, liquidity, non performing loans and the degree of competition across the ECCU on an aggregate and disaggregated basis.

Aggregate (Country Wide) Statistics

Lending rates tended downward over the period under review with most countries recording declines, the most significant was that of Montserrat where rates fell by 26 per cent i.e. from 12.98 per cent at the beginning of the period to 9.58 at the end. Average rates over the period of analysis ranged from 11.87 per cent in St Lucia to 10.53 in St Kitts and Nevis. The volatility of rates was generally low with standard deviation of around .85 in most countries. Interestingly however excess reserves were extremely volatile and increased in most islands with the exception of Montserrat. It is important to highlight that there was a sharp rise in the excess reserves held by commercial banks in the ECCU region by the fourth quarter 2001. This may reflect new measures which may have been put in place after the September 2001 attacks in the US. Reserves increased by more than 30 per cent in six of the ECCU

territories. The rate of non performing loans was ranged between 17 per cent in Montserrat to 8.6 per cent in St Vincent and the Grenadines.

Table 2: Descriptive Statistics

Country	Average Lending Rates		Average Liquidity		Average NPL's	
	mean	*std dev*	*mean*	*std dev*	*mean*	*std dev*
Anguilla	10.78	0.91	9716.80	8619.79	12.52	9.83
Antigua and Barbuda	11.33	0.75	43273.67	28668.69	11.47	2.86
Dominica	10.54	1.01	19848.89	16480.39	15.43	5.13
Grenada	10.67	0.88	23038.79	21814.62	9.68	14.65
Montserrat	11.41	0.86	8039.52	9176.38	17.97	12.53
St. Kitts and Nevis	10.54	0.98	28953.38	23515.84	12.84	7.70
St. Lucia	11.88	1.55	33680.39	21439.28	15.34	18.20
St. Vincent and the Grenadines	10.79	0.94	18302.62	12444.12	8.63	3.44

Source: ECCB database

Figure 1: ECCU Member Countries' Lending Rates

Source: ECCB database

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Figure 2: ECCU Member Countries' Excess Reserves
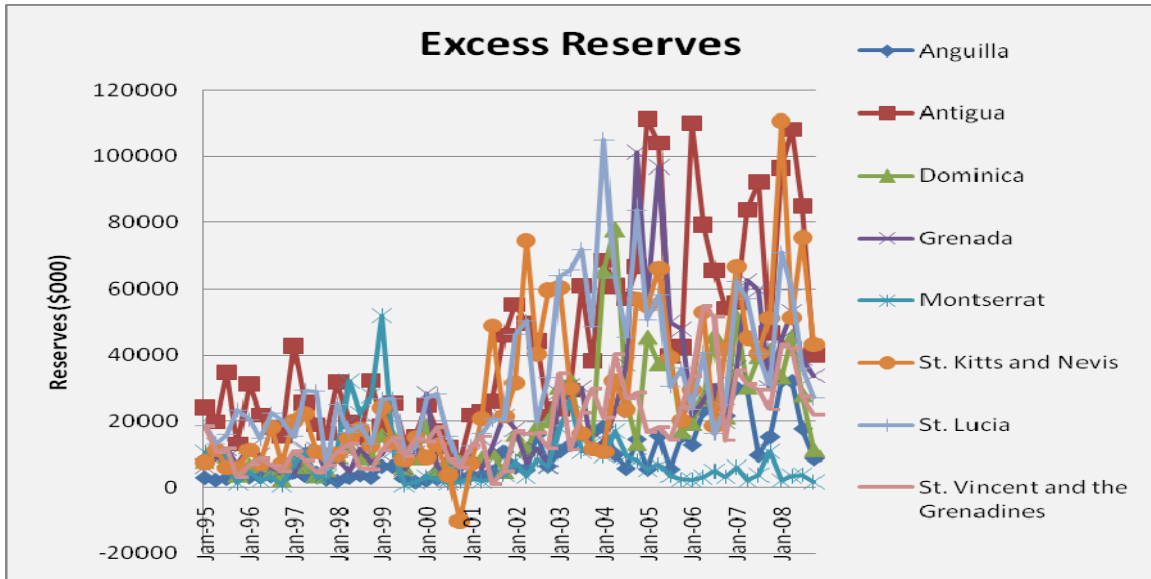
Source: ECCB database

Disaggregate Statistics

Average lending rates varied significantly between indigenous and foreign banks in several ECCU islands with the exception of lending rates in Anguilla, Antigua and Barbuda and Saint Lucia. In the countries where there was a significant difference indigenous banks had the lower lending rates with the exception of Grenada. Rates across the ECCU ranged from 9 to 11 per cent with St Kitts and Nevis having the lowest rate indigenous banking rate, 9.01 per cent whiles Grenada had the lowest foreign bank rate at 9.96 per cent. The most significant in country divergence was in St Vincent and the Grenadines. Volatility in lending rates was fairly consistent across the ECCU except in the case of Saint Lucia where volatility of both types of banks were high.

Significant differences were also observed in the rate of non-performing loans across the ECCU with the exception of Anguilla. Where significant differences were observed the rate of non- performing loans was higher in indigenous banks than foreign banks, with the

exception of Montserrat[29]. The largest disparity between banks occurred in Antigua and Barbuda. This appears to be a structural issue given that Antiguan banks had the lowest recorded levels of volatility. Indigenous banks in St Vincent and the Grenadines had the lowest rates of non-performing loans among indigenous banks whiles among foreign branch banks St Kitts and Nevis had the lowest rates.

The level of liquidity between banks also varied significantly with the exception of Anguilla. In all cases where significant differences existed foreign branch banks had higher average liquidity. Liquidity in indigenous banks ranged from $.36m in St Vincent and the Grenadines to $1.4m in Saint Lucia. In foreign branch banks however liquidity ranged from $1.1m in Dominica to $3.1m in Antigua and Barbuda. Liquidity was volatile in both indigenous and foreign based banks with the exception of Grenada, Montserrat and St Vincent and the Grenadines where indigenous banks liquidity was fairly stable over the period reviewed. The other ECCU territories recorded marked increases in volatility post 2001 which continued to the end of the period covered.

Table 3: Indigenous vs Foreign Lending Rates

Country	Average Lending Rates		Difference	Significance	
	Indigenous	*Foreign*		*t-value*	*p-value*
Anguilla	10.06	9.47	0.59	1.573	0.119
Antigua and Barbuda	11.33	11.23	0.10	0.265	0.791
Dominica	9.66	10.30	-0.64	-2.769***	0.007
Grenada	10.52	9.96	0.56	1.909*	0.059
Montserrat	10.28	11.60	-1.32	-4.112***	0.000
St. Kitts and Nevis	9.01	10.14	-1.13	-3.609***	0.000
St. Lucia	10.93	11.20	-0.27	-0.579	0.564
St. Vincent and the Grenadines	9.23	10.61	-1.38	-4.197***	0.000
*, **, *** indicates significance at the 10, 5 and 1 per cent levels					

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[29] Montserrat's NPL's particularly in its indigenous banks was significantly higher than other ECCU islands, intuitively this however reflects the impact of the Soufriere hills volcanic eruption. Many individuals were forced to leave the island shutting down businesses and disrupting the islands economy leading therefore to a vicious cycle of increased non performing loans.

Table 4: Indigenous vs Foreign NPL's

Country	Average NPL		Difference	Significance	
	Indigenous	*Foreign*		*t-value*	*p-value*
Anguilla	12.79	10.79	2.00	0.756	0.451
Antigua and Barbuda	17.53	5.87	11.66	17.11***	0.000
Dominica	20.04	13.69	6.35	4.185***	0.000
Grenada	13.70	8.69	5.01	1.913*	0.058
Montserrat	18.02	33.25	-15.23	-2.901***	0.005
St. Kitts and Nevis	19.98	5.23	14.75	7.404***	0.000
St. Lucia	20.84	12.72	8.12	2.054**	0.042
St. Vincent and the Grenadines	12.24	6.13	6.11	6.65***	0.000
*, **, *** indicates significance at the 10, 5 and 1 per cent levels					

Source: ECCB database

Table 5: Indigenous vs Foreign Liquidity

Country	Average Liquidity		Difference	Significance	
	Indigenous	*Foreign*		*t-value*	*p-value*
Anguilla	4982.30	4734.30	248.00	0.245	0.807
Antigua and Barbuda	13666.30	31684.94	-18018.64	-5.232***	0.000
Dominica	8360.90	11487.90	-3127.00	-1.744*	0.084
Grenada	3362.62	19676.16	-16313.54	-6.221***	0.000
Montserrat	1962.41	6075.92	-4113.51	-3.343***	0.001
St. Kitts and Nevis	10045.33	18908.03	-8862.70	-3.122***	0.002
St. Lucia	14674.41	19005.00	-4330.59	-1.788*	0.076
St. Vincent and the Grenadines	3663.23	14639.39	-10976.16	-6.241***	0.000
*, **, *** indicates significance at the 10, 5 and 1 per cent levels					

Source: ECCB database

In Anguilla, Saint Lucia and St Vincent and the Grenadines indigenous banks continually increased their market share of the banking sector post 2001 at the expense of foreign branch banks. The situation was slightly reversed in Antigua where indigenous banks increased their

market share post 2000 but subsequently lost market share towards the later part of the period reviewed. Indigenous banks continually lost market share in Dominica and Montserrat over the period. No significant variation was observed in Grenada and St Kitts and Nevis where indigenous banks continually had a larger share of the market.

Figure 3: ECCU Member Countries' Herfindahl Index[30]
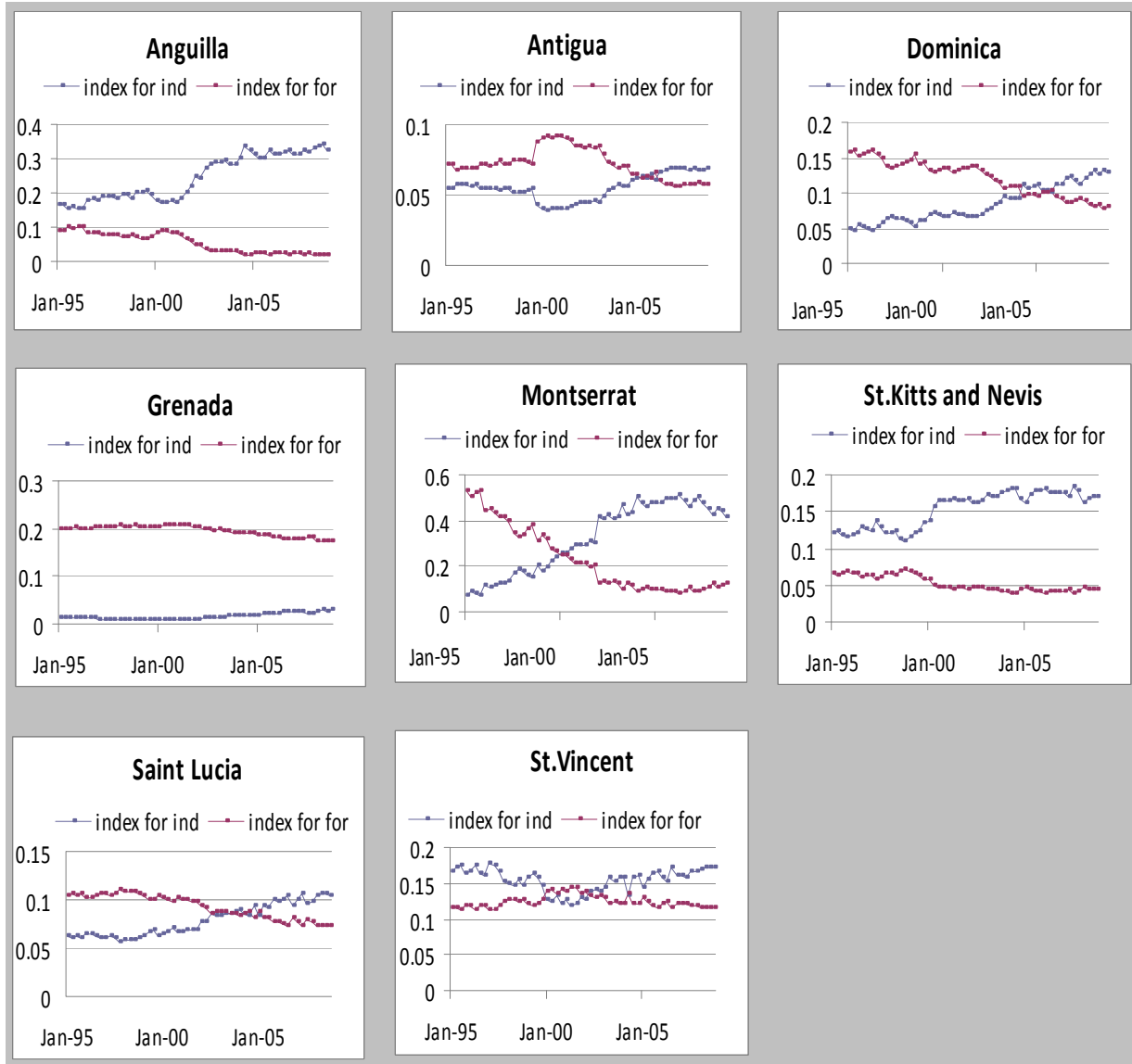
[30] Ind: indigenous, For: foreign banks

Average quarterly inflation was highest in St Kitts and Nevis and Anguilla with rates of .99 and .96 respectively. Inflation in the other islands ranged from .45 per cent in Antigua and Barbuda to .78 in Montserrat.

To summarize, real lending rates were lower and less volatile in indigenous banks relative to foreign branch banks. Secondly indigenous banks had significantly higher levels of non-performing loans and were less liquid than foreign branch banks. Based on the demand deposit herfindahl index, indigenous banks increased their market share particularly post 2002.

