ECCB Staff Research Paper

Identification of Loan Supply Function and Credit Growth Determinants: Evidence from the Eastern Caribbean Currency Union (ECCU)

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Abstract: This paper aims to contribute to the established body of literature on the monetary transmission process by focusing on the transmission of shocks to small open economies with a fixed exchange rate regime. To this end, the paper analyses the role of commercial banks in the Eastern Caribbean Currency Union (ECCU) in the transmission of international monetary shocks, particularly from the United States. A version of the Bernanke-Blinder (1998) model is used as the theoretical organising framework, as it allows for testing the restriction of perfect substitutability between loans and bonds in banks portfolios and specifically facilitates empirically identifying the loan supply function. This is a critical condition in the model for determining whether the bank lending channel is a conduit for the transmission of such shocks. In addition, the impact of key bank characteristics such as size, capitalisation and liquidity, on the existence of the channel is considered. The paper also examines the main factors influencing supply of loans to the private sector by commercial banks. A dynamic panel autoregressive model, using system GMM, is estimated for the sample of thirty-eight (38) banks in the currency union covering the period 1990-2007. Preliminary results indicate that, at the ECCU level, there is an operative bank lending channel which, while not dependent on the inclusion of the banks specific characteristics, is significantly impacted by the capitalisation of banks. Results also suggest that past credit growth, deposit growth and profitability of banks have the largest impact on the extension of credit to the private sector.

Keywords: ECCU**;** Currency Union**;** **M**onetary transmission process; Dynamic panel; Bank lending channel
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1.0 INTRODUCTION

The Eastern Caribbean Currency Union (ECCU) is comprised of eight small middle income countries[1], who share a common currency (the Eastern Caribbean dollar, EC$) that is issued by a common central bank, the Eastern Caribbean Central Bank (ECCB)[2]. The EC dollar has been pegged to the U.S. dollar since 1976. Given this monetary arrangement it means that the ECCU monetary policy is adopted from the anchor country, the US, with interest rates virtually determined by exogenous forces. This raises the need for policy makers in the region to better understand, not only how monetary impulses are transmitted from the US, but also how they are transmitted across the ECCU and the channels that are most effective for the transmission process.

Theoretical discussions on the channels through which monetary policy affects real variables such as aggregate output have differed widely. Views range from the traditional interest rate, exchange rate and asset price channel to the modern 'credit view' channel. Theories that emphasise the important role of banks, as in the case of the credit view, are of particular interest to policy makers in the ECCU. This is because

[1] Six of the countries are independent and are members of the IMF. These are Antigua and Barbuda, Dominica, Grenada, St.kitts and Nevis, Saint Lucia, and St. Vincent and the Grenadines. The other two members, Anguilla and Montserrat are U.K. dependent territories.

[2] The ECCB replaced the Eastern Caribbean Currency Authority as the main regional monetary institution in 1983.

businesses and households are heavily dependent on banks' financing as commercial banks are the dominant players in the financial market. In addition, the market structure is quite similar across the ECCU, with the foreign owned banks accounting for the majority of shares of the assets and deposits in the system.

However, accurately determining the role banks play in the monetary transmission process have been far from conclusive, as the validity of the different econometric approaches used in empirical studies, continues to be debated.

Bernanke and Blinder (1988) and Bernanke and Gerlter (1995), the main proponents of the credit view, distinguished two channels through which monetary policy shocks are transmitted through an economy. These are the *balance sheet channel* and the *bank lending channel*. The balance sheet channel emphasises a link between a lending contract and the financial health of the borrowing firm. The hypothesis is that the external finance premium is inversely related to the borrowers' net worth. Since borrowers' financial position affects the external finance premium and thus the overall terms of credit they face, fluctuations in the quality of borrowers' balance sheet affect their current cash flow or the value of their pledged assets. Conversely, the bank lending channel holds that monetary policy works in part by affecting the supply of

credit. The essential insight is that because banks rely on demand deposits as an important source of funds, fluctuations in money affects reserves and retail deposits. In response, banks alter their balance sheet which affects the supply of loanable funds. To the extend that borrowers and banks do not view loans and other securities in their portfolio as perfect substitutes, then changes in monetary policy stance could affect the supply of loans and hence other real macroeconomic variables, such as investment and consumption spending in the economic.

Bernanke and Blinder (BB) proposed a model for analyzing the effectiveness of the bank lending channel. In order to highlight the importance of bank loans and the special role of banks in the monetary transmission process, they extended the conventional IS-LM model to include a loanable funds market. The IS-LM model represented the traditional “money view” of monetary transmission with its focus on how interest rate changes affect real activity and restore equilibrium.

One of the critical assumptions of the model is that loans and bonds are perfect substitutes. The BB model dropped this assumption and introduced a loanable funds market, which allowed for banks’ lending activities to play a role in the monetary transmission process. In this model the imperfect substitutability between bank loans and bonds,

based on incomplete markets and information asymmetries between lenders and borrowers, meant that loan supply shifts helped to propagate monetary impulses and amplified the interest rate effect. Therefore the following is an important condition which must hold for an operative bank lending channel to exist. The loan demand and supply functions must not be perfectly elastic with respect to the loan rate. If they are then the demand for (supply of) loans cannot be defined separately from the demand for (supply of) bonds.

Empirically testing the implications of the BB model have generated a lively debate and attracted a large amount of research. One of the major challenges which researchers faced in these empirical studies was how to identification of the loan supply function. That is distinguishing between changes in the observed quantity of loans caused by loan supply shifts as opposed to demand shifts.

There still remain considerable disagreements among researchers regarding the best method that could be used for resolving the inherent simultaneity problem involved in testing for the existence of lending channel. Some studies have used the indirect method of examining time series relationships between measures of credit volume or price and a monetary policy variable (Brissimis and Magginas, 2005). However, one of the deficiencies of this approach is that only short-run

responses are analysed. The estimation of reduced from equations using cross-sectional (bank level) data have also been used by researchers in an attempt to resolved some of the short comings of the time series approach. However, this approach has its problems too. The implicit assumption is that the presence of asymmetries means that loan supply shits could be identified.

One of the goals of this paper is to investigate the existence of loan supply function for the ECCU. As small open economies with a relatively open financial and capital accounts and fixed exchange regime, it is expected that developments in their monetary sphere will follow that of the US, the anchor country. This has implications for the specific testing procedure used.

In this paper we employed a direct approach, developed by Brissimis and Delis (2007), aimed at directly identifying the loan supply function in the ECCU. The approach develops a number of restrictions which allow for testing whether perfect substitutability exist between loans and bond rates in the banks' portfolio. A dynamic panel framework is applied to annual bank level data corresponding to the thirty eight (38) banks in the ECCU for the periods 1990-2007. One of the novel innovations of this study is that US bond rates is used in the specification of the loan supply function instead of local bond rates.

Therefore, the function can be seen as a measure of the international substitutability of the assets between the US and the ECCU. In the second part of the paper we also use the model to investigate the main factors influencing credit growth in the ECCU.