Results

This section presents our results on the two stage least square analysis and the resulting elasticities which are then used to find calibrated lending rates. We also show liquidity preference curves on the basis of these calibrated rates.

Elasticity Derivation Results

Theoretically "price elasticity of demand is a measure of responsiveness of the quantity demanded of a good to a change in that goods price". The magnitude of the price elasticity is affected by the closeness and availability of substitutes, the proportion of income spent on the good, degree to which that good is a necessity and the time elapsed since a price change (duration). Within our model closeness and availability of substitutes would refer to prevalence or lack thereof of other non bank financial institutions such as credit unions. The greater the availability of such institutions the more elastic demand is expected to be. Higher portions of incomes versus loans would indicate higher price elasticity of loan demand. The duration with which lending rates remain high or low for instance would influence the degree to which consumers shift away or towards banking institutions for loans and thereby influence the elasticity. However the elasticity or the nominal value is expected to be low as the banking sector in developing countries is dominated by few banks. Consumers maintain the

traditional norms of using bank loans for financing as the financial markets are not as developed.

Table 6: 2SLS Output (Aggregate)

	Anguilla	Antigua	Dominica	Grenada	Montserrat	St. Kitts	St.Lucia	St. Vincent
				Coefficients (Aggregate)				
Constant	-15.248	44.990	14.980	32.280	37.690	80.740	21.669	25.502
	-0.54	*3.74****	*0.23*	*1.41*	*2.44***	*1.80**	*0.60*	*1.18*
Real Lending	0.056	-1.770	-0.483	-2.048	-4.672	-2.004	-0.976	-0.529
	0.04	*-4.28****	*-0.80*	*-2.23***	*-2.49***	*-1.98**	*-3.23****	*-1.05*
Output Gap	0.183	0.024	0.292	0.192	1.380	-0.119	0.140	0.163
	1.35	*1.01*	*1.06*	*2.18***	*1.07*	*-0.65*	*2.97****	*1.75**
Expected Income	-0.221	-3.851	-2.947	-0.658	5.380	-12.301	-0.850	-3.825
	-0.05	*-2.57***	*-0.22*	*-0.22*	*0.69*	*-1.74**	*-0.15*	*-1.09*
Expected Inflation	19.350	-2.980	8.944	-7.816	-5.947	0.982	-5.780	0.891
	2.18**	*-3.96****	*1.60*	*-2.48***	*-2.58***	*0.24*	*-1.84**	*0.45*
Unexpected Inflation	-0.597	-2.990	-2.030	-2.440	-6.309	-3.404	-2.130	-1.628
	-0.45	*-6.51****	*-2.31***	*-1.97**	*-2.98****	*-2.86*	*-5.04****	*-2.66***
R^2	0.299	0.606	0.172	.	0.255	0.075	0.410	0.245
N	46	54	50	53	50	52	54	53
Wu Hausman F-test	*0.052*	*0.104*	*0.077*	*8.689****	*0.146*	*2.532*	*2.720*	*0.163*
Sargan N*Rsq test	*1.573*	*2.678*	*7.714***	*3.780*	*19.690****	*16.816****	*7.713***	*4.971*

*, **, *** indicates significance at the 10, 5 and 1 per cent levels
t,F statistics in *italics*

Dependent variable: Real Credit Growth
Instrumented: Real lending
Instruments: output gap, expected income,real deposit rate, inflation expected and unexpected, liquidity, npl's and the herfindalh index

Source: Author's estimates

The table above shows the results of the model for the entire banking sector in the ECCU individual countries. The variable of most importance here is the real lending rate as the coefficients represents the interest elasticity of demand. The real lending rate was significant in five out of the eight countries modeled and strongly significant in St Kitts and Nevis. The interest elasticity with respect to demand for credit is relatively elastic showing the sensitivity

of borrowers to changes in the interest rates. This response differs when the banking sector is subdivided into the indigenous and foreign banking sector.

Table 7: 2SLS Output (Indigenous Banks)

	Anguilla	Antigua	Dominica	Grenada	Montserrat	St. Kitts	St.Lucia	St. Vincent
				Coefficients (Indigenous Banks)				
Constant	0.076	0.209	-0.557	-0.905	-0.061	-0.428	-0.769	0.067
	0.22	*1.01*	*2.28***	*-2.23***	*-0.26*	*-0.54*	*-2.77***	*0.10*
Real Lending	-0.009	-0.014	-0.006	0.014	-0.011	0.010	0.000	-0.010
	-0.55	*-1.60*	*-0.28*	*1.49*	*-0.37*	*0.48*	*-0.45*	*-0.42*
Output Gap	0.005	-0.006	0.005	-0.003	0.000	0.001	0.001	0.001
	4.08***	*-1.39*	*0.61*	*-3.26****	*-0.02*	*0.26*	*1.80*	*0.40*
Expected Income	-0.024	-0.001	0.125	0.151	0.073	0.052	0.143	0.010
	-0.53	*-0.06*	*0.28*	*2.59**	*0.87*	*0.45*	*2.96***	*0.11*
Expected Inflation	-0.830	-1.044	-0.913	-1.000	-1.009	-0.898	-1.032	-0.993
	-8.96***	*-57.96****	*-8.37****	*-38.49****	*-29.91****	*-10.63****	*-27.56****	*-21.32****
Unexpected Inflation	-1.005	-1.018	-1.010	-0.989	-1.003	-0.990	-1.001	-1.013
	0.22	*-100.62****	*-36.21****	*-80.61****	*-31.61****	*-38.84****	*-294.72****	*-39.44****
R^2	0.997	0.999	0.996	0.999	0.997	0.997	0.999	0.999
N	50	51	52	51	51	46	50	46
Wu Hausman F-test	*0.665*	*2.028*	*0.151*	*0.011*	*0.124*	*0.021*	*0.349*	*0.122*
Sargan N*Rsq test	*5.900*	*0.362*	*1.354*	*17.751****	*10.164***	*2.953*	*5.348*	*0.279*

*, **, *** indicates significance at the 10, 5 and 1 per cent levels
t,F statistics in *italics*

Dependent variable: Real Credit Growth
Instrumented: Real lending
Instruments: output gap, expected income, inflation expected and unexpected, liquidity, npl's and the herfindalh index

Source: Author's estimates

Table 8: 2SLS Output (Foreign Banks)

	Anguilla	Antigua	Dominica	Grenada	Montserrat	St. Kitts	St.Lucia	St. Vincent
				Coefficients (Foreign Banks)				
Constant	-0.540	0.982	0.055	0.174	1.681	0.472	1.606	0.680
	-2.13*	*3.54****	*0.10*	*0.91*	*1.70*	*2.39**	*1.96**	*3.19***
Real Lending	-0.027	-0.017	-0.001	0.007	-0.165	-0.011	-0.020	-0.010
	2.20**	*-3.06***	*-0.13*	*0.80*	*-1.68*	*-3.10****	*-3.02****	*-2.51**
Output Gap	-0.004	0.001	0.002	-0.001	-0.012	-0.002	0.002	0.002
	-1.81	*3.34****	*0.76*	*-0.76*	*-0.30*	*-1.54****	*3.00****	*2.29**
Expected Income	0.084	-0.130	-0.013	-0.048	0.109	-0.073	-0.229	-0.110
	2.04*	*-3.47****	*-0.12*	*-1.93**	*0.61*	*-2.21**	*-1.77*	*-3.07****
Expected Inflation	-1.041	-1.020	-0.957	-0.957	-1.135	-0.975	-1.044	-0.990
	-6.72***	*-60.45****	*-21.71****	*-30.27****	*-14.22****	*-44.52****	*-23.27****	*-48.95****
Unexpected Inflation	-0.973	-1.022	-1.000	-0.982	-1.197	-1.011	-1.022	-1.011
	-79.14***	*-142.01****	*-163.61****	*-80.10****	*-10.90****	*-214.09****	*-125.92****	*-188.48****
R^2	0.999	0.999	0.999	0.999	0.987	0.999	0.999	0.999
N	48	52	55	55	42	53	54	53
Wu Hausman F-test	*2.346*	*0.081*	*0.121*	*0.989*	*1.244*	*0.195*	*6.525***	*1.818*
Sargan N*Rsq test	*0.770*	*9.346***	*4.651*	*13.681****	*5.520*	*0.801*	*5.500*	*6.115*

*, **, *** indicates significance at the 10, 5 and 1 per cent levels

t,F statistics in *italics*

Dependent variable: Real Credit Growth

Instrumented: Real lending

Instruments: output gap, expected income, inflation expected and unexpected, liquidity, npl's and the herfindalh index

Source: Author's estimates

In fact, the real lending rate was not significant in any country's indigenous banking sector. Implying that loan demand in the indigenous banking sector was not influenced by lending rates. This is in stark contrast to the results obtained for the foreign branch banks were lending rates were significant in six islands. An analysis as to why this is so could form the backdrop of further study. It has been posited that foreign based banks are less accommodative in providing loans that indigenous banks. This could substantiate somewhat the claim that foreign branch banks price risk more effectively and have tougher credit standards than indigenous banks. Unexpected inflation was strongly significant in all the

islands and also strongly correlated to the real lending rate. Suggesting that unexpected events shift person's decision making and as a result it is intuitive to expect this correlation.

Intuitively inflation, both expected and unexpected was highly significant in both types of banks. The coefficients were all negative suggesting that increases in inflation was often associated with credit growth declining and vice versa. Inflation growth erodes the purchasing power of credit and inflationary periods are often indicative of macroeconomic instability or an economic boom. Given that our "output gap" metric proxies for the latter the negative signing on the inflation coefficient could be indicative of the former. Consumers therefore will demand credit in low inflationary periods as opposed to high ones so as to preserve the purchasing power of the funds received and possible to the high lending rates which may result in such periods. Banks pricing in inflation risk could also lead to higher lending rates and thus weaker credit growth resulting in the negative relation.

It is also important to highlight that results for the indigenous banking sector show that five out of the eight countries had negative constants of which three were significant i.e. Dominica, Grenada and Saint Lucia. Comparing this to the foreign branch banks however positive constants were recorded in seven out of the eight countries with five being significant.

Validity of Instruments and Endogeneity

Tests for endogeneity of the lending rate in a quantity dependent demand function produced mixed results. A Wu-Hausman test of endogeneity was followed by the Sargan test of overidentifying restrictions[31]. The Wu-Hausman test of endogeneity considers whether the instrumental variable approach provides more accurate estimates. This test proved to be strongly valid for Grenada in the aggregate and for the Anguillan and Saint Lucian foreign-branch banks. Interestingly these were the cases where the real lending rate data showed the most variability. The instruments were weak in all other cases, suggesting further investigation into this aspect of the model.

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[31] See Thurman (1986) for an extensive discussion on endogeneity testing in a Supply and Demand Framework

The Sargan test measures whether the residuals are uncorrelated with the instruments, that is, it tests whether the instruments are truly exogenous. On an aggregated basis the Sargan and Basmann test showed that the instrument choice was uncorrelated with the error term in several countries namely Anguilla, Antigua and Barbuda, and Grenada, weakly valid in St Vincent and the Grenadines and not valid in Dominica, Montserrat, St Kitts and Nevis and Saint Lucia.

Calibrated Results

These results were formulated using equation 1 substituting the appropriate variables to calibrate the real lending rate. The model as mentioned before followed a markup function of interest rates which resulted in a flattened liquidity preference curve at very high and persistent interest rates[32].

For the ECCU, the average calibrated lending rate on a country wide basis ranged from 1.51 per cent in Anguilla to 12.6 per cent St Vincent and the Grenadines. With the exception of Anguilla all the other islands had rates which averaged between 10 to 12 per cent. Given the construction of the metric Anguilla's relatively low calibrated lending rate was due primarily to its low elasticity (0.05). Lending rates were most volatile in Grenada (standard deviation of 12.81) and least volatility in Anguilla (sd .791). Over the period reviewed lending rates decline in all islands except for slight increases during the 2006 to 2007 period where they subsequently declined.

The calibrated lending rates were compared to the nominal rates observed in each country over the same period. More specifically the mean of the calibrated rates and nominal interest rates were tested to investigate if the differences were significant. Our results show that there was no statistical mean difference between the two lending rates in Antigua and Barbuda, Grenada, St Kitts and Nevis and Saint Lucia, suggesting that lending rates in these countries may be mark-up rates as defined above Table 10 presents the full details.

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[32] See section 4.4 lowess results for the liquidity preference curves.

Table 9: Significance of Mean Difference in Calibrated Rates

Country	Mean Rate		Difference	t-stat
	Nominal	Calibrated		
Anguilla	10.78	1.49	9.28	*56.6****
Antigua and Barbuda	11.34	10.64	0.70	*1.669*
Dominica	10.14	12.36	-2.21	*-5.356****
Grenada	10.67	7.95	2.73	*1.573*
Montserrat	11.41	9.58	1.84	*2.149***
St Kitts and Nevis	10.54	10.21	0.32	*0.575*
Saint Lucia	11.88	10.46	1.41	*1.83**
St Vincent and the Grenadines	10.79	12.67	-1.88	*-4.664****

*, **, *** indicates significance at the 10, 5 and 1 per cent levels

Source: Author's estimates

Lowess Results

The relationship between the real lending rate and excess reserves was further examined by the construction of liquidity preference curves using the Lowess[33] technique. These curves were constructed for each country on an aggregate and disaggregated level. Khemraj (2010) argued that lending rates in LDC's were simply mark up rates over foreign interest rates and bank identified risk and cost. As such under this hypothesis liquidity preference curves should flatten at relatively high interest. Figures 3-5 illustrate our aggregate, indigenous and foreign liquidity preference curves for the ECCU.

Aggregate country results were intuitive and were inline with our expectations. The flattening of the curve occurred in Anguilla, Antigua and Barbuda, Grenada and Saint Lucia. With the exception of Anguilla curves flattened at rates of 12 to 13 per cent indicating that at these rates commercial banks are indifferent between accumulating reserves and loan provision. It is

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[33] Locally weighted polynomial regressions introduced by Cleveland (1979)

important to point out that these countries were the same ones which had no significant differences between calibrated lending rates and nominal rates and where there was no significant difference between indigenous and foreign bank lending rates. These findings suggest that within these countries the lending rate is a mark-up rate over foreign interest rates and bank identified risk for both indigenous and foreign branch banks. Our findings are also similar to related studies as Khemraj noted that liquidity preference curves for Guyana, Barbados and Jamaica flattened at 14.5, 8.5 and 17.5 per cent respectively.

Dominica and St Kitts and Nevis saw a continued decline in the liquidity preference curves with that of St Kitts and Nevis being more pronounced. Both had significant differences in lending rates between indigenous and foreign banks but only Dominica had a significant difference between calibrated and nominal lending rates. The continued decline in the liquidity curves suggest that banks in these countries were less likely to see loan provision and accumulation of reserves as perfect substitutes at particular rates.

Montserrat's liquidity preference curve was an anomaly as it sloped upward. Given however the aforementioned particular circumstances which faced Montserrat over the period this finding is not unexpected.

Figure 4: Lowess Smoothing - Total Banking Sector

Graphs by country
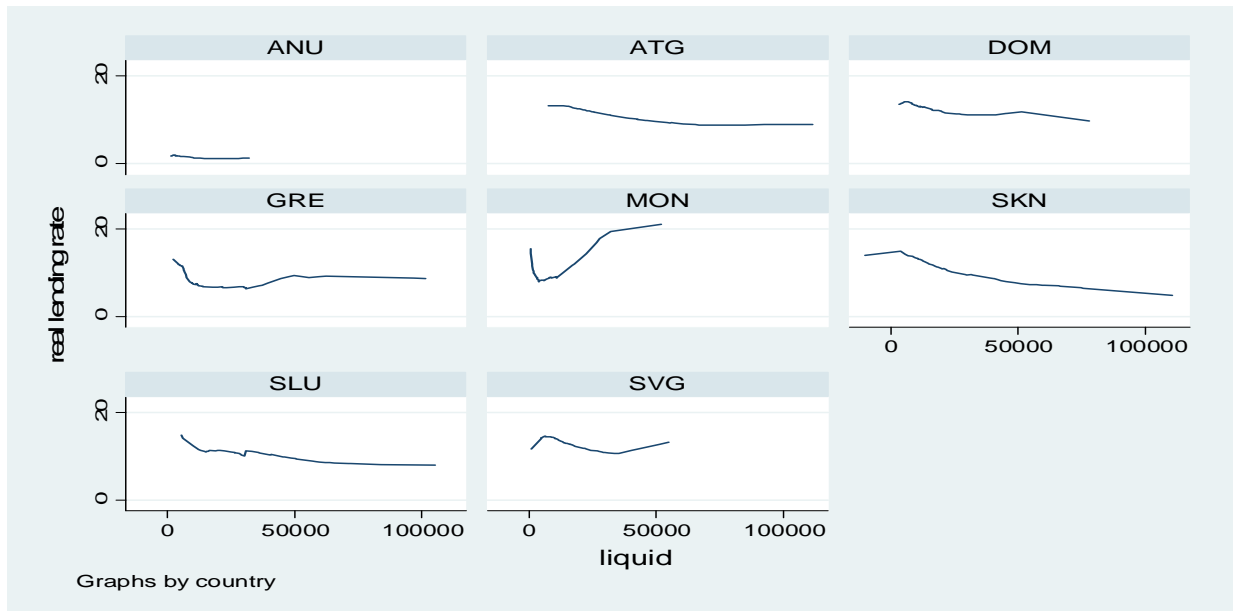
Source: Author's estimates

Figure 5: Lowess Smoothing - Indigenous Banking Sector

Graphs by country
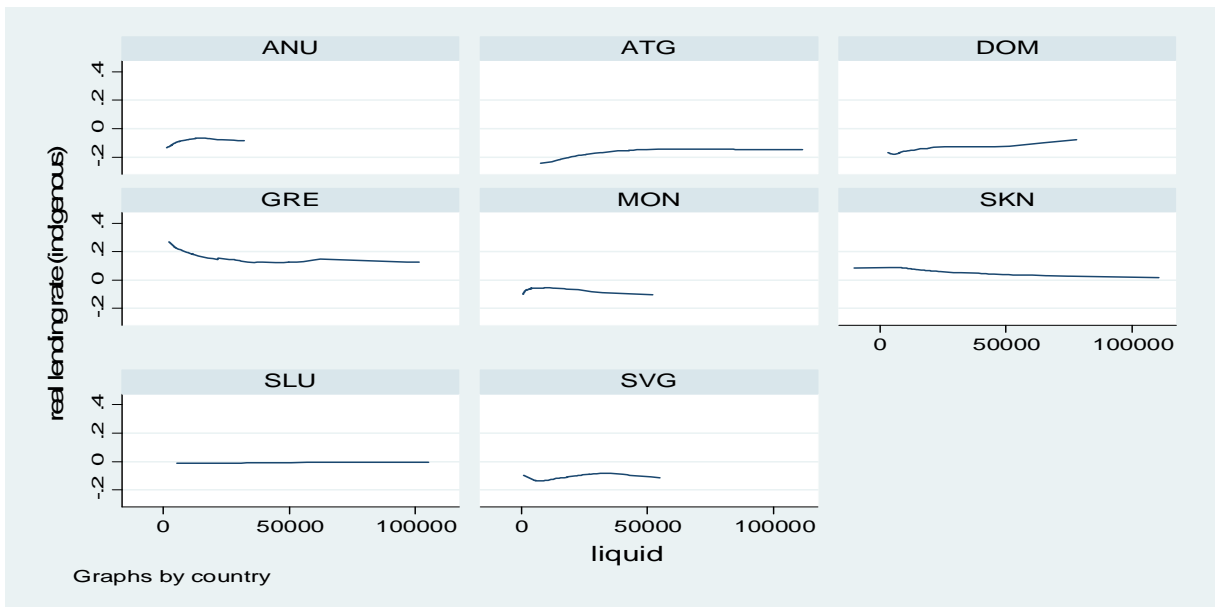
Source: Author's estimates

Figure 6: Lowess Smoothing - Foreign-branch Banking Sector (excl. Montserrat)

Graphs by Country
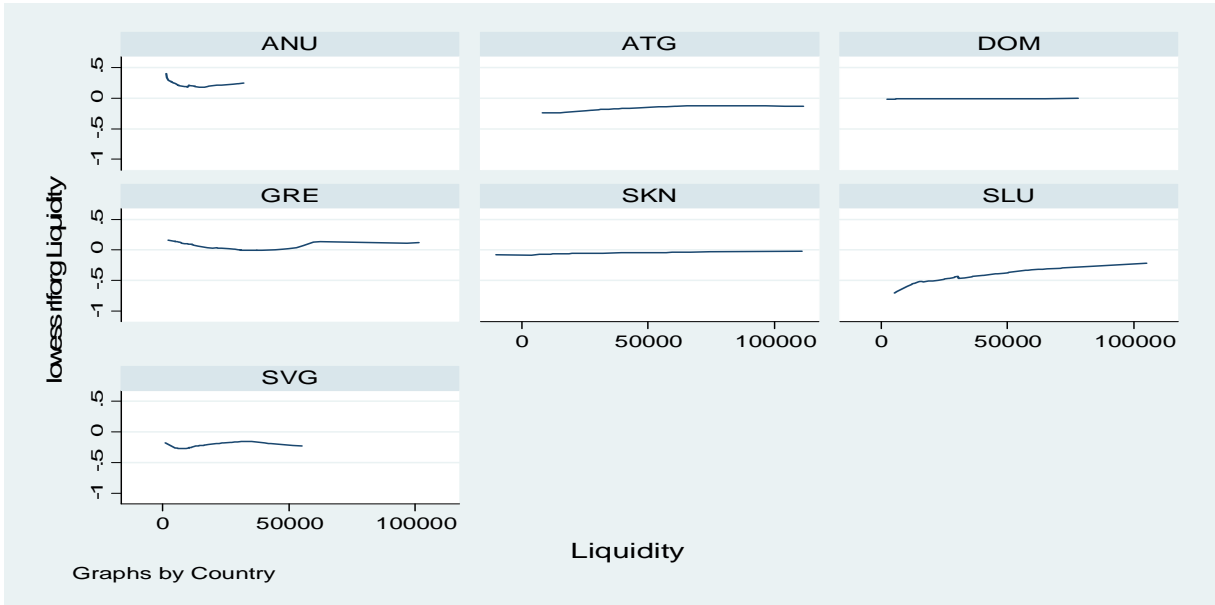
Liquidity

Source: Author's estimates

Given the low calibrated lending rates observed, liquidity preference curves on a disaggregated basis showed little variation with most flattening almost immediately at 2 to 4 per cent. The liquidity curves for foreign-branch banks with the removal of Montserrat[34] (where large negative rates existed and therefore skewed the scale of the charts) still lead to the curves which showed little variation.

Antigua and Barbuda, St Kitts and Nevis and Saint Lucia had the most number of banks in the ECCU averaging six each. The operating cost of loan provision was proxied by the ratio of operating cost over average earning assets. With the exception of Montserrat, Anguilla on average had the lowest operating cost (3.2) and Antigua and Barbuda the highest with (4.4). Dominica, Grenada and St Vincent and the Grenadines observed similar patterns in the movement of this variable over the period review. In all three countries the operating cost increased post 1996 and remained fairly stable thereafter. Antigua and Barbuda and St Kitts and Nevis however saw a steady decline in operating cost whiles St. Lucia saw an increase in the metric post 1996 but subsequently declined. Anguilla saw a double dip.

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[34] See appendix 3.0 for the graphs inclusive of Montserrat

In keeping with the turmoil in US financial markets following the September 11 attacks and the collapse of the housing market, US t-bills yields declined post 2001-2002 but subsequently increased during 2003 to 2007 after which yields declined again.

Policy Recommendations

Commercial bank lending rates serve as the price of acquiring capital, more so in countries such as those of the ECCU where commercial banks are the dominant financial intermediaries. Financial intermediaries can spur growth by providing the investment required to undertake projects with positive net present values. We sought to examine whether ECCU lending rates were mark up rates of financial and economic risks (as reproduced below) and thus at these rates banks would see loan provision and the accumulation of reserves as perfect substitutes.

$$r_L \ (1 \ + \ 1/N\epsilon_L) = [r_F + c_i \acute{} \ (L)] \ / \ (1- p)$$

Having found some evidence to support our hypothesis that the above equation sufficiently explains bank behavior in setting rates in some islands it is imperative that policy makers study the parameters above which it can albeit indirectly influence such as the number of banks, the cost of loan transactions and the rate of non-performing loans. At the 21st Annual Conference with Commercial Banks held in St Kitts the issue regarding the establishment of strategic alliances among banks, in particular credit bureau systems was discussed. Such a system will pool together client information allowing for the creation of a central repository of information regarding prospective clients. This system will significantly reduce bank cost and information asymmetries which exist when vetting prospective clients. This in turn can assist in reducing cost and the non performing loan portfolio of banks. Such a repository would also provide for the establishment of debt profiles and credit ratings for individuals and companies. This may lead to a reduction in either transaction costs and/or non-performing loans. These initiatives aimed at lessening the information asymmetries can result in greater facilitation of positive net present value projects and growth in the ECCU.

Of note were a few areas which can be discussed in further policy analysis and research. These areas revolved around the existence of lower and less volatile lending rates in the

indigenous banks relative to foreign-branch banks. In addition lending rates were not significant in explaining credit growth (loan provisioning) in indigenous banks but appear to do so in foreign branches. Another notable observation was that indigenous banks have significantly higher levels of non-performing loans than their counterparts. Determining reasons for these differences will prove instructive in the discussions surrounding the restructuring of the banking sector.

Lastly evidence was found to suggest that banks perceive loan provisioning and the accumulation of excess reserves as substitutes at interest rates of 12 and 13 per cent. Projects therefore which have positive net present values at rates below 12 and 13 per cent may not be funded by banks. As such small scale projects by entrepreneurs may go unfunded leading to a continued cycle of low entrepreneurship and growth. There exists the possibility therefore for developmental institutions to target projects which can be profitable at rates below those articulated above.

Conclusion

We have shown that excess reserves, our measure of liquidity in the ECCU was extremely volatile over the later part of the period under study and that average lending rates did decline. The degree to which lending rates declined however given the increases and volatility of excess reserves suggest that there is indeed some persistence in average lending rates. This paper in keeping with our expectations also showed that variations existed in bank specific and macro economic conditions between countries with Montserrat recording the most significant divergences from other ECCU member countries. Evidence that significant differences as it relates to lending rates and liquidity do exist between indigenous and foreign branch banks within the ECCU was also found. Indigenous banks tended to have lower and less volatile real lending rates but were also more likely to have higher non performing loans and less liquidity. On the basis of the herfindahl index it was observed that indigenous banks increased market share in most ECCU territories with the exception of Grenada and St Vincent and the Grenadines.

On an aggregated basis borrowers were more sensitive to changes in interest rates in five of the eight ECCU countries as noted from the relatively high loan demand elasticities. On a disaggregated basis lending rates were *not significant* in the model which estimated loan demand and supply for the indigenous banking sector. This emphasizes the lower impact monetary policy would have if directed through the interest rate channel as it may not influence investment in the real sector. Using these elasticities calibrated lending rates were constructed and varied between 8 to 12 per cent, similar to nominal average lending rates (with the exception of Anguilla). We found no significant difference between these rates in Antigua and Barbuda, Grenada, St Kitts and Nevis and weakly so for Saint Lucia. Interestingly these were among the same countries whose liquidity preference curves on an aggregated basis exhibited a flattening of the liquidity preference suggesting that there is some credence to the hypothesis that lending rates in these countries are indeed mark up rates in line with Khemraj (2010).