In the context of the ECCU the study is important to the development of a knowledge base about the link between the financial sector in the sub-region and its role in the transmission of monetary shocks. In addition, an enhanced understanding of the monetary transmission process will enable policymakers to better analyse the effects of US monetary policy on supply of credit and the banking sector as a whole. For example, if the credit channel is found to exist then it suggests that the authorities should pay closer attention to the asset side of banks' balance sheet and not only the liabilities side (Farinha and Marques, 2002). Furthermore, information about the significance and magnitude of the factors affecting credit growth should prove useful for policymakers charged with maintaining the stability of the financial system. This paper adds to this body of knowledge as it is the first empirical study that has attempted to identify the loan supply function and measure the magnitude of the effects of the determinants of credit growth in the ECCU.

To this end the rest of the paper is organised as follows: Section 2 provides a review of the literature on the bank lending channel. The theoretical model is outlined in section 3 while section 4 presents the econometric approach and data issues. Section 5 deals with the stylised facts on the structure of the financial system in the ECCU and implications for the existence of the credit channel. Meanwhile, section 6 discusses the findings of the empirical investigation while section 7 outlines the policy issues. Section 8 presents the concluding remarks.

2.0 LITERATURE REVIEW

The study seeks to answer two general questions. These are; 1) Does the bank lending channel exist in the ECCU? and 2) What are the main determinants of credit growth in the ECCU?

2.1 Identification of Bank Lending Channel

The first question is essentially concerned with testing for the existence of the bank lending channel. One strand of empirical studies[3] used time series (aggregated) data to test for the existence of the bank lending channel. They relied mainly on the vector autoregressive (VAR) modeling technique to examine the timing relationship, using impulse response functions, between quantity or price variables and monetary

[3] See papers by Jui-Chuang Chang, 2007 and Brissimis and Delis for an excellent summary of the different studies and the approaches used to investigate the existence of the bank ending.

policy variables (e.g. Bernanke and Blinder, 1992 and Kashyap and Stein, 1995). However, these time series approaches suffered from some short comings. Firstly, they focused on short-term responses of loan supply which might not really capture the true responses of banks to monetary shocks, given the fact that banks are slow to adjust their loan portfolios. Their commitment to loans payment schedule and other contractual agreements may prevent them from adjusting their loan portfolio quickly (Bernanke and Blinder, 1992). Secondly, they failed to isolate loan supply shifts from loan demand shifts for the observed changes in credit volume.

To overcome these difficulties researchers turned to using bank level data and indirectly tested for loan supply shifts through estimation of reduced form equations that examine the relationship between bank lending, a monetary policy variable and bank characteristics. Implicit in this approach is the assumption that when asymmetries are present loan supply shifts can be identified (Brissimis and Delis, 2007). Some other common features of these approaches were that they used theoretical models of individual bank behaviour from which the loan supply function was derived and included the problem of informational asymmetry between borrowers and lenders.

Kashyap and Stein (2000) use a twenty year (20) panel data set that included quarterly observations of various balance sheet items; such as cash, securities, total domestic loans, capital, fed funds rates, total deposits of all insured US commercial banks from 1976 to 1993. The study characterised banks based on liquidity and asset size to test for the evidence of a bank lending. Kishan and Opiela (2000), who also examined bank lending channel in the United States, extended the literature by specifying an additional bank characteristic- the capital leverage ratio along with asset size. The premise being that capital is important in assessing the impact of policy on loan growth and in determining the distributional effects of policy. The data used [4] included various types of loans, securities, demand deposits, large time deposits and capital obtained from the Report of Condition and Income (or Call Report) submitted to the Federal Reserves.

Following the approach suggested by Kishan and Opiela (2000), Y. Altunbas et al (2002), use a panel dataset of variables such as total loans, securities, total deposits, interbank borrowing and short- term interest rates for the period between 1991 and 1999 to estimate the response of bank lending in the European Monetary System to changes in monetary policy stance. In this study banks were classified according

[4] See papers by Jui-Chuang Chang, 2007 and Brissimis and Delis for an excellent summary of the different studies and the approaches used to investigate the existence of the bank lending.

to asset size and capital strength to see if these factors have significant effect on the lending channel.

One of the common findings of these studies was that the bank lending channel is operative mainly in economies characterised by high dependency on small banks, weak capitalisation and liquidity as well as underdeveloped capital markets. Other studies have found that small banks are more affected by changes in monetary policy. In contrast, countries in which the capital markets are deep, liquid and easily accessible have generally shown little evidence of bank lending channel. However, the use of this indirect approached, which employed reduced formed equations linking bank loans and some variable measuring monetary policy, has been strongly criticised. Brissimis and Delis argued that while they offered insights into the effect of differential bank characteristics they have two fundamental limitations.

Firstly, they did not allow for the identification of the structural factors that are relevant for the existence of the bank lending channel i.e. the interest elasticity of loan supply. There are two necessary conditions that must be fulfilled for lending channel to be operative or for identification of the loan supply function. These are: 1) banks cannot shield their loan portfolio from changes in monetary policy; and 2) borrowers must not be able to fully insulate their spending from changes

in the availability of bank credit. The first condition says that banks must be unable to or are unwilling to completely offset declines (increases) in deposits brought about by a contractionary (expansionary) monetary policy shock, by sourcing alternative funds. While banks may hold securities as a buffer against reduction in deposits these are not expected to fully offset the fall in deposits (Farinha and Marques, 2002). Hence, in response banks reduce the amount of credit they extend. The second condition implies that spending financed by banks loans will be reduce concomitantly with the reduction in bank loans.

The second problem with these studies is that they use simple panel data techniques such as ordinary least squares and instrumental variables. These methods are known to produce bias estimators when the underlying data generating process is non-stationary and has a dynamic structure.

This paper adopts the framework proposed by Brissimis and Delis (2007)[5] for the direct estimation of the loan supply function using bank level data. In combination with the use of dynamic autoregressive model (Arellano and Bond, 1998) and using system GMM estimators, it allows

[5] Their study used bank level data for 16 OECD countries for the years 1996 to 2003 to identify the loan supply function and assess the impact of differential bank characteristics on banks' ability to supply loans. The study amplified the Bernanke - Binder (1998) model of bank lending channel to include a number of bank characteristic variables namely capitalisation, liquidity and size. Bank balance sheet variables used include loans, deposits lending rates, capital, ratio of liquid assets, total assets among others.

us to address the simultaneity problem and assess whether differential bank characteristics are important for the existence of the loan supply function.

2.2 Development of Hypotheses for Determinants of Credit Growth

A large volume of empirical studies have considered the effects of different balance sheet constraints on the ability of banks to extend credit[6]. One of the central tenets of these models is that a bank capital structure matters for credit growth. In fact the Basle Accord attaches great importance to capital adequacy in the regulation of banks. Diamond and Rajan (2000) argued that this has implications for the ability of banks to extend credit since greater capital, not only reduces the probability of financial distress but it also reduces liquidity creation. The implication being that higher the capital adequacy the less credit bank may be able to extend.