This study has also opened up avenues for further study along the following topics namely; a sensitivity analysis of the mark-up function in order to determine which factors the lending rate is most sensitive to, the structural or operational policies in some banking sectors which may account for the differences in the results from the mark-up model, the corporate governance or other issues which may explain why lending rates in indigenous banks are not significant in explaining credit growth as it should be and the response of banks and thus the impact on borrowers from a tax on excess reserves?

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Appendix

Model developed by Tarron Khemraj

'Equation 1 is the representative bank's profit function that is assumed to be concave in loans to the private sector (L); domestic government securities (G); and deposits (D). The i subscript attached to each variable signals the quantity of the respective variable held by the representative bank. Other key variables include r_L = the average loan rate; r_D = average deposit rate; r_F = rate of interest on the international security (the LIBOR for instance); c_i (L) = transaction and monitoring costs associated with making loans to private agents; p = the proportion of borrowers (where $0 \leq p \leq 1$) who are likely to default on their loans; and Ω = the probability (where $0 \leq \Omega \leq 1$) that the government will fail to meet its debt obligations. The latter probability, for instance, is a function of the debt-GDP ratio or some other measure of debt sustainability. The bank's balance sheet identity in which zD = required reserves (where z = ratio of total excess and required liquidity) is given by the identity equation 2.

$$\Pi_i = (1\text{-}p)r_L(\text{L})\text{L}_i + (1\text{-}\Omega)r_G(\text{G})\text{G}_i + r_F\text{F}_i - r_D(\text{D})\text{D}_i - c_i(\text{L}) \tag{1}$$

$$z\text{D}_i + \text{G}_i + \text{F}_i + \text{L}_i = \text{D}_i \tag{2}$$

After solving the balance sheet constraint for Fi and substituting into equation 2, the profit function (equation 3) is derived.

$$\Pi_i = [(1\text{-}p)r_L(\text{L}) - r_F]\text{L}_i + [(1\text{-}\Omega)r_G(\text{G}) - r_F]\text{G}_i - [r_D(\text{D}) - r_F(1\text{-}z)]\text{D}_i - c_i(\text{L}) \tag{3}$$

$$\text{L} = \text{L}_i + \sum_{i \neq j}\text{L}_j \text{ ; } \text{G} = \text{G}_i + \sum_{i \neq j}\text{G}_j \text{ ; } \text{D} = \text{D}_i + \sum_{i \neq j}\text{D}_j \tag{3a}$$

Following Freixas and Rochet (1999), the paper assumes a Cournot oligopoly. In the Cournot equilibrium the ith bank maximizes profit by taking the volume of loans, Treasury bills, and deposits of other banks as given. In other words, for the ith bank, (L_i*,G_i*,D_i*), solves equation 3. Equation (3a) denotes the aggregate quantity of loans, Treasury bills and deposits demanded, respectively, by the entire banking sector.

The loan market

It is now possible to derive a pricing equation for the representative bank in the loan market. Equation 4 is the first order condition after maximizing the profit function with respect to L_i. The market demand curve the bank faces is downward sloping thus giving the elasticity of demand expression in equation (4c) in which ϵ_L denotes the elasticity of demand. Bank i accounts for the fraction S_i^L out of the industry's total quantity of loans (4b). The expression $r´_L(L)$ represents the first derivative of the loan rate with respect to L. As demonstrated by (4a) it is simply the inverse of $L´(r_L)$.

$$d\Pi_i / dL_i = [(1-p)r_L(L) + [(1-p)\, r´_L(L)\, L_i - r_F - c_i´(L) = 0 \tag{4}$$

$$r´_L(L) = 1 \tag{4a}$$

$$S_i^L = L_i / L \tag{4b}$$

$$\epsilon_L = r_L . L´(r_L)/L \tag{4c}$$

Upon substituting 4a, 4b and 4c into the first order condition, equation 5 is obtained. The equation shows that the loan rate is a mark-up over the foreign rate and the marginal cost of transacting, $c_i´(L)$. The markup is dependent on the market elasticity of demand and the share of the individual bank's demand for loan out of the total for the industry. As $S_i^L \rightarrow 1$ there is the case of a monopoly and the mark-up is highest, while as $S_i^L \rightarrow 0$ one bank has an infinitesimal share of the market; the equilibrium approaches the competitive state in which the mark-up approaches zero. The bank also increases the mark-up rate once the perceived probability of default increases (that is $p \rightarrow 1$).'

$$r_L (1 + S_i^L/\epsilon_L) = [r_F + c_i´(L)] / (1- p) \tag{5}$$

Khemraj (2007)

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Lowess Results

Figure 9: Lowess Smoothing - Foreign-branch Banking Sector
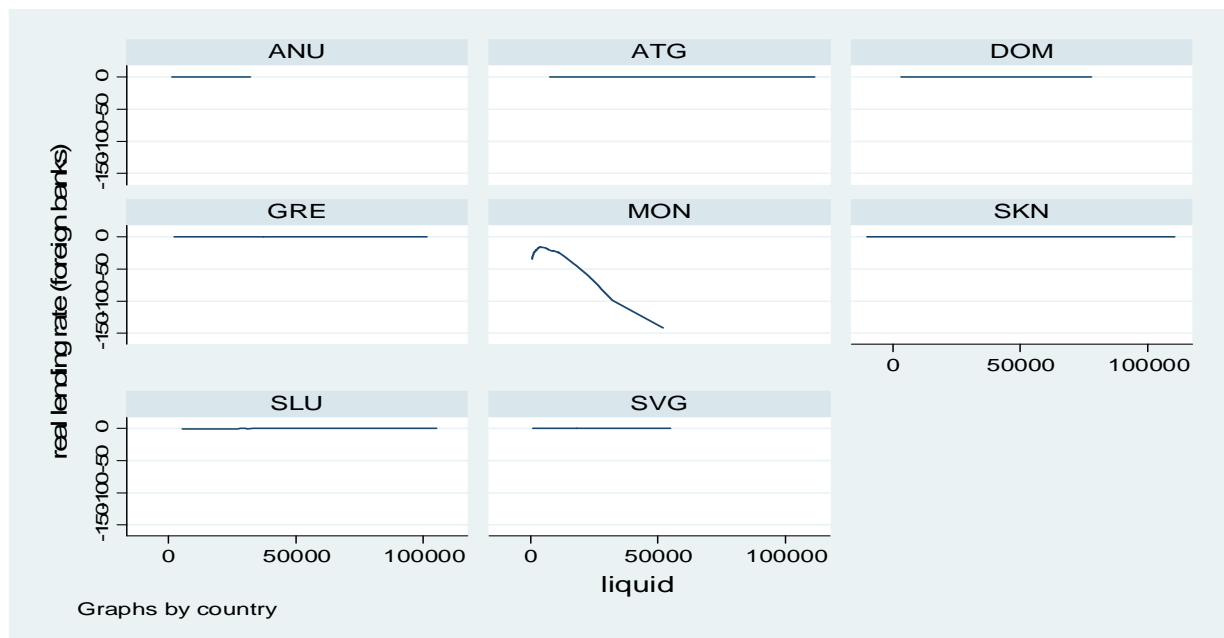
STATA Codes

Change string variables to numeric data for the programme to recognise the data:

encode year, generate (time)

Derive fitted values for logged 'expected income':

regress realgdp L.realgdp

predict yhat

label variable yhat "expinc"

g logexpinc = log(yhat)

Derive fitted and residual values for expected and unexpected inflation respectively:

regress infation_pa L.infation_pa

predict xb

label variable xb "expinf"

predict res, residuals

label variable res "unexpinfl"

Generate log variables:

g logher = log(herifindahlindex)

g lognpl = log(nplratio)

g loglq = log(liquid)

Two stage least square regression – Hausman test for IV vs OLS:

ivreg realcreditgrowth ouputgap logexpinc expinf unexpinf (reallendingrate = outputgap logexpinc expinf unexpinf realdeprate logherf loglq lognpl)

eststore IV

reg realcreditgrowth ouputgap logexpinc expinf unexpinf reallendingrate

hausman IV. , sigmamore

Two stage least square regression – Residual tests, Wu Hausman test of endogeneity and SARGAN over-identification test:

ivreg realcreditgrowth ouputgap logexpinc expinf unexpinf (reallendingrate = outputgap logexpinc expinf unexpinf realdeprate logherf loglq lognpl)

ivhettest, all

ivendog

overid

Lowess technique by indigenous, foreign and the entire banking sector:

twoway lowess totrl liquid, by(country)

twoway lowess forrl liquid, by(country)

twoway lowess indrl liquid, by(country)

THE NEXUS BETWEEN COMPETITION, EFFICIENCY AND BANK SOUNDNESS IN THE ECCU BANKING SECTOR

ALLISTER HODGE

RESEARCH DEPARTMENT

EASTERN CARIBBEAN CENTRAL BANK

NOVEMBER 2011

ABSTRACT

Banking competition is expected to provide welfare gains by reducing monopoly rents and cost inefficiencies, favoring a reduction of loan rates thereby increasing investment. First, we measure the level and evolution of banking competition between 1998 and 2007. Competition is measured using two methodologies the one proposed by the Panzar-Rosse (1989) and the Lerner index. The research implies that ECCU banking can be considered a monopolistically competitive industry. The research summarized in this article suggests that, overall, ECCU banks appear to be relatively inefficient producers of financial services though there is some heterogeneity. As well, some efficiency gains from becoming larger appear to be possible.

In the second stage of the paper, we investigate the two relationships, namely the relationship between competition and efficiency and competition and financial stability. We perform a Granger-causality-type analysis. The results supports the 'banking specificities' hypothesis, according to which heightened competition can lead to an increase in monitoring costs through a reduction in the length of the customer relationship and due to the presence of economies of scale in the banking sector, in this way reducing the cost efficiency of banks. Therefore, our results reject the intuitive 'quiet life' hypothesis and indicate a negative relationship between competition and efficiency in banking. Additionally, it corresponds to the relationship between competition and financial stability the results are weak but suggest that competition negatively affects financial stability. This finding has major implications, as it casts uncertainty on the view of favoring banking competition from the perspective of reducing prices of financial services. Indeed, greater banking competition may hamper the cost efficiency of banks, which could result in higher loan rates.

Introduction

Safe, efficient and competitive financial systems are touted as being important pre-requisites for the development and longer-run growth of the economy. Banks as we know play a pivotal role in the financing of the economy, additionally, banking intermediation has been shown to impact positively on economic development. A high degree of competition in the banking sector is expected to provide welfare gains and enhance development by reducing the prices of financial services thereby accelerating investment and growth. However, some have the view that safe and efficient banking appears to be an oxymoron since in order to maximize profits banks need to undertake increasing risky business.

These gains are usually transmitted via two channels. On the one hand, a higher degree of banking competition should result in a lower monopoly power of banks, and therefore a decrease in banking prices (interest rates) thereby increasing the demand for loans and aggregate investment in the economy. On the other hand, heightened competition should encourage banks to reduce their costs, i.e. their cost inefficiencies. However, the literature emphasizes some potential negative effects of banking competition through excessive risk-taking by banks, which may hamper financial stability (Allen and Gale, 2004; Carletti and Hartmann, 2002).

The issues regarding banking competition and its effects, especially on efficiency are therefore of particular interest to developing countries like ours, as bank credit there is by far the largest source of external finance for firms. Since investment is particularly sensitive to a decrease in loan rates, a reduction of monopoly rents and cost inefficiencies would consequently impact on investment and economic growth over the long run. It is therefore of interest to investigate how banking competition impacts on efficiency what would be even more insightful is if competition leads invariably to greater level of investment and economic growth however this is beyond the scope of this paper.

The aim of this research is twofold. First, we provide evidence on the level and evolution of banking competition and efficiency in a sub set of ECCU countries between 1998 and 2007 bearing in mind the banking landscape experienced significant changes during this period such as the merger of the Canadian Imperial Bank of Commerce CIBC and Barclays to form First Caribbean International Bank FCIB. The paper relies primarily on the estimation of the Panzar-Rosse H-statistic as a measure of competition for the banking sector.

The second aim of the paper seeks to investigate the relationship and causality between competition and efficiency and competition and financial stability performing Granger-causality-type estimations. The commonly accepted view seems to favor a positive relationship; the rather scanty empirical literature in banking on this issue supports rather a negative link (Berger, 1995; Goldberg and Rai, 1996; Weill, 2004). Furthermore, the theoretical literature provides arguments for both signs of this relationship. The 'quiet life' hypothesis (Hicks) suggests that competition positively influences efficiency, whereas the 'efficient-structure' hypothesis, proposed by Demsetz (1973), predicts a negative impact of efficiency on competition, as the most efficient banks would benefit from lower costs and therefore higher market shares. Finally, the specificities of banking competition it is expected that competition negatively influences efficiency, as reduced competition allows banks to benefit from economies of scale in monitoring and from longer customer relationships.

This paper, therefore, aims to empirically test the sign of this relationship for the ECCU banking industry. The computation of the Lerner index and the H-statistic, provides measures of competition at the firm and industry level, allows us to investigate the causality between competition and efficiency. This is an issue of considerable interest to the ECCU banking industry as it usually regarded that some countries are over banked, and also to the empirical banking literature as a whole. Indeed, to knowledge this is the first work to investigate the causality between competition and efficiency in banking for the ECCU. Moreover, to knowledge this is the first paper to address all these issues in the same paper which the novelty of the paper. Substantiation on this issue will enrich the discussion on the conflicting assumptions surrounding this topic. Such evidence is helpful to provide the normative implications of competition policy in the banking industry. Specifically, a negative

relationship between competition and efficiency and stability would mean a trade-off between these two objectives.

The structure of the paper is as follows. Section 2 describes the recent evolution of the ECCU banking industry and surveys the theoretical and empirical background of the relationship between competition and efficiency in banking. The methodology is described in section 3, followed by the data and variables in section 4. Section 5 develops the empirical results. Finally, we provide some concluding remarks in section 6.

Background

The Evolution of the ECCU Banking Industry

The ECCU Banking industry has generally been regarded as strong and stable banking environment dominated by foreign bank branches more specifically Canadian banks which have generally been touted as being some of the safest banking institutions in the world. Beginning in 2002 the ECCU banking sector underwent massive structural change when CIBC and Barclays banks merged to form FCIB and the introduction of RBTT. Unlike many other developing countries there has never been any incidence of banking crises in the ECCU although they have been times of bank distress. The stability of the system has been anchored by a strong regulatory framework of the ECCB and the conservative nature of the banks. However, the rapid expansion credit unions and the encroachment of insurance companies into the baking activities has invariably led to decline market shares for banks, to maintain profitability this meant that that now had to compete with themselves but also these NBFI which should increase the level of competition in the banking sector at least at the conceptual level. Generally the region has been described as being over banked with a population of approximately 600,000 and 40 banks invariably means that each bank has to compete for about 15,000 persons. This situation is even more acute in countries such as Antigua and Barbuda and Saint Kitts-Nevis which have populations of 85,000 and 42,000 respectively but each has

7 and 6 banks respectively. This can lead to heightened competition and excessive risk taking by banks as they seek to expand their market shares and profits.

The issue of competition in the banking sector is often mentioned both in public discussions and among practitioners, especially given the fact that banks' representatives declared that increased competition in the banking market was one of their goals. A surge in the number of services and products supplied, especially regarding loans, is the main hard fact viewed as signaling an increase in competition in the ECCU banking sector.

HHI BY Assets
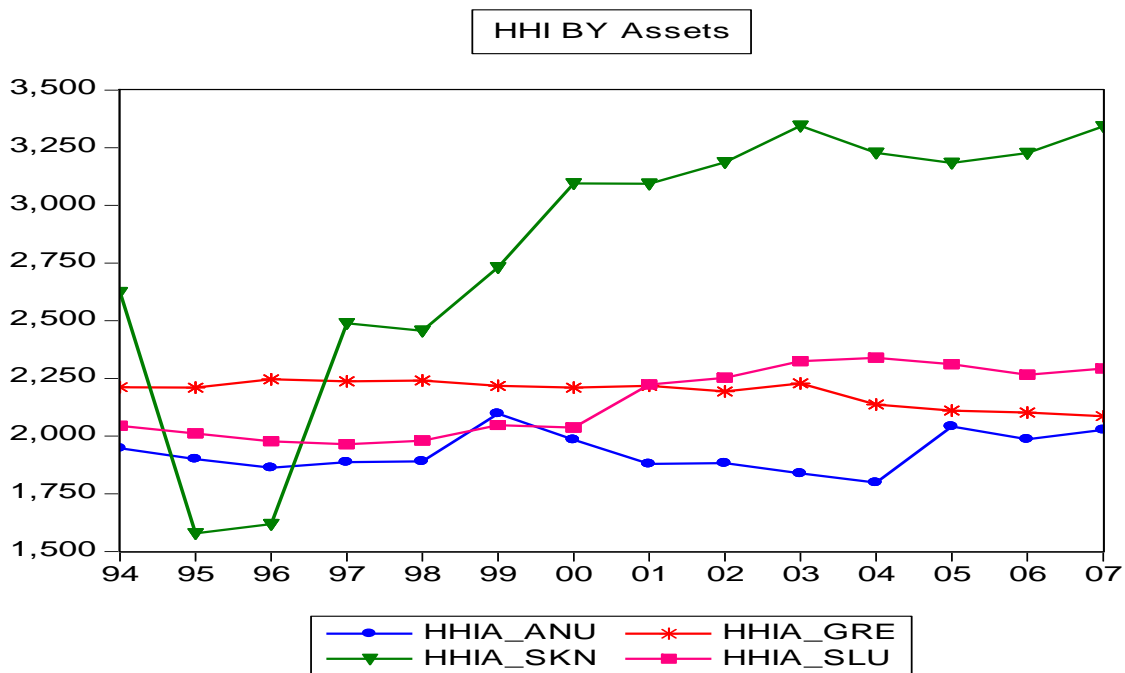
Competition can be measured using concentration indices such as the Herfindahl- Hirshman index hereinafter labeled HHI, with higher concentration signaling lower competition and vice versa. Figure 1 shows the evolution of the Herfindahl index for both assets and deposits of the ECCU banking sector calculated from 1998 to 2007. According to HHI, has been increasing steadily in Saint Kitts- Nevis from 1997, while in Grenada concentration has been relatively flat with no tendency to increase or decrease suggesting that banking system is relatively competitive.   While in Saint Lucia there has been marginal increase in the level of

concentration. Concentration has been the lowest in Antigua and Barbuda which should signal that competition is fierce within this territory.

HHI By Deposits
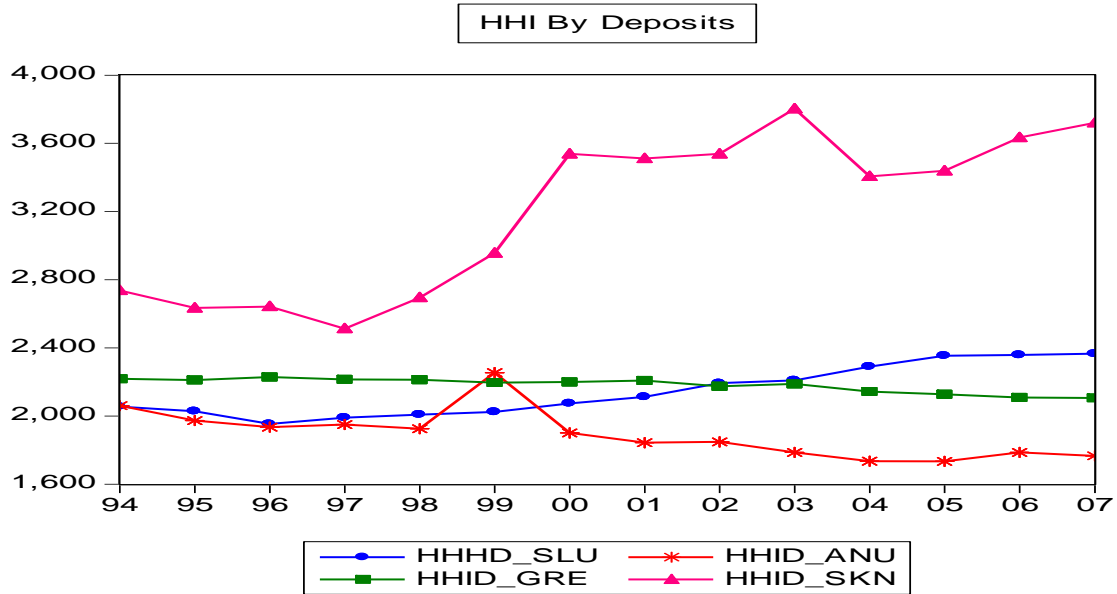
The results from the Herfidanhal Index strike some strong differences between the banking sectors in the four countries under investigation. According to the Herfindahl Index, concentration fell has been increasing steadily in St Kitts and Nevis from 1997, while in Grenada concentration has been relatively suggesting that banking system is relatively stable. While in Saint Lucia there has been marginal increase in the level of concentration. What we garner from these results is that competition should be highest in the case of Antigua and Barbuda and lowest in the case of Saint Kitts–Nevis.

ROA By Country
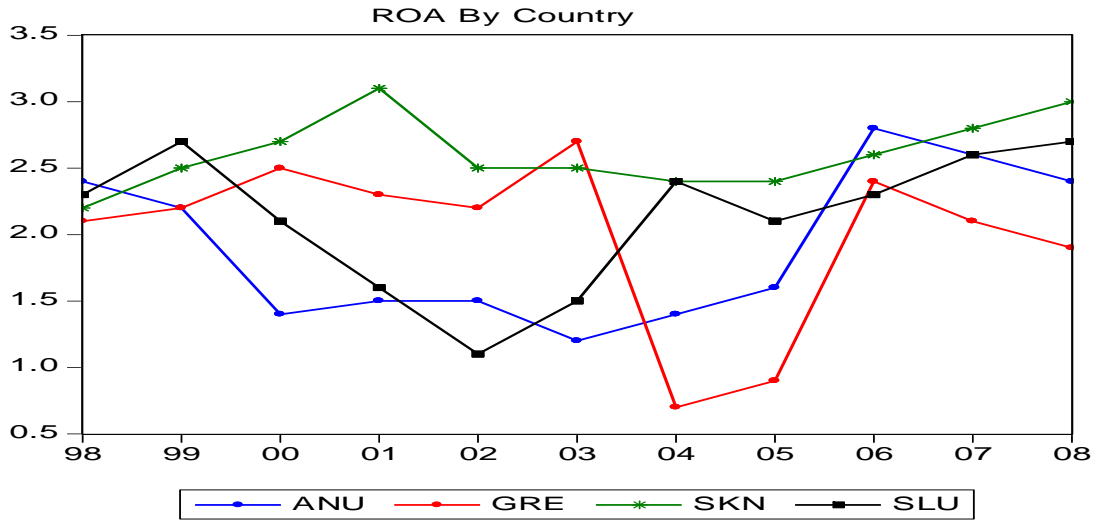
Focusing on bank's profitability measured by their returns on assets (ROA) we see that banks in St Kitts have generally outperformed their counterparts in the region. In 2004 we saw a sharp fall in ROA in Grenada which marked by the passage of Hurricane Ivan which decimated the island. While in both Saint Lucia and Antigua ROA has been increasing steadily since 2003.

ROE By Country
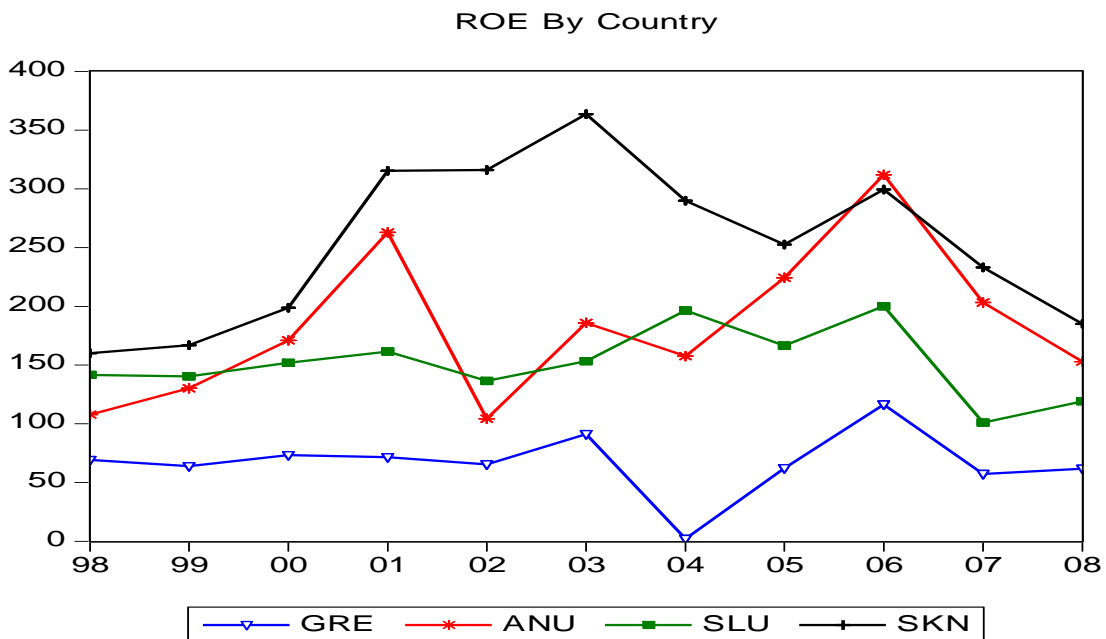
However what is notable that bank profitability as measured by ROA has been far above developed countries average and most developing countries average.

Total Cost To Total Assets By Country
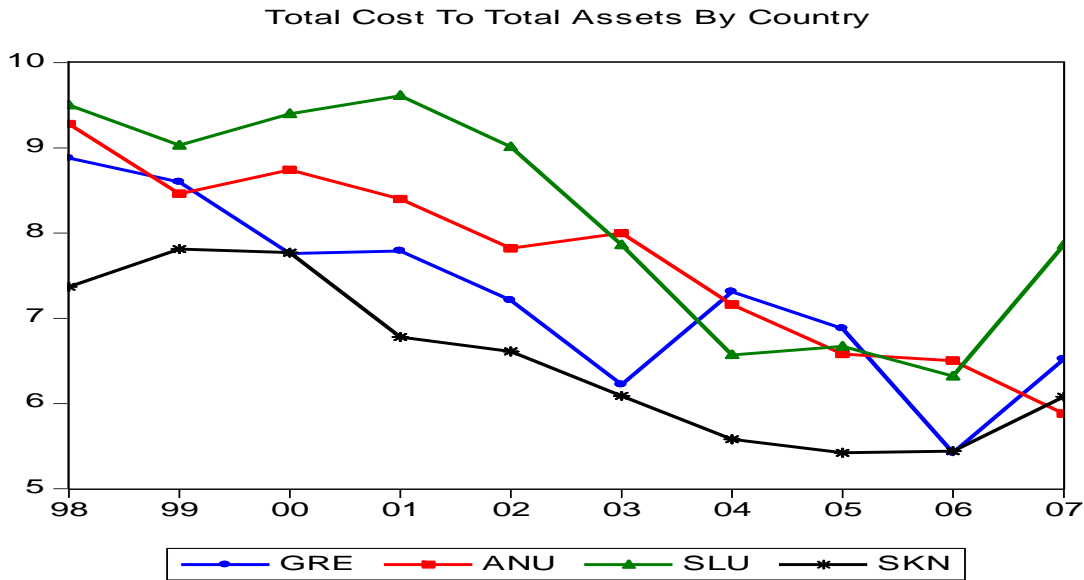
A proxy which is commonly used to measure cost efficiency is the ratio of total expenses to total assets, which is shown in the figure below. From 1998 we have seen a steady decline in the ratio implying that banks are getting more efficient. It is noteworthy to note that Banks in Saint Lucia and Antigua and Barbuda are found to have higher cost than their regional counterparts used this study and banks in St Kitts have the lowest cost as measured by this ratio.