Kishan and Opiela (2000) and Ehrmann (2001) studied the interaction between banks size, based on assets, their level of capital, monetary policy and their effect on credit growth. Banks were divided into three categories based on their capital leverage ratio. They regarded banks with a ratio below 8.0 percent as undercapitalised, those with a ratio between 8.0 per cent and 10.0 per cent as adequately capitalised and

[6] See work by Diamond and Rajan (2000 &2006), van den Heuvel (2001), Ruby Kishan and Timothy Opiela (2000) as well as Chiesa (2001).

those with ratio in excess of 10.0 per cent as well capitalised. Using assets measures to segregate banks into different sizes they provided evidence suggesting that small undercapitalised banks loan supply are more responsive to changes in monetary policy than larger well capitalised banks. This finding supports the hypothesis that loan supply shifts comes from the bank lending channel.

Another group of studies also considered how shocks to bank capital can be a key determinant of credit growth. These studies examined how borrowers' defaults result in balance sheet stress/tightening and hence reduction in credit supply, e.g. Diamond and Rajan (2006), Nier and Zicchino (2008). Other models, such as the one by Brunnermeier and Pedersen (2007), posited that the effects of loan losses on credit depend on the initial capital position of the bank. They argued that liquidity is rationed only if initial capital is sufficiently low given loan losses and this constrains banks ability to extend loans.

Studies have also shown that changes in monetary policy affect banks' lending[7]. Some models show that monetary policy tightening, by increasing the cost of financing leads to cut back in lending. This is due to the fact that banks are involved in transforming short term liabilities into long term assets which implies that their balance sheets are

[7] See work by Stein (1998) Chiesa (2001) van den Heuvel (2001) and Nier and Zicchino (2008)

exposed to interest rate risk. However, these effects might be more prevalent in market based financial system where banks rely heavily on market funding as opposed to those systems where deposit funding is more significant.

The different theories and models present a number of hypotheses which we would attempt to test in the case of the ECCU. These are as follows;

- H1) High levels of capital may lead to an initial reduction in credit growth.
- H2) Loan losses negatively affect the ability of banks to extend credit.
- H3) Shocks to capital in the form of defaults/loan losses amplify the effects on credit growth for those banks that are undercapitalised compared to those that are well capitalised.
- H4) the effect of loan losses is further amplified for banks that are undercapitalised relative to those that are well capitalised.
- H5) the spread between lending and domestic rates negatively affects credit growth.

- H6) Tightening of US monetary policy negatively affects credit growth in the ECCU while loosening has a positive effect.

3.0 THE THEORETICAL MODEL

In this section the theoretical framework for investigating the existence of the bank lending channel and analysing the factors influencing credit growth in the ECCU is outlined. As it relates to testing for the existence of the bank lending channel, the approach is similar to that proposed by Brissimis-Delis (2007). Using this model we developed the testable restrictions which are needed to uncover the existence of the lending channel and which underlie the econometric approach presented in the next section.

As noted earlier, one of the main problems associated with studies that used macro-economic data to investigate the existence of the bank lending channel, was that they failed to resolve the simultaneity problem. In addition, the earlier panel studies used simple panel data techniques which produced bias results given the non-stationarity and dynamic nature of the data generation processes. In an attempt to resolve the identification problem we used individual bank-level- data to examine the loan supply behaviour of banks in the ECCU.

The model is built in the spirit of the Bernanke-Blinder framework (or the BB model). As in the BB model a competitive loanable funds market is assumed. The aggregate loan demand and supply functions are specified as follows:

$$L_t^d = L(\underset{-}{\pi_t}, \underset{+}{i_t}, \underset{+}{y_t}) \quad (1)$$

$$L_t^s = L(\underset{+}{\pi_t}, \underset{-}{i_t}, \underset{+}{D_t}) \quad (2)$$

$$L^d = L^s \quad (3)$$

Where L, D, and y are real loans, deposits and output, π is the bank lending rate and *i* is the U.S. bond rates. The superscripts *d* and *s* refer to the loan demand and supply schedule respectively. Equation (1) is a loan demand function faced by household and firms across the ECCU. The quantity of loan demanded is a negative function of interest rates on loans, a positive function of U.S bond rates and output.

The supply of credit by banks is captured by equation (2). It is written as a positive function of deposits, which is a major source of funding for banks, and the lending rate. It is a negative function of the US bond rate which gives the price of the alternative source of funding for commercial banks. The loan rate varies across banks while each bank faces the same US bond rates.

The use of the US bond rates could be justified on the following grounds. The ECCU is currency union that is pegged to the US dollar. Given the open financial and capital accounts, it means that the ECCB has given up the right to practice independent monetary policy and instead imports the monetary policy dynamics of the anchor country. This suggests that over time we would expect rates in the ECCU's money and capital market to converge to those in the US. The US rates could therefore be treated as good proxies for the domestic rates. In addition, they also capture the extent to which the banks and firms portfolio selection decisions are influenced by developments in the anchor country. Furthermore, given the under developed nature of the regional capital markets, it is reasonable to assume that banks and barrowers looking to adjust their portfolios after a monetary shock or address any asset-liability mismatches will source these longer-term instruments in the US capital market. The inclusion of the loan and US bond rates in both equations is based on the assumption that both assets are imperfect substitutes in the portfolio of banks and as a source of external finance for firms.

Equation (3) is the equilibrium condition in the aggregate loans market. Once the market rate is set individual banks are price takers with

respect to the given market interest rate and face the following equilibrium loan supply function:

$$L_{it}^{s} = \sigma + \theta(\pi_t - i_t) + \varphi D_{it} \qquad (4)$$

This equilibrium market equation now includes the spread (π-i) between the loan rate and US bond rates. The critical assumption underlying the inclusion of the spread is that the investment decisions of banks are characterized by rates of return of homogeneity. That is, if the rates of return on all assets rise by the same amount, banks will not alter the structure of their balance sheet (Brissimis and Delis 2007).

The use of banks level data along with the specification of equation 4 provides a means by which the simultaneity problems associated with identifying shifts in banks' loan supply function from those in demand could be resolved.

The loan supply function is not defined, if loans and bonds are perfect substitutes in the portfolio of banks. This was one of the key assumptions underlying the traditional "money view" of the monetary transmission process. As a result bank credit was not seen as an important asset in the IS/LM model neither did it play a role in the transmission of monetary shocks.

The alternative view, which was developed by Bernanke-Blinder (1998)[8], focused on the incompleteness of financials markets, information asymmetry and agency cost, which caused loans and bonds to be imperfect substitutes. The "credit view" recognised the special role that bank credit plays in the transmission of monetary impulses through an economy. Identification of the loan supply function is therefore critical to the existence of bank lending channel. If households or businesses are dependent of bank loans, to the extent that they cannot easily switch to other sources of financing, then monetary policy changes could affect their spending through changes in loan supply. Another condition which must be satisfied for the bank lending channel to exist (S.N. Brissimis, N.S. Magginas, 2005) is that banks must not be able to substitute for loans in their portfolios in response to changes in monetary policy. According to equation 4 if banks view loans and bonds as perfect substitutes, $\theta \to \infty$, as loan and bond rates are equalized and the supply function, L_{it}^{s}, is not defined. Since, it is difficult to test directly whether, $\theta \to \infty$, equation 4 is rewritten in a form that allows for better testing of the hypothesis. Solving equation 4 for the spread $\pi - i$ we get;

$$\pi - i = -\sigma/\theta + (1/\theta)L_{it} - (\varphi/\theta)D_{it} \qquad (5)$$

[8] Gertler also made a significant contribution

This allows for the identification of the structural parameters of the loan supply function and facilitates the investigation of whether or not a bank lending channel exists. Evidence of a bank lending channel is provided if a test, of the joint significance of the right-hand variables, is rejected. That is a test of the null hypothesis that all the right hand side variables are zero must be rejected for supply function to be identified and by extension for the bank lending channel to exist. Rejection of the null implies that the loan supply is not perfectly elastic, with respect to the interest rate spread ($\pi - i$), or that loans and bonds are not perfect substitutes in the portfolio of banks.

Assuming that loan demand is homogeneous across banks we could expect changes in monetary policy to be impact the ability of banks to extend loans based on there specific circumstances. The differences in responses by banks given a monetary shock will help to further identify the loan supply shifts. Size, capitalization and liquidity are three of the fundamental bank specific characteristics that are used to investigate the differential responses of banks. They are all expected to have a negative effect on the supply of loans. Banks that are not well capitalized and illiquid will not be able to continue to extend credit in light of a negative monetary shock. Likewise, smaller banks find it more difficult to raise capital which could severely restrict their ability to lend in light of a negative economic shock. In the context of the ECCU the

distinction between foreign branch and domestic banks are also important. The foreign branch banks are able to access lines of credit from their head offices and so may be better able to buffer the effects of monetary policy shocks on their loan portfolios. The effects of the bank characteristics are captured in the theoretical framework through the deposits coefficient, φ, which is written as;

$$\varphi = \varphi_0 + \varphi_1 X_{it} \qquad (6)$$

where X_{it} is the vector of bank specific characteristics. If we substitute equation 6 into 5 we get another testable equation that allows us to investigate the importance of the bank lending channel. This equation is written as;

$$\pi - i = -\sigma/\theta + (1/\theta)L_{it} - (\varphi_0/\theta)D_{it} - (\varphi_1/\theta)D_{it}X_{it} \qquad (7)$$

A joint test of the significant of the right-hand side variables is a test for the existence of the bank lending channel as stated earlier in the section. In addition, the magnitude of the coefficients capturing the effects of the bank characteristics should tell us how potent the lending channel is if it exist. For example, if the banks' characteristics effects are not that significant, the shift parameter φ_1 would be small and the lending channel will be more important. Therefore testing for the existence of bank lending channel in the ECCU will be formally done using equation 5 and 7.

4.0 THE ECONOMETRIC APPROACH AND DATA ISSUES

4.1 Identification of the Loan Supply Function

To test for the existence of a loan supply function which is essential for an operative bank lending channel the paper uses a dynamic autoregressive model, based on the technique developed by Blundell and Bond (1998) and Arellano (2003). Brissimis and Delis considered an empirical reformulation of equation (6) in the following form;

$$Y_t = \alpha_0 + \alpha_1 L_{it} + \alpha_2 D_{it} + \alpha_3 D_{it} X_{it} + \eta_t + \varepsilon_{it} \quad (7)$$

$$\varepsilon_{it} = \mu_i + \mu_{it} + \nu_{it}$$
$$\mu_{it} = \tau \mu_{i,t-1} + \delta_{it} \quad |\tau| \quad 1$$
$$\delta_{it}, \nu_{it} \rightarrow MA(0)$$

Where Y_t is the spread between the lending and US bond rate at time *t* and η_t is a year-specific intercept reflecting shocks that are common to all banks (Brissimis and Delis, 2007). The error term μ_i is the unobservable bank specific shock, μ_{it} is an autoregressive shock and ν_{it} is a serially uncorrelated error component.

This approach is appropriate since it addresses the robustness issue associated with estimating these types of equations, due mainly to the non-stationarity of the variables, and existence of co-integrating

relationships. Brimissis and Delis argued that in model 7 above, loans and deposits are likely to be correlated with μ_i, δ_{it} and v_{it}, in which case, according to Bond (2002) there are no valid moment conditions if the disturbances μ_{it} are autoregressive.

The use of the dynamic autoregressive model advocated by Arellano-Bond (1991) and Arellano-Bover/Blundell-Bond (1995, 1998)[9], along with the system GMM estimators help to overcome these problems. The estimated model is specified as;

$$Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \alpha_2 L_{it} + \alpha_3 L_{i,t-1} + \alpha_4 D_{it} + \alpha_5 D_{i,t-1} + \alpha_6 D_{it} X_{it} + \alpha_7 D_{i,t-1} X_{i,t-1} + \eta_t + \varepsilon_{it} \quad (8)$$

where one period lags are used to capture the system dynamics. The one step and two step estimators[10] used are derived by using moment conditions in which the lagged differences are used as instruments in the level equation along with the moment conditions of lagged levels as instruments in the difference equation (Blundell and Bond, 1998). The

[9] Some of the key assumptions underlying these models are 1) few time periods and many cross sections; 2) a linear functional relationship; 3) a single left-hand side variable that is dynamic; 4) independent variables that are not strictly exogenous, meaning correlated with past and possibly current realization of the errors; 5) fixed individual effects; and 6) heteroskedasticity and auto correlation within individuals but not across them (David Roodman, 2006).

[10] The xtabond2 command, developed by David Roodman (2006), implements these estimators in Stata. The following are some of the main features; improved efficiency by making the Windmeijer (2005) finite-sample correction to the two-step standard errors; allows for better control over the instrumental variables; support for observational weights and forward orthogonal deviations transform as well as automatic difference in-Sargan/Hansen testing.

lagged levels and lagged first-differences instrument are chosen so as to ensure the over-identifying restriction are valid. This requires transforming the regressors using orthogonal deviations. That is instead of expunging the fixed effect by differencing, it transforms the differences to make them exogenous to the fixed effects. The approach involves instrumenting levels with differences as opposed to instrumenting the difference equation with levels. It is much more efficient when dealing with a panel that has gaps (David Roodman, pp 29-34, 2006).

The maximum number of instruments that can used in this case are $Y_{t-2},\ldots,Y_{1}$, ΔY_{t-1}; $L_{i,t-2},..,L_{i1},\Delta L_{i,t-1}$; $D_{i,t-2},\ldots,D_{i,1},\Delta D_{i,t-1}$ and when bank characteristics are included, $D_{i,t-2}X_{i,t-2},\ldots, D_{i,1}X_{i1},\Delta D_{i.t-1}\Delta X_{i,t-1}$ too. The two step estimator is the preferred to the one step since it more efficient. However, one weakness is that the variance/covariance estimator (vce) tends to be serious bias. The paper uses the bias-corrected robust estimator for two-steps VCEs derived by Windmeijer (2005). In addition, test of over-identifying restrictions is done using the Hansen test [11]which is robust to heteroscedasticity and autocorrelation in the error term.

[11] Hansen's J statistic; under the assumption of conditional homoskedasticity, Sargan's statistic becomes Hansen's J statistic (Hayaashi 2000. p. 227-228).

Individual bank level data from thirty-eight banks in the Eastern Caribbean Currency Union (ECCU) covering the period 1990-2007 are used in the panel study. Bank size is measured as the logarithm of total assets, liquidity by the liquid assets to total deposits plus liquid liabilities ratio, and capitalization by the ratio of total capital to total assets.

The spread is calculated as the difference between the ECCU lending rate and the US 10 year bond rate. The bank characteristic variables are further transformed as follows;: the size variable is defined as the deviations from their cross-sectional mean at each time period so as to remove the trend; liquidity and capitalization are defined as deviations from the overall mean since they do not exhibits any trend. Table 1 (appendix A) shows some summary statistics of the variables used in the study.

The significance of the model and results are conditioned on three key diagnostic tests. Firstly, when the errors are independently and identically distributed (i.i.d.), the first difference errors are expected to be first order serially correlated[12]. However, serially correlation in the first differenced errors at higher order normally indicates that moment conditions used in the estimations are not valid or that the lags of the dependent variable are bad instruments. Hence, the test for second

[12] By construction $\Delta v_{it} = v_{it} - v_{i,t-1}$ should be correlated with the first difference error, $\Delta v_{i,t-1} = v_{i,t-1} - v_{i,t-2}$, since they have the same first lag error term.

order autocorrelation in the first difference errors should fail to reject the null hypothesis of no serial correlation.

The next test is probably the most critical of the three. That is the test for the validity of the instruments used. The paper uses the Hansen test, as oppose to the Sargan test, to verify the validity of the identifying restrictions. The former has been found (Arellano and Bond, 1991) not to be robust to heteroscedasticity in the data generating process, hence it tends to over reject in the case of the one-step estimator and under reject in the case of the two-step estimator. The Hansen test implemented is robust to heteroscedasticity in the errors. To this end the Hansen test should accept the validity of the lagged levels and lagged first differences as instruments. Rejection of the null hypothesis, that the excluded instruments are valid, suggests that they are correlated with the error term and therefore are not good instruments. This raises the issue of model misspecification.

The final diagnostic which is critical in the context of this study, relates to the test for the existence of the bank lending channel. This amounts to testing whether or not he loan supply function is defined. A Wald test, of the joint significance[13] of all the right hand side variables, excluding the constant, is conducted for this purpose. A rejection of the null hypothesis that the right hand side variables are all equal to zero implies

[13] That is all the coefficients are zero.

an operative banking channel which indicates that there is imperfect substitutability between loans and bonds in bank portfolios i.e. $\pi \neq i$.

4.2 Determinants of Credit Growth in the ECCU

The dynamic panel framework laid out above is also used to examine the factors which drive credit growth in the ECCU over period 1990-2007, with special emphasis on the role of capital.

The modeling strategy involves estimating a benchmark equation and then using it to test the specific hypothesis highlighted in previous section. The benchmark equation is specified as follows;

$$Y_{it} = \alpha_0 + \alpha_1 Y_{i,t-1} + \psi_1 Cap_{it} + \psi_2 Cap_{i,t-1} + \beta_1 X_{it} + \beta_2 X_{i,t-1} + \gamma Z_{i,t-1} + \gamma Z_{i,t-1} + \eta_t + \varepsilon_{it} \quad (9)$$

The dependent variable, Y_{it}, is credit growth, measured as the growth rate in log of loans extended to the private sector by bank i at time t. The left hand side variables are group as follows;

Balance Sheet Variables: These are represented by the vector X which includes; log growth of deposits; a profitability measure- defined as the ratio of net profit before taxes to average earning assets; a capitalisation measure- defined as the ratio of total capital to total assets; and a measure of loan losses- defined as the ratio of provision for loans losses to total loans advances and bills discounted.

Macroeconomic/exogenous variables: These are represented by the *Z* vector. They include log nominal GDP growth across countries in the ECCU, period specific dummies (2001-2003) and log US GDP growth which is used to capture economic conditions in the anchor country.

The other left-hand side variables and η_t which is a year-specific intercept reflecting shocks that are common to all banks while ε is the error term. The balance sheet variables are lagged one period in order to mitigate against any simultaneity problems between them and the dependent variable. The hypotheses concerning cost of borrowing and effects of US monetary policy are investigated by including them in this baseline regression and then reestimate the model.

5.0 ECCU FINANCIAL STRUCTURE: SOME STYLIZED FACTS

This section provides a short description of the structure of the banking system and implication for the bank lending channel. The financial system of the ECCU has undergone a number changes over the past decade and has grown in terms of the scope and depth of activities. These changes have been driven mainly by advances in information technology, introduction of new products and the development of a money and capital market. However, notwithstanding these changes the pace of expansion in the role played by market-based financing has

been very slow and the financial system still remains dominated by banks. It is therefore unlikely that these changes would have fundamentally changed the way monetary impulses are transmitted through the economies. Given the heavy dependence of the economies on bank financing and banks' dependence on deposit funding, the potential for transmission of monetary impulses through the banks' balance sheet and or supply of credit is very strong.

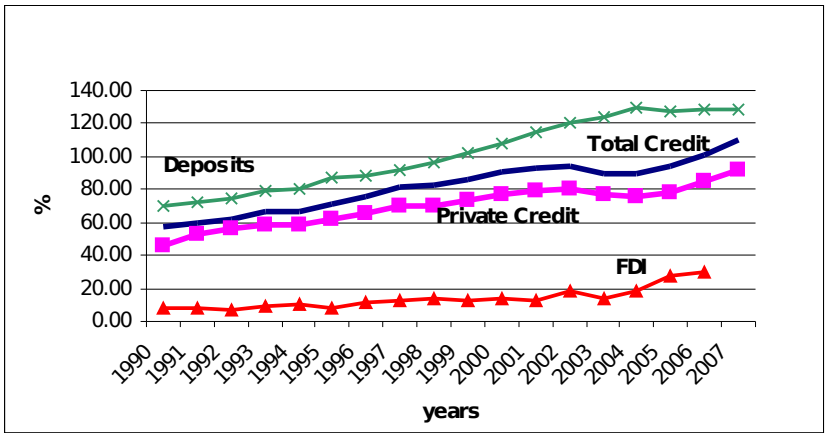
The analysis concentrates on commercial banks as credit providers, giving credence to the hypothesis that the credit channel is a vital conduit for the transmission of monetary policy impulses through the economy. The following are some of the more pertinent stylized facts:

- **An Expanding and Sound Banking Sector**

As figure 1 shows over the period 1990 to 2007 domestic credit, credit to the private sector and deposits, as a share of GDP, have been on an upward trend. The growth in credit and deposits in the system has been fuelled mainly by strong FDI flows to the region which has led to balance of payment surpluses. This has been accompanied by many positive developments, including continued economic expansion and a banking system that remains well capitalized and profitable.

According to figure 2, over the period of analysis actual growth in real credit varied significantly, while trend growth remained flat for most of the period before starting to trend upwards from around 2004.