However in terms of diversification of business for banks within the region as measured using the proportion of total income earned from interest income and the proportion earned from non interest sources we observe that business remains concentrated in the loan market with the exception of Saint Kitts-Nevis which seems to be generating a lot more income from non-interest sources since 2003. The Figures are shown in Appendix.

A Brief Survey of the Link between Competition and Efficiency in Banking

As observed by Caves, economists have "a vague suspicion that competition is the enemy of sloth." This suspicion is nonetheless supported by a couple of arguments in the literature. Hicks (1935) were perhaps one of the first economists to address the issue of competition and efficiency based on the so called '*quiet life*' hypothesis. Based on his supposition he argues that there is a link between market structure and efficiency. He posited monopoly power allows managers to grab a share of the monopoly rents through discretionary expenses or a reduction of their effort. Based on his hypothesis the lack competition reduces efficiency at the firm level since managers have no incentive to increase efficiency since they face no competition. This invariably leads to high profits despite being highly inefficient due to the lack of competition leading to a quiet life. However, the existence of monopoly rents does not explain its appropriation by managers. Indeed, there is no obvious reason why owners of monopolistic firms would exert weaker control of managerial effort than those of competitive firms. Therefore, complementary theories have been suggested by Leibenstein (1966) and Demsetz (1973).

Leibenstein (1966) explains why inefficiencies exist inside firms (the "X-inefficiencies") and why they are reduced by the degree of competition in the product markets. X-inefficiencies would result from the existence of imperfections in the internal organization of firms: those imperfections have an impact on the level of information asymmetries between owners and managers. Following Leibenstein's , a few studies have proposed a formalization of his ideas (Hart, 1983; Selten, 1986; Scharfstein, 1988). Leibenstein's X-efficiency theory in fact lies within the scope of the "Structure–Conduct–Performance" (SCP) paradigm proposed by Bain (1951). According to this paradigm, market structure would influence firm behavior in terms of prices and quantities, and therefore firm profits.

The 'efficient-*structure*' hypothesis proposed by Demsetz (1973) predicts a reverse causality between competition and cost efficiency. He considers that the best-managed firms have the lowest costs and consequently the largest market shares, which leads to a higher level of

concentration. Thus, the causality of the relationship between competition and efficiency is reversed in comparison to the SCP paradigm: efficiency determines competition. As concentration can be considered as an inverse measure of competition, there should then exist a negative link between competition and efficiency.

This survey has so far only presented some theoretical references about the link between competition and efficiency which are not necessarily specific to the banking industry. However, banking markets have some specific characteristics as compared to other markets. First, banking markets have a structure of imperfect competition, as observed in most studies on banking competition (De Bandt and Davis, 2000; Bikker and Haaf, 2002; Weill, 2004).

In fact, the theoretical literature in banking suggests that imperfect competition may result from the information asymmetries between bank and borrower in credit activity. As a consequence, banks have to implement some mechanisms to resolve the resulting problems such as adverse selection and moral hazard. One way out of this dilemma is the implementation by the bank of a customer relationship, meaning a long-term repeated relationship, to gain information on the borrower. Banks can then reduce the problems related to information asymmetries. Nevertheless, an increase in banking competition may reduce the length of the customer relationship. These specific characteristics of the banking industry may consequently modify the relationship between competition and efficiency in banking, which invariably affects the stability of the financial system. According to Diamond (1984), banks have a comparative advantage in the ex post monitoring of borrowers, in comparison to investors, because of the existence of economies of scale resulting from their role of delegated monitor.

As a consequence, competition may increase monitoring costs because of the existence of economies of scale and a potential reduction in the length of the customer relationship, further decreasing the cost efficiency of banks. In other words, the specificities of the banking industry provide some additional arguments in favor of a negative relationship between competition and cost efficiency. This assumption is referred to as the *'banking specificities' or Competition-Inefficiency* hypothesis. This theoretical relationship is also closely related to the

Franchise Value hypothesis: greater market power leads allows banks to protect their franchise value by generating large capital buffers which makes them act more prudently and pursue low risk strategies.

The *prudent and efficient management hypothesis* provides a rationale for the competition efficiency hypothesis in that competition actually increases the efficiency of banks. A study by Peteresen and Rajan (1995) argue that in markets where firms are exposed to a greater level of competition, screening and monitoring procedures are far more sophisticated, whereas banks in a monopolistic industry are likely to spend less resources investing in screening and monitoring, this is corroborated by a theoretical model put forward Chen (2007) which actually shows that this can actually reduce non- performing loans.

To counter the argument put forward under the efficient management hypothesis, the poor *inefficient management hypothesis* supports the idea that competition adversely impacts bank efficiency, resulting in a negative effect on bank soundness. Consider a case where inefficiency declines as outlined under the competition inefficiency hypothesis. In this situation banks become pre occupied with attracting both old and new customers at any expense to maintain their profitability. As result they pay relatively little attention to screening customers that is to sound underwriting practices. Therefore, they adopt less stringent risk management model this inevitably lead to loans with low or negative net present values which ultimately affects bank soundness.

We now turn to the empirical studies on the relationship between competition and efficiency in banking. Only a few studies have been performed on this issue, most of them regressing cost efficiency on a set of variables for market structure: Berger (1995) and Berger and Hannan (1997) on US banks, Lang (1996) on Western German banks, and Goldberg and Rai (1996) and Punt and Van Rooij (2003) on European banks. In these studies, cost efficiency is measured mostly using the stochastic frontier approach, while market structure is taken into account through market share or concentration indices based on the SCP ratios these being the CR and HHI. These papers tend to support a positive relationship between cost efficiency and concentration/market share. Therefore, they tend to be in favor of the *'efficient structure'*

hypothesis. In a paper devoted to Western European banks, Weill (2004) also supports this view, but by regressing efficiency scores on the non-structural measure obtained with the Panzar-Rosse model.

The level of efficiency in the banking sector in the OECS has been explored by Polius and Samuel (2001). The authors used the structure Performance paradigm and the relative efficiency paradigm to measure the performance of banks in the region over the period. The SCP hypothesis asserts that there exists a non-linear increasing monotonic relationship between concentration and market power. That is, as the market becomes more concentrated, the banks tend to collude and act as a monopoly in setting prices above the competitive level. This implies that there is an inverse relationship between concentration and consumer welfare.

The deficiency of their paper is that authors did not explicitly look at the level of competition in the banking sector given the high bank to population ratio. Moreover this is now considered an antiquated model for assessing competition. Moreover the literature has shown that empirical evidence tends not to support this inverse relationship which these models purport. Bikker (2004) has shown that concentration measure such as the HHI tends to exaggerate the level of competition and is unreliable when the country is small and the numbers of banks are few as in the case of the ECCU.

Ramon, H et al (2005) evaluated the performance of commercial banking system in the ECCU using statistical analysis. Their results pointed to the fact that banking system was concentrated neither within nor across countries. Additionally they were able to show that large banks tended to reduce their scale over time, in terms of efficiency it was that while both indigenous and foreign branch bank exhibited similar cost it was that foreign banks were far more profitable than local indigenous banks.

In summary, the theoretical literature provides conflicting arguments with respect to the relationship between competition and efficiency, while the empirical literature tends to be in favor of a negative relationship. It therefore seems relevant to provide new empirical evidence with respect to the relationship between competition and efficiency by measuring competition

with the P-R index and by investigating the sense of causality of this link. Furthermore, as no former empirical study has been done on this issue in these countries

Methodology

Our aim is to investigate the relationship between competition and efficiency in the ECCU banking industry. We therefore explain in this section how we estimate both variables i.e. competition and efficiency estimates.

Measurement of Competition

Empirical research as to how one goes about estimating competition within the banking sector can be subdivided into the traditional Industrial Organization (IO) and the new empirical NEIO approaches. The traditional IO approach proposes structural tests to assess banking competition based on the Structure Conduct hypothesis SCP model suggested by Bain (1956). The SCP hypothesis argues that greater concentration causes less competitive bank conduct and leads to greater profitability (meaning lower performance in terms of social welfare). According to this hypothesis, competition can be measured by concentration indices such as the market share of the five largest banks, or by the Herfindahl index.

The new empirical IO approach provides non-structural tests to circumvent the problems of measuring competition by the traditional IO approach. The former (i.e. SCP) measures suffer from the fact that they infer the extent of competition from indirect proxies such as market structure or market shares. In comparison, the new empirical IO approach infers banks' conduct directly. Furthermore, it allows us to consider the actual behavior of banks by taking contestability into account. Indeed, as observed by Claessens and Laeven (2004), the actual behavior of a bank is related not only to market structure, but also to barriers to entry, influencing the likelihood of the entry of new competitors and therefore the behavior of incumbents forecasting such entry.

The most commonly applied tool for assessing competition emanating from the NEIO approach is the Panzar -Rosse (P-R) (1978) and the Bresnahan-Lau (BL) test. The P-R model basically provides a characterization of the degree of competition for the banking industry as a whole while the BL model is based on the estimation of a structural model with separate demand and supply equations (Bresnahan, 1982, 1989; Lau, 1982) which basically estimates the mark-up on aggregate data.

In this paper use is made of the model developed by P-R (1982 and 1987) and the market power index of the Lerner index. The P-R model uses individual bank data to estimate a reduced-form revenue equation. The nature of competition in the sector is evaluated using the H-statistic–the sum of the factor price elasticities obtained from the estimation. The advantage of the PR methodology is that it uses bank-level data and allows for bank specific differences in the production function. It also allows one to study differences between types of banks (e.g., large versus small, foreign versus domestic). It's popularity over other measures off competition is that it is premised on profit maximizing conditions. Its drawback is that it assumes that the banking industry is in equilibrium, but we can test whether this condition is satisfied (see Appendix). As we have access to bank-level information and want to study differences among banks, we use the PR approach.

Two critical implications exist for this equilibrium model. First, at the bank level, profit is maximized where marginal revenue is equal to marginal cost:

$$R_i^{'}\left(y_i^*, Z_i^R\right) = C_i^{'}\left(y_i^*, W_i, Z_i^C\right) .... (1)$$

R is the marginal revenue function, C is marginal cost function, y_i is the output of bank i, W_i is a dimensional vector of factor input prices of bank i, Z_i^R is a vector of J exogenous variables affecting the revenue function and Z_i^C is a vector of L exogenous variables that shift the cost function. At the individual level it is assumed that, marginal revenue equal marginal cost.

The measure of competition formulated by P-R, the H statistic, evaluates the elasticity of total revenues with respect to change in factor input prices:

$$H = \sum_{k=1}^{K} \left(\frac{\partial R_i^*}{\partial w_{ki}} * \frac{w_{ki}}{R_i^*} \right) \dots \dots \dots 2$$

The marginal cost and marginal revenue (C′)(R′) functions of the P-R model are as follows:

$$Ln(R_i) = a_o + a_1 Ln(y_i) + \sum_{j=1}^{J} d_j Ln\left(a_{ji}^R\right)$$

$$Ln(C_i) = c_o + c_1 Ln(y_i) + \sum_{k=1}^{K} b_k Ln(w_{ki}) + \sum_{l=1}^{L} v_j Ln\left(z_{li}^C\right) \dots \dots \dots (3)$$

where, "" denotes the natural logarithm, is the output of the bank, is the factor input prices, and v are exogenous variables that shift the bank's cost and revenue functions respectively. Setting marginal revenue equal to marginal cost – the equilibrium profit-maximizing condition – yields the following equation:

$$Ln(y_i^*) = \frac{1}{(a_1 - c_1)} \bullet \left(c_o - a_o + \sum_{k=1}^{K} b_k Ln(w_{ki}) + \sum_{i=1}^{L} v_l Ln(z_{li}^c) - \sum_{i=1}^{J} d_j Ln(z_{ji}^R) \right) \dots \dots \dots (4)$$

Multiplying equation, by the common price level yields the reduced-form revenue equation for bank i. As such, to estimate the H-statistic for the ECCU banking sector the following equation was used:

$$Ln(R_i^*) = \alpha + \sum_{k=1}^{K} \beta_k Ln(w_{ki}) + \sum_{q=1}^{Q} \delta_q Ln(z_{qi}) \dots \dots \dots (5)$$

$$Ln(R_{it}) = \alpha + \beta_1 LnUPF_{it} + \beta_2 LnUPL_{tt} + \beta_3 UPC_{it} + \gamma_1 LTA_{it}$$
$$+ \gamma_2 NPL_{tt} + \gamma_3 NL/TA_{it} + \varepsilon_{it}$$

$$H = \sum_{k=1}^{K} \beta_k$$

Equation shows the P-R H statistic which ranges from minus infinity to unity. A summary of the testable hypotheses of the different market structures is presented below. The intuition behind the equation is that market power is reflected in the extent to which changes in factor prices are reflected in revenues, this gives a measure of how easily a bank passes on increases in factor prices to its customers.

H-statistic Hypotheses

- Perfect competition or monopoly in a contestable market $H = 1$
- Monopolistic competition $0 < H > 1$
- Monopoly or collusion $H \leq 0$- an increase in input prices leads to an increase in marginal cost, reduce equilibrium output and subsequently reduce revenues.

To investigate whether the banking system is in long-run equilibrium the following equation is estimated with the pretax return on assets as a dependent variable.

$$Ln(ROA) = \alpha + \beta_1 \ln(UPF) + \beta_2 \ln(UPL) + \beta_3 \ln(UPC) + \gamma_1 lta + \gamma_2(l/ta) + \varepsilon \ \ldots\ldots(6)$$

The equilibrium statistic is also calculated as $\beta_1 + \beta_2 + \beta_3$. We test for $E = 0$, using an F-test. Long-run market equilibrium indicates that the sum of the coefficients on the input prices equals zero. In other words, the test aims to establish whether input prices are uncorrelated with industry returns since a competitive system will equalize risk-adjusted rates of return across banks in equilibrium. If this hypothesis is rejected, the market is assumed to be in disequilibrium. We note that Shaffer (2004b) underscores that rejection of equilibrium does not necessarily invalidate the inferences based on H for the purpose of our study, because observing values of $H > 0$ (which holds for most of the observations) indicates that the long-run equilibrium assumption is not strictly necessary for the interpretation of the H-Statistic. He stresses that disequilibrium suggests that the industry develops dynamically.

The application of the P-R model, it is important to clearly define the production activity of the banks since they are not exactly comparable to other types of firms. The current literature presents two alternative approaches - the "production approach" and the "intermediation approach" – that can be taken in empirical work. Although there is some amount of debate as to which approach should be taken in empirical work, this paper will follow the intermediation approach, which classifies deposits and loans as inputs and outputs, respectively.

Proxies were used for most price variables where $R\,it$ is the ratio of gross interest revenue (or total revenue) to total assets and (proxy for output price of loans), $UPLit$ is the ratio of personnel expenses to total assets (proxy for input price of labor), $UPFit$ is the ratio of interest expenses to total deposits (proxy for input price of deposits), and $UPC\,it$ is the ratio of other operating and administrative expenses to total assets (proxy for input price of equipment/fixed capital). Other control variables were also included in equation (5). These variables include (loans to total assets), (non-performing loans to total assets) and (total loans/total assets) ratios. Equation (5) was estimated using a panel data set for country utilizing panel GLS accounting for any heterogeneity among the banks as well as to avoid specification problems. As second measure of competition the Lerner index (LI) is also calculated[35]. When LI=0 it indicates perfect competition while LI=1 indicate s monopoly power. To estimate the LI a translog cost equation was estimated.

Measurement of Efficiency

Direct approaches of measuring efficiency rely on financial/bench mark ratios which while quite useful suffer from major drawbacks as alluded to by Demirgüç-Kurt and Huizinga (1998). As they showed, the problem with these bench mark ratios are that changes in these ratios are the result of a change in the numerator or denominator and not as result of the overall ratio changing. Akhavein, Berger, and Humphrey (1997) also point to the fact these ratios do not take into account concepts such as X-efficiency, scale and scope efficiency.

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[35] The technical details of the computation of the index is left out but readers can be referenced to ().

Farrell (1957) pioneered the work in measuring efficiency which he defined as "the deviation of actual behavior from optimum". In so doing a frontier is calculated to assess the deviations of actual behavior from optimum. In the frontier analysis the two main measures of efficiency from a microeconomic standpoint are profit and cost efficiency which measures how far away a firm is from a firm/ frontier which produce the same output.

There are two popular approaches of measuring efficiency in the empirical literature; these include the non parametric approaches (Data Envelope Analysis and free disposal hull) and the parametric approaches (Stochastic Frontier, Thick Hull and Distribution Free models). The main difference between the two approaches is the imposition of a priori assumption regarding the distribution of the model, while the non parametric approaches do not impose any structure on the data the parametric approaches do.

The main shortcoming of the SFA is the *a priori* distributional assumption of μ_{is}. The assumption of a specific functional form by the SFA model has the drawback that if the functional form is incorrectly specified then it could lead to misleading results and incorrect inferences to be drawn. This assumption is necessary in order to use the maximum likelihood method to solve for the parameters.

In this paper efficiency is computed using two approaches the Stochastic Frontier and data envelope models. These models allow the measurement of how close a bank is to a best practice banks. The SFA is able to provide information on waste in the production process and on the optimality of the chosen mix of inputs.

The basic model assumes total cost deviates from the optimal cost by a random disturbance, v, and an inefficiency term, μ. Thus, the cost function is:

$$TC = f(Y, P) + \varepsilon \ldots\ldots\ldots\ldots (7)$$

Where TC represents total cost, Y is the vector of outputs, P the vector of input prices and ε the error term which is composed of μ and v. μ is a one-sided component representing

cost inefficiencies while v is assumed to be a two-sided component representing random disturbances, reflecting either bad (good) luck or measurement errors.

The decomposition of the error term into its two components, v_i and u_i, remained unresolved until Jondrow et al. (1982) proposed how to calculate the observation (bank) specific estimates of inefficiency conditional on the estimate of the error term ε. The best predictor for u_i is the conditional expectation of u_i given the value of $e_i = v_i - u_i$. The predictor for efficiency is obtained by subtracting the inefficiency from one. The inefficiency factor μ incorporates both technical inefficiency (i.e. employing too many inputs) and allocative inefficiency (i.e. failures to react optimally to changes in relative prices of inputs) (Berger and Mester, 1997). The random error and the inefficiency term are assumed to be multiplicatively separable from the cost frontier.

The literature has highlighted a number of distributions when estimating the error distribution μ the inefficiency term; these are the gamma, half normal, truncated and exponential distributions.

To estimate equation (7) a specfic functional form has to imposed the literature has put forward three functional forms these are the Cobb Douglas, the translog and fourier-flexible in this paper the trans-log functional form was specified as follows:

$$\ln(C/w_3 z) = \alpha_0 + \sum_{i=1}^{2} \alpha_i \ln(w_i /w_3) + \frac{1}{2} \sum_{i=1}^{2} \sum_{j=1}^{2} \alpha_{ij} \ln(w_i /w_3) \ln(w_j /w_3) +$$

$$+ \sum_{k=1}^{3} \beta_k \ln(y_k z) + \frac{1}{2} \sum_{k=1}^{3} \sum_{m=1}^{3} \beta_{km} \ln(y_k /z) \ln(y_m /z) + \tag{8}$$

$$+ \sum_{k=1}^{3} \sum_{i=1}^{2} \delta_{ki} \ln(y_k /z) \ln(w_i /w_3) + \kappa_1 \ln z + \frac{1}{2} \kappa_2 (\ln z^2) +$$

$$+ \sum_{i=1}^{2} \rho_i \ln(w_i /w_3) \ln z + \sum_{k=1}^{3} \tau_k \ln(y_k /z) \ln z + \ln v + \ln u$$

where $\qquad C \qquad$ is total cost

y_k is the k-th output

w_i is the i-th input price

v is measurement error term

u is the inefficiency term

Data Envelopment Analysis (DEA) is a linear programming type technique developed by Charnes, Cooper and Rhodes (1978), which is more adept than parametric approaches at describing frontiers as opposed to central tendencies: Instead of fitting a regression plane through the center of the data, DEA constructs a piecewise linear surface that connects the set of the best-practice producers, yielding a convex production possibilities set. Under input minimization (in contrast to output maximization), the best-practice producers are those for which there is no linear combination of producers that use as little or less of each input component, given output quantities. In a particular, if N firms use a vector of inputs to produce a vector of outputs, the input oriented firm CCR measure of efficiency of a particular firm is calculated as;

$$\min_{\theta,\lambda} \ \theta_i$$

$$st \sum_{r=1}^{N} y^t mr \, \lambda_r^t \geq y_{mi}^t$$

$$\sum_{r=1}^{N} x^t kr \, \lambda_r^t \leq \theta_i x_{ki}^t$$

$$\lambda_r^t \geq 0$$

Where $\theta_i \leq 1$ is the scalar efficiency score for the ith unit, if $\theta_i = 1$ the ith firm is efficient as it lies on the frontier, whereas if $\theta_i < 1$ the firm is said to be inefficient and needs a $(1-\theta_i)$ reduction in inputs levels to reach the frontier. The CCR model assumes constant returns ti scale type technology, which is the optimal scale in the long run. By adding the convexity constraint $\sum \lambda_i = 1$ to above set up we can introduce variable return to scale to the model.

Modeling a bank production process poses a unique problem as it relates to economic theory as Hauner, D and Peiris, S (2005) highlight," *the fact that it is not exactly obvious whether*

services to customers are an input to the production process or an output. The fact that customers usually pay a fee that does not cover the costs of these services suggests that they are a bit of both, with no consistent way to separate them and with no economically reasonable input price available."

To get around this problem (i.e. definition of what is an input and output) three techniques have been established by the literature these are the user cost, value added and intermediation/asset approaches. The production approach assumes that banks use labour and capital to produce services for customers which is approximated by the number of transactions that is carried out. The intermediation approach originated by Sealey and Lindley (1997) on the other hand assumes that banks play an intermediary role in the economy by transforming the deposits of savers into capital for investors created through loans. Following Sealey and Lindley (1977) I assume the intermediary aspect that banks play in the economy.

Here, the production process of a bank is modeled as follows: Banks use deposits, loans, and contingent liabilities as inputs which they intermediate into deposit holdings, securities, and loans as outputs (see Table 1 for descriptive statistics). On the liability side, loans and contingent liabilities are lumped together to save degrees of freedom.

Two inputs that are used in several other studies are explicitly not included here: first, physical capital, because no economically reasonable input price could be calculated from the available data; and second, equity, because it increases via retained profit, and more profitable banks would thus be less cost-efficient if equity were included as an input—a rather counterintuitive line of causality.

Testing the Relationship between Competition and Efficiency

Concerning the link between competition and efficiency, the theoretical and empirical literature does not provide a clear-cut conclusion in favor of a positive influence of competition on efficiency in banking. Several hypotheses can be advanced on this

relationship. While the *'efficient-structure'* hypothesis suggests a negative influence of efficiency on competition, the *'quiet life'* and *'banking specificities'* hypotheses are both in favor of an impact of competition on efficiency, even if they disagree on the sign of this effect.

We analyze the link between competition and efficiency in the ECCU banking industry in a Granger-causality manner, formally specified in the equations as follows:

$$y_{it} = \alpha_0 + \sum_{l=1}^{m} \alpha_l^y y_{it-1} + \sum_{l=1}^{m} \delta_l^y x_{it-1} + \mu_{it}^y \dots\dots\dots\dots\dots (8)$$

$$x_{it} = \beta_0 + \sum_{l=1}^{m} \alpha_l^x y_{it-1} + \sum_{l=1}^{m} \delta_l^x x_{it-1} + \mu_{it}^x \dots\dots\dots\dots\dots (9)$$

where *y* represents *'Efficiency'* and *x* either the Panzar-Roose H statistic or the Lerner index . *fi* represents the bank's 'individual effect'. *Efficiency* and *Lerner* are the yearly averages of the cost efficiency score and the Lerner index, respectively. *i* and *t* represent the indices for the bank and the time (year), respectively. Each dependent variable is regressed on its yearly lags and on those of the other variable. We resort to using yearly averages in order to be able to capture the genuine effect, if any, of competition on efficiency and vice versa.

To test the relationship between financial stability and competition we use three dependent variable to measure the level of financial, these being ratio of non performing loans which captures the riskiness of the loan portfolio, the Z score and equity to total assets ratio. To provide some analysis as to the choice of variables used in the study.

The rationale for the Z-score as variable in bank soundness is due to the fact that it combines a banks financial buffer (capital and profits) with the risks they face (measured by the standard deviation of the returns) in a way that is grounded in theory. In particular, it can be shown that the Z-score is inversely related to the probability of financial institution's insolvency, ie the probability that the value of its assets becomes lower than the value of its debt. The probability of default is given by $p(ROA < E/A = \int_{-\infty}^{E/A} \phi(ROA)dROA$. If ROA is normally

distributed, then $p(ROA < E/A) = \int_{-\infty}^{z} N(0,1)dROA$, where z is the Z-score. In other words, if returns are normally distributed, the Z-score measures the number of standard deviations a return realization has to fall in order to deplete equity. Even if μ is not normally distributed, z the lower bound on the probability of default (Tchebycheff inequality). A higher Z-score therefore implies a lower probability of insolvency providing a direct measure of banks soundness that is superior to, for example, analyzing only banks leverage.

Data and Variables

Data

The analysis covers four ECCU countries: Antigua & Barbuda, Grenada, St Kitts and Nevis and Saint Lucia. Although there are differences between the banking sectors of these countries, they nevertheless form a relatively homogeneous group, in particular, the common ECCB legislative framework and common regulation standards. This allows us to perform an efficiency analysis and compare estimated efficiencies across countries.

We use quarterly data reported to the ECCB for all ECCU commercial banks during the period 1998–2007, panel data estimation techniques are used to estimate both P-R model and Lerner index. Two approaches are proposed in the banking literature for the definition of inputs and outputs. The intermediation approach assumes that the bank collects deposits to transform them, using labor and capital, into loans, as opposed to the production approach, which views the bank as using labor and capital to produce deposits and loans. As our focus is on lending activity, we adopt the intermediation approach.

In specifying input prices and outputs of the cost function, we follow the intermediation approach as suggested by Sealey and Lindley (1977). Three inputs (labour, funds and physical capital) are used to produce three outputs (loans, other earning assets and deposits) (Table 2). The three inputs reflect the three key groups of inputs in the bank production process: bank personnel and the management expertise necessary for the provision of bank services (*labour*),

funds collected on the liabilities side (*funds*), and offices, branches and computer hardware (*physical capital*).