Figure 1: Selected Variables as percentage of GDP



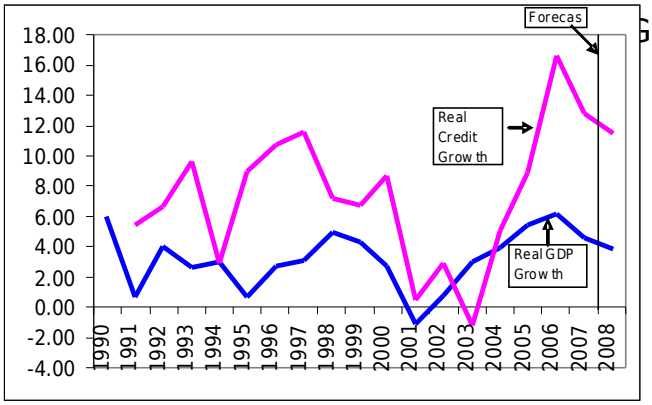
Source: Author's own calculation

In fact four distinct periods could be recognised in actual credit growth. The period 2001-2005 had the lowest average growth and the most volatility (table 7 appendix A).

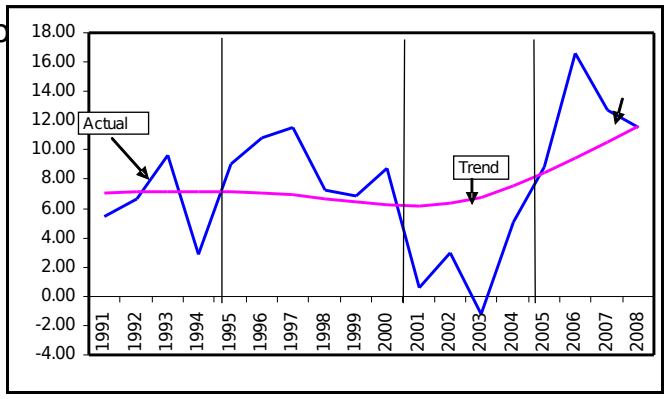
On a year on year basis, real credit growth has outpaced that of real GDP over most the review period except in 2003 when it fell below and grew at a negative rate. After rebounding in 2004 it continued to grow at a faster paced than real GDP, reaching a peak of 16.2 per cent in 2006.

Figure 2: Trends in Credit Growth 1990-2007

Real Credit Growth vs. Real GDP Growth



Trend Growth vs.



- **Commercial banks, most of which are foreign owned, are the main players in the ECCU financial system.**

It decelerated by 4.3 percentage points by the end of in 2007 to 12.6 per cent. This was in line with the deceleration in real GDP growth as there is a strong positive correlation between economic growth and credit demand and supply.

The financial system in the ECCU comprises a plethora of institutions including commercial banks, credit unions, insurance companies, mortgage companies and building societies. A survey of the financial sector in the region, conducted in January 2007, found in excess of 400 onshore institutions.[14] Financial intermediation is primarily undertaken by the 38 commercial banks, which hold approximately two-thirds of total assets in the system. Consequently the financial environment in the ECCU may be characterised as bank-centric. Foreign Branch banks dominate the system. The twenty four (24) branches of foreign-owned international banking groups have more than half of the loan market relative to the locally incorporated banks. The parent companies of these branches, based in Barbados, Canada and Trinidad and Tobago, satisfy most of the funding needs. Of the fourteen (14) locally-incorporated banks, four are fully or largely owned by the resident government.

[14] Offshore institutions numbered over 60,000.

- **Deposits are the major source of commercial banks funding strategy**

Banks depend to great extent on the deposits as a major source of funding. Notwithstanding the dominance of the foreign banks and the access they have to funds from their head office, deposits still accounted on average for about 75.0 per cent of banks' liabilities over the 2000-2007 period (table 9 appendix B). Core deposits, mainly demand and savings, which is generally interest inelastic and which help to insulate banks' funding from economic shocks accounted for approximately 39.0 per cent over the same period. Meanwhile, foreign liabilities which include the banks borrowing outside of the ECCU, only accounted for about 5.0 per cent of total liabilities over the same period. However, it must be noted that the data showed a slight shifting away from deposit funding to borrowing form outside of the ECCU.

- **A large proportion of firms and households rely heavily or exclusively on bank financing**

Bank credit is the main form of funding for the private sector. Lending by the non-bank financial institutions is generally small and often restricted to their members. Foreign direct investment flows have financed large projects in the tourism industry.

- **There are not many alternative sources of investment capital**

With the advent of institutions like the Eastern Caribbean Securities Exchange (ECSE) in 2001 and the Regional Governments Securities Market (RGSM) in 2002, more options have become available to large corporations and governments for acquiring equity and debt capital from a wider pool of regional resources. However capital market development is still in its early stages. Not many companies are listed on the exchange and market capitalisation is low. Furthermore these additional options are not accessible to the majority of households and businesses that remain dependent on the commercial banking system for their financing needs.

6.0 RESULTS

The results pertaining to the two general research questions which the paper seeks to answer are presented in this section.

6.1 Identification of the Loan Supply Function

The estimation results for the ECCU are shown in Tables 1. Column (1) gives the results for the baseline regression involving equation 5- the inverted loan supply function equation. Meanwhile, column's (2) (3) and (4) present the results for the regression involving the banks specific characteristics of size, liquidity and capital respectively. **The evidence suggests that at the ECCU level there is an operative and strong**

bank lending channel. The results also hold for the two major banking groups considered by the study, foreign and domestic, and are not contingent on the inclusion of the bank specific characteristics. Therefore, the banks in the ECCU appear to play a significant role in the transmission of international monetary shocks to the region.

The relevant Wald test for the baseline regression strongly rejects the hypothesis of right hand side coefficients being zero for the estimation of equation 5. In addition, the test also rejects the null hypothesis when the bank characteristics variables are included. However, the results suggest that the level of capital is an important bank characteristic that affects the operation the channel. We also examine whether the lending channel is operative across the two major banking groups.

Table 1: Identification of Supply Function ECCU Level

Dependent Variable Spread (π-*i*)	(1)	Banks' Characteristics	
		(2)	(3)
		(4)	

Spreads (-1)	0.45***	0.42***	0.42***	0.43***
Loans	(0.00)	(0.00)	(0.00)	(0.00)
Loans (-1).	-0.73*	-1.16**	-0.88*	-1.13**
Deposits	(0.09)	(0.02)	(0.06)	(0.04)
Deposits (-1)	0.67	1.24**	0.82*	1.16*
Bank Size	(0.14)	(0.02)	(0.10)	(0.04)
Liquidity	0.78***	0.07	0.21	0.55
Capital	(0.05)	(0.92)	(0.67)	(0.18)
Capital (-1)	0.84***	-0.38	- 0.33	-0.76**
Time specific Dummies(2001-2003)	(0.006)	(0.58)	(0.51)	(0.03)
Time Trend		0.06		
	Yes	(0.35)		
	Yes		0.00	
			(0.21)	
				-0.003**
				(0.05)
				0.003*
				(0.08)
		Yes	Yes	Yes
		Yes	Yes	Yes
		Yes		
Arellano-Bond test for AR(1)[a/]	0.00	0.00	0.00	0.00
Arellano-Bond test for AR(2)[a/]	0.60	0.00		
Hansen test[a/]	0.287	0.598	0.596	0.567
Wald test[a/]	0.00	0.784	0.737	0.466
Number of instruments	19	0.00	0.00	0.00
Number of obs	555	15	15	15
Number of groups	38	553	546	553
		38	38	38

Notes:

1. ( ) and a/ give the P-values.

2. ***, **, * denotes coefficient significantly different from zero at the 1%,5% and 10% respectively.

The evidence confirms the existence of lending channel for both foreign and domestic banks. As can be seen from table 10 (appendix B) the Wald test strongly rejects the hypothesis that right hand side variables are zero in the inverted equation 5 for both group.

The size of the magnitudes on the variable for the foreign banks relative to those for the domestically incorporated banks indicate that they are much more effective in the transmission of monetary policy impulses across the ECCU. This is expected given their dominance in the sector and their close relationship with their head offices which they depend on for funding of their activities.

Overall the results are consistent with the stylised facts presented earlier on the ECCU financial system which creates the environment for an operative lending channel. As noted in a previous section the financial system is still heavily dominated by banks, despite attempts to develop the money and capital markets. In sum the financial system can be generally characterized by: 1) existence of relatively small banks, which are highly dependent on deposit funding; 2) dominance of foreign branch banks whose activities are highly controlled by their head offices 3) limited availability of other non- bank sources of financing for businesses and households. These features of

the ECCU financial system make the banks more sensitive to the impact of international monetary policy changes, especially in the US.

The results also suggest that, despite the openness of the economies and the highly liberalized nature of the financial system, the region is still not fully integrated into the global financial system. According to tables 8 & 9 (appendix A) foreign assets on averaged, accounted for approximately 16.05 per cent of total assets, while foreign liabilities accounted for only 5.68 per cent of the banks' total liabilities over the period 2000-2007. In contrast, loans and deposits accounted for about 59.2 per cent and 75.0 their total assets and liabilities respectively.

The findings are also consistent with other empirical studies that have found an operative bank lending channel in countries with a similar financial structure as that of the ECCU. Brissimis and Delis (2007) in their study of sixteen (16) countries found that the channel was only operative in Japan and Greece. Like the ECCU, the majority of financial assets in Japan are accounted for by banks while in Greece their financial system is characterised by small banks and a high dependence on bank financing by businesses and households. In contrast, in countries with financial systems that were more representative of the Anglo-Saxon type, the lending channel was found to be either non-existent or very weak at best. These financial systems tend to be more

market-based and characterised by low concentration, availability of non-bank sources of finance to firms, highly liberalised and globalised as well as high levels of transparency, information symmetry and efficiency[15].

Banks in the ECCU on average have accounted for approximately 85.0[16] per cent of total assets in financial system over the sample period. Furthermore, the banks' portfolio structure is overwhelming skewed towards loans relative to other investment instruments such as bonds. Loans and advances averaged just about 60.0 per cent over five year period 2000-2007 compared to 4.0 per cent for investment in bonds and government securities. Over the sample period the banks portfolio has remained relatively inflexible reflecting the imperfect asset substitutability of loans and bonds. It must also be noted that the region has not suffered any major financial crisis and given the relatively high returns received from investment in the real estate markets, there is no incentive for them to realign their portfolios.

In summary the following key points are worth noting***: The higher the level of liberalization and integration of a country's financial system into the world financial and capital markets the less***

[15] The US and UK financial systems are representative of the Anlgo-Saxon type. A number of studies (e.g Kishan and Opiela have found the the bank lending channel to be non-operative in the US.

[16] See IMF report entitled "Monetary Policy Implementation at Different Stages of Market Development – Country Cases and Appendices- Supplementary Information". (October 2004)

potent the bank lending channel will be. In cases where banks and firms have relatively easy access to more market based means of financing, it lessen the dependence of firms on bank financing and banks on deposits funding. This weakens and in most cases renders the bank lending channel nonexistence.

6.2 Determinants of Credit Growth in the ECCU: Impact of capital and loan losses

This section considers the results from the first four hypotheses (H1-H4). Table 2 (column 1-4) presents the results.

The results suggest (column 1) that after controlling for overall economic activity banks with higher capital ratios had a contemporaneously negative impact on credit growth. However, after two years this effect turned into a positive one as banks extended more credit.

Table 2: Determinants of Credit Growth in the ECCU

Dependent Variable: Private Sector Credit Growth				
Independent Variables	(1)	(2)	(3)	(4)

Credit Growth (-1)	0.179*** (0.066)	0.175* (0.08)	0.183*** (0.05)	0.182** (0.04)
Profitability	0.184*** (0.00)	0.172*** (0.01)	0.172*** (0.00)	0.169*** (0.01)
Profitability (-1).	-0.138* (0.01)	-0.115** (0.04)	-0.134**8 (0.01)	-0.116** (0.03)
Capital leverage	-0.038* (0.07)	-0.042 (0.129)		0.058*** (0.00)
Capital leverage (-1)	0.042** (0.03)	0.058*** (0.003)	-0.048** (0.04)	
Loan Loss Provisions	-0.033* (0.06)	-0.044** (0.04)	0.056*** (0.00)	0.085** (0.04)
Nominal GDP	0.077* (0.06)	0.077* (0.07)	-0.027 (0.21)	0.261*** (.0.00)
Deposits Growth	0.263** (0.00)	0.264*** (0.00)	0.079* (0.08)	
Loan loss Prov* Capital leverage(-1)		**0.081*** (0.06)	0.25*** (0.00)	**-0.076*** (0.08)
Loan Loss Prov*Undercapitalised			**-0.049*** (0.09)	
Loan Loss Prov*Overcapitalised	Yes Yes			
Time specific Dummies(2001-2003) Time Trend		Yes Yes		
Arellano-Bond test for AR(1)[a/] Arellano-Bond test for AR(2)[a/] Hansen test[a/]	0.00 0.207 0.236	0.00 0.160 0.10	0.00 0.158 0.215	0.00 0.120 0.141
Number of instruments Number of obs Number of groups	22 611 38	23 611 38	26 608 38	24 609 38

Notes:

1. ( ) and a/ give the P-values.

2. ***, **, * denotes coefficient significantly different from zero the 1%, 5% and 10% respectively.

The magnitude of the effect is significant in economic terms. A 10.0 percentage point increase in the capital ratio reduces loan growth by

0.38 per cent in the first year and increases it by 0.42 per cent by the second year.

It should be noted that growth in private sector credit averaged approximately 10.0 per
cent over the review period. These results from the baseline regression are consistent with some of the theories on role of bank capital structure and the impact on banks ability to extend credit.

For example Diamond and Rajan (2000) postulated that while the accumulation of capital reduces the probability of financial stress and creates the capacity to extend future loans, initially it may affect the ability the banks to generate liquidity.

To test the second hypothesis (H2) about the effects of shocks to capital, through loan defaults, on credit growth an interaction term between the loan loss provision variable and capital is added to the specification in column (2). **The positive lagged effect indicates that banks with high capital ratio are better able to cushion the impact of loan losses on their ability to extend credit relative to banks that are not well capitalised**. In terms of the economic significance, we note that the mean value of the loan loss provision ratio in the sample is 3.03, so at the mean loan loss provision, the effect of lagged capital on

credit growth is 0.303 *(=0.058+0.081(3.03))*. Since capital is measured as a percentage it means that a 10 percentage point increase in the ratio increases credit growth by 3.03 standard deviations from the mean credit growth. Nier and Zicchino[17], 2008 also found a similar positive coefficient for the interaction term in their panel study.

The study also found evidence in support of hypothesis H3 but not H4. The negative contemporaneous effect of loan losses (column 1) suggests that losses lead to balance sheet stress which forces banks on average to reduce credit. In economic terms, a 10 percentage point increase in the ratio results in to a 0.38 percentage point reduction in credit growth.

Results concerning for H4 are some what contradictionary. These are presented in columns 3 and 4 and relate to the interaction terms between the bank's loan loss provisions and the dummy for those banks that under-capitalised and well-capitalised. It should be noted that the interaction term for undercapitalised banks have the correct sign and is significant while for well-capitalised banks the coefficient sign is wrong but significant. This contradicts hypothesis H4 since it suggest that well loans losses impact well-capitalised banks worst than those that are under-capitalised.

[17] They used a cross-country dataset of 600 banks from 32 countries to impact of loan losses on credit growth.

In terms of the other controls the study founded that at the ECCU level, past credit growth, profitability, deposit and GDP growth all had a contemporaneous positive relationship with credit growth. As regards the magnitude of the effect, past credit growth, profitability and deposit growth have the largest impact on credit extended to the private sector.

According to the results deposit growth has the largest impact on the credit growth in the ECCU. In fact a 10.0 per cent fall in deposits growth will result in a 2.63 percent reduction in loan growth. This is rather large magnitude since the average increase in deposit growth is almost 1.0 per cent as indicated in table 2 (appendix A). In fact 85.35 per cent of the observations in the sample fell in the range of growth between 0 and 5 per cent while 13.60 per cent were between the range of 0 to -5.0 per cent.

The profitability of the banks is the next major factor influencing credit growth. The positive contemporaneous relationship with credit growth suggests that the more profitable banks tend to extend more credit. In economic terms, a 10 per cent increase in a bank's return on average assets leads to a 1.84 percentage point increase in credit growth. Likewise, growth in GDP has a positive effect on credit growth. However the economic effect is relatively small as indicated by the small

magnitude of the coefficient. This maybe due to the fact that in this case the GDP variable captures the demand side effects on the loanable funds market, as oppose to the supply side effects, given that we have already controlled for deposits growth.

6.3 Determinants of Credit Growth in the ECCU: Foreign Vs Domestic

There were some differences in the results are it relates to the two banking groups when compared to the ECCU results and in terms of the significance of the factors affecting both groups. As shown in table 11 (appendix B), in the case of the foreign banks both the capital and loan loss provisions were found not to be significant factors affecting of credit growth for this group of banks.

On the other hand according to the results in table 12 (appendix B) only GDP growth did not have a significant impact on credit growth for the domestic banks. Also in contrast to the findings for the foreign banks, the level of capital had a positive contemporaneous effect on credit growth while provisions for loan losses had the expected negative impact. Meanwhile, deposit growth and profitability had the highest positive economic impact.

The subtle differences highlighted in the results above, between the results the two banking groups, maybe indicative of specific operational

arrangements which dictate how they function. For example the foreign banks are less constrained by deposit funding since they could access funds relatively easy from their head offices to meet any short fall in funding needs. This may explain the larger value on the deposit growth variable for domestic banks (0.45 per cent) relative to that for foreign banks (0.21 per cent) and the insignificance of capital in the benchmark regression for the latter.

In summary, the evidence suggests that at the ECCU level, banks' profitability, past growth in loans, growth in nominal GDP and deposits all have a positive contemporaneous effect on credit growth. However, it takes at least two years for increases in capital to have a positive affect. In terms of the magnitude of the economic impact, deposit growth, profitability and past credit growth have the largest effects. Meanwhile, for any given level of economic activity an increase in losses on loans results in banks reducing credit. The study also found that domestic banks are more dependent on deposit funding to meet their credit demand and are more constrained in their lending activities by their level of capital and loan losses when compared to their foreign incorporated counterparts.

6.4 The Effects of Domestic Spreads and International Borrowing Cost

Hypothesis five (H5) attempts to answer the question, how does the domestic spread affect credit growth? According to the results presented in table 3 below, the spread has a negative impact on credit growth. In terms of the economic magnitude of this effect, the baseline regression (column 1), suggests that a 10.0 percentage point increase in the spread leads to a 1.7 percentage point reduction in credit growth after controlling for a number general economic conditions an some other balance sheet effects.

As noted earlier, theory postulates a positive relationship between spreads and actual capital ratio. Therefore we examined whether the effects of spreads on growth is amplified give the level of capitalization by banks. An interaction term between of both variables is used to study this effect. The results in column 2 and 3 show that the effect of spreads on credit growth is not amplified given initial level of capital. In fact the effect of the interest rate spread by itself is larger than that on the interaction term.

Table 3: Effects of Banks' Spreads

Independent Variables	(1)	(2)	(3)

Credit Growth (-1)	0.132 (0.17)	0.129 (0.20)	0.130 (0.20)
Profitability	0.163*** (0.01)	0.165*** (0.01)	0.177*** (0.01)
Profitability (-1).	-0.115*** (0.04)	-0.115*** (0.05)	-0.110* (0.06)
Capital leverage			0.189* (0.06)
Capital leverage (-1)			-0.176* (0.07)
Loan Loss Provisions			
Loan los Provision(-1)			
Nominal GDP Growth		0.149** (0.03)	0.146** (0.05)
Deposits Growth	0.144** (0.04)		0.26*** (0.00)
Spreads	0.266*** (0.00)	0.266*** (0.00)	
Spreads(-1)		-0.169* (0.08)	
Spreads*Loan loss Prov(-1)	**-0.169**** (0.03)		
Spreads*Capital Leverage			-0.023** (0.05)
Spreads*Capital leverage(-1)		**-0.001** **(0.885)**	0.021** (0.04)
Time specific Dummies(2001-2003)			
Time Trend			
Arellano-Bond test for AR(1)[a/]	0.00 0.175	0.00 0.158	0.00 0.186
Arellano-Bond test for AR(2)[a/]	0.233	0.239	0.161
Hansen test[a/]	26 551	28 551	26 551
Number of instruments	38	38	38
Number of obs			
Number of groups			

Notes:

1. ( ) and a/ give the P-values.

2. ***, **, * denotes coefficient significantly different from zero the 1%,5% and 10% respectively.

It is possible that above a certain threshold the effect becomes significant. For example maybe the effect is important for banks holding capital in excess