Table 1: Input and output variables

	Variable	Name	Description
Dependent	C	Total cost	Sum of labour, interest, physical capital and other costs
Variables			
Input	w_1	Price of labour	Personnel expenses over total assets
Prices	w_2	Price of funds	Interest expenses over the sum of deposits, other funding
	w_3	Price of physical capital	Fixed assets over Total Assets
Output	y_1	Total loans	Sum of short- and long-term loans, mortgages and other
quantities	y_2	Other earning assets	Sum of total securities, deposits with banks and equity investments
	y_3	Total deposits	Sum of demand and savings deposits, deposited by bank and non-bank depositors
Other variables	z	Equity capital	Total amount of equity capital

Source: ECCB

Data is not readily available on the *price of labour* (w_1) directly, i.e. there is no information on the number of employees to enable the construction of the ratio of personnel expenses to the number of employees as the unit price of labour. Instead, we use the ratio of personnel expenses over total assets, which is a common approach in bank efficiency literature. *Price of funds* (w_2) is measured as the ratio of interest expenses over funding. *Price of physical capital* (w_3) is also not readily available and was constructed as fixed assets over total assets. The three outputs, loans, other earning assets and deposits are proxies for banking services provided. *Total loans* (y_1) is the total customer loans item, *other earning assets* (y_2) is the sum of total securities, deposits with banks and equity investments. *Total deposits* (y_3) is the sum of demand and savings deposits held by bank and non-bank depositors. The dependent variable, *total cost* (C), is the sum of total operating expenses and interest expenses. *Equity*

capital (z) is the amount of bank equity that reflects both the size and riskiness of banking operations.

Following Berger and Mester (1997), cost, and input prices were normalised in order to impose homogeneity. Cost and output quantities were normalised by equity to control for potential heteroscedasticity. Normalisation also allows the model a more economic interpretation.

Results

This section presents the empirical results. The first subsection displays the evolution of banking competition based on both the Lerner index and the P-R H statistic[36]. In the third subsection, we investigate the relationship between competition and efficiency.

The Evolution of Banking Competition

We present the results from the estimation of both the P-R statistic and the Lerner index. As regards market structure, the results (Table 6) suggest that the ECCU banking sector is characterized by monopolistic competition according to the P-R classification. Irrespective of model specification, the *H*-statistic consistently lies between 0 and 1. The results from the P-R model are largely in line with what we gather from the HHI. In that St Kitts and Nevis which has the highest level of concentration has the lowest level of competition within the baking sector, while Grenada which showed very little change in concentration has the highest level of competition within the banking sector. The Wald statistic also failed to accept the H statistic as measured by ()is equal to zero.

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[36] To test whether the banking sector is in equilibrium in the P-R model the dependent variable Total revenue over total assets is replaced with return on assets which is equal to net income over total assets where when $H < 0$ indicates disequilibrium while $H = 0$ indicates equilibrium. Note that H is calculated as previous defined in the body of the paper.

In interpreting the coefficients in Table () the following results should be underscored:

- The unit price of labor (*UPL*) is significant in all specifications and with similar positive coefficients. This result appears to confirm that personnel costs are as important as overhead costs.

- The unit cost of funds (*UPF*) is significant in all specifications and greater than zero.

Moreover, as expected the cost of capital has a higher impact on interest revenue than other revenue. The elasticities of the scaled specifications of the model are much lower, giving further support to a presence of economies of scale as the relative interest expense depends on asset size. This variable should also capture the market interest rate, as a point of reference for deposit rates.

- The unit cost of fixed assets (*UPC*) is positively correlated with total revenue, with the exception of the case of Saint Kitts and Nevis which may be due to limited branch offices and ATM machines.

- The scale variable (*TA*) is strongly significant in all models, but only positive in Antigua and Barbuda and Grenada.

Table 2: Results for P-R Estimation

	Grenada	St Kitts and Nevis	Saint Lucia	Antigua and Barbuda
PL	0.26	0.18	0.05	0.17
PF	0.36	0.29	0.82	0.44
PK	0.06	-0.14	0.01	0.20
LDEP	0.00	0.06	0.14	-0.04
L_TA	0.42	0.41	-0.08	0.23
LTA	0.02	-0.02	-0.12	0.07
C	-0.23	-0.05	0.09	-0.18
R-squared	0.63	0.82	0.94	0.64
F-statistic	10750.40	6238.78	9578.90	6873.99
Durbin-Watson stat	1.45	1.54	1.60	1.64
H- Statistic	0.68	0.34	0.89	0.80

The second measure of competition utilized in the paper was the Lerner index which measures market power. The results from the Lerner index indicate the level of market power within the banking industry was lowest in Antigua and Barbuda followed by Grenada, while market power was highest in Saint Kitts and Nevis followed by Saint Lucia. These results are largely in keeping with what was established with the findings from the HHI and the P-R H statistic. The implication of these results seems to suggest that degree of competition with the Kittitian banking system appears to very low, while it is quite high for both Antigua and Barbuda and Grenada.

Table 3: Results for Lerner Index

Year	anu_li	gre_li	slu_li	skn_li
1999	0.30	0.62	0.82	0.92
2000	0.27	0.65	0.81	0.92
2001	0.30	0.65	0.81	0.93
2002	0.35	0.67	0.82	0.93
2003	0.33	0.72	0.84	0.94
2004	0.40	0.67	0.87	0.94
2005	0.42	0.68	0.87	0.94
2006	0.45	0.75	0.87	0.94
2007	0.50	0.71	0.85	0.94

The Evolution of Banking Efficiency

The results from the SFA and DEA for the countries are shown in Table (). The results from the DEA model showed that in general the banks that formed the sample performed relatively well in terms of technical efficiency which measures how well a bank can produce maximum output with a given set of inputs but did poorly in terms of both their cost and allocative efficiency, allocative efficiency which measures the ability of the firm to use inputs in optimal proportions given input prices.

The best performing banks in the sample for both cost and allocative efficiency were St Kitts and Nevis and Saint Lucia. Average cost inefficiency for banks in St Kitts and Nevis is 12.0 per cent whereby banks could increase their efficiency by reducing their inputs or increasing their outputs by 12.0 per cent while in Saint Lucia the average inefficiency for banks was 12.7 per cent. The worst performing bank in the sample was Antigua and Barbuda and Grenada which registered cost inefficiencies of 15.4 per cent and 20.2 per cent respectively. The results for both Antigua and Barbuda and Grenada are hardly surprising given that for instance in Grenada banks have typically paid higher interest than their counterparts for attracting funds and the low level of concentration that we in that market. What we come away with is that allocative inefficiency is the dominant cause of inefficiencies in the baking system that is the failure of banks to use their inputs in an optimal fashion.

Antigua: DEA Results

Year	te	ae	ce
1998	0.984	0.851	0.838
1999	0.980	0.840	0.824
2000	0.969	0.839	0.815
2001	0.975	0.850	0.829
2002	0.980	0.936	0.918
2003	0.961	0.950	0.914
2004	0.991	0.868	0.860
2005	0.983	0.836	0.823
2006	0.987	0.830	0.820
2007	0.992	0.828	0.822

Grenada: DEA Results

Year	te	ae	ce
1998	0.999	0.85	0.851
1999	0.994	0.860	0.855
2000	0.998	0.844	0.842
2001	0.999	0.838	0.837
2002	0.994	0.824	0.820
2003	0.996	0.766	0.763
2004	0.991	0.735	0.729
2005	0.991	0.766	0.759
2006	0.992	0.789	0.783
2007	0.993	0.750	0.745

Saint Lucia: DEA Results

Year	te	ae	ce
1998	0.998	0.909	0.907
1999	0.998	0.895	0.893
2000	0.999	0.877	0.876
2001	0.998	0.872	0.870
2002	0.999	0.901	0.900
2003	0.999	0.889	0.888
2004	0.987	0.861	0.850
2005	0.984	0.856	0.844
2006	0.982	0.860	0.845
2007	0.977	0.879	0.859

Saint Kitts-Nevis: DEA Results

Year	te	ae	ce
1998	0.984	0.891	0.877
1999	0.998	0.866	0.864
2000	0.993	0.848	0.842
2001	0.999	0.948	0.947
2002	0.997	0.938	0.935
2003	0.993	0.934	0.927
2004	0.992	0.947	0.939
2005	0.993	0.834	0.829
2006	0.992	0.823	0.817
2007	0.986	0.839	0.828

The results from the SFA model basically corroborates the results that DEA model with exception that inefficiency scores are much less and the inefficiency for banks in Grenada is reduced. However banks in Antigua continued to perform extremely poor in terms of their cost efficiency with. Prima facie it appears competitions in variably cause's banks have high levels of inefficiencies which can have a debilitating impact on banking sector stability implying that there is negative correlation between competition and efficiency or rather a positive correlation between inefficiency and competition.

Table 4: Stochastic Frontier Results

Year	anu_sfa	gre_sfa	slu_sfa	skn_sfa
1999	83.01	84.46	97.90	93.72
2000	80.65	94.67	97.29	91.38
2001	80.77	96.61	76.69	93.30
2002	81.41	88.11	99.23	92.21
2003	82.45	96.41	85.21	93.66
2004	81.81	95.40	95.79	91.93
2005	82.27	87.04	97.83	89.00
2006	82.54	98.61	94.01	87.22
2007	81.86	92.67	92.99	91.55

The Link between Competition and Efficiency

Starting off with a simple correlation analysis between the level of competition and efficiency, a negative correlation was found between competition and efficiency for all countries with the exception of Saint Lucia. On the surface it appears that the result supports the *banking specificities hypothesis* for all the countries with the exception of Saint Lucia. However, correlation analysis in of itself does not tell us about causality. Which variable is causing which in fact it can be very well be that the causation is going one direction or it can be bi directional. Therefore we move on to the results from the Granger causality test.

Table 5: Correlation Matrix between Variables

	BE_DEA	BC_PR	BE_SFA	HHI	LI	LTA	Z-score
BE_DEA	1.00						
BC_PR	-0.24	1.00					
BE_SFA	-0.01	0.01	1.00				
HHI	0.33	-0.61	0.31	1.00			
LI	0.22	-0.20	0.65	0.73	1.00		
LTA	-0.07	0.27	-0.25	-0.17	-0.14	1.00	
Z-Score	0.29	-0.04	-0.02	0.12	0.25	0.39	1.00

The results of the GMM estimation of the dynamic equations represented in (8) and (9) are displayed in Table (). The Sargan test and the first- and second-order serial correlations in the differenced residuals are reported at the bottom of the table. A test for hetroscedasticty was employed using the Breush-Pagan and Cook-Weisberg statistic. The statistics favor a valid set of instrument variables and a significant negative first-order serial correlation and no evidence of second-order serial correlation in the differenced residuals.

The results using the P-R measure of competition shows a negative relationship between competition and efficiency, implying that as competition increases this reduces the cost efficiency of the banking system. When the model is using the Lerner index it was found that LI positively Granger-causes efficiency, hence, competition negatively Granger-causes efficiency but efficiency does not Granger-cause competition. Moreover, when the model is estimated using the HHI it was found that greater concentration in the banking system which implies less competition also shows that increase banks cost efficiency. Therefore the results are robust across which dependent variable is used as a measure of competition implying the competition affects competition affects efficiency in negative way. This result is consistent with the *'banking specificities'* hypothesis, according to which greater competition should reduce the cost efficiency of banks.

In summary, our findings endorse only a negative causality running from competition to efficiency in the ECCU banking sector during the period from 1998 to 2007, meaning that heightened competition can lead to an increase in monitoring costs through a reduction in the length of the customer relationship and due to the presence of economies of scale in the banking sector. Therefore, the results seem to support the fact the less competition favors greater cost efficiency in the banking system.

Further testing the relationship between bank competition and stability it was found that there was a negative correlation between the measures of competition, the Z-score implying that greater competition reduces the Z-score which could destabilize the banking system. The results give credence to competition fragility hypothesis.

The finding of a negative link between banking competition and banking efficiency suggests that policies favoring banking competition should take into consideration its possible effects on banking efficiency and therefore on financial stability. It is worth mentioning that our findings can be considered as a contribution to the literature regarding the trade-off between banking competition and financial stability (Allen and Gale, 2004). Namely, several papers have underlined the possible negative effects of banking competition on financial stability, notably through increased risk-taking by banks. We provide another channel of transmission for the negative effects of banking competition through hampered cost efficiency of banks.

The finding of a negative relationship between competition and efficiency in the ECCU banking industry is in accordance with most studies providing results on the link between competition and efficiency in banking (Berger, 1995; Goldberg and Rai, 1996; Weill, 2004). The uniqueness of the paper is that it provides three empirical measures of concentration which lends itself to more robust results on the link between competition and efficiency in banking in the framework. As a consequence, this result brings some robustness to the counterintuitive negative relationship between competition and efficiency in banking generally observed in empirical studies.

Conclusion

This research provides new evidence on the link between competition and efficiency in the banking sector of the ECCU. Our first results show an absence of increased competition in the ECCU banking market between 1998 and 2007. This may seem a surprising finding, as one may have expected that the massive entry of foreign investors into the ECCU banking industry would have contributed to enhancing the degree of banking competition. However, one has to keep in mind the imperfect competition observed in banking markets in developed economies.

Furthermore, we analyze the relationship and causality between our proposed measure of competition and estimated efficiency and provide evidence in favor of a negative causality running only from competition to efficiency in the ECCU banking sector. This finding may appear counterintuitive. It is, however, in accordance with the previous literature, which supports the existence of a negative link between competition and efficiency in banking. Furthermore, it can be explained by the fact that increased competition leads to greater monitoring costs for banks, owing to economies of scale and a reduction of the length of the customer relationship between the bank and the borrower. The finding of a negative link between banking competition and banking efficiency suggests that policies favoring banking competition should take into consideration its possible effects on banking efficiency and therefore on financial stability. Our work supports the literature regarding the trade-off between banking competition and financial stability (Allen and Gale, 2004; Carletti and Hartmann, 2002).

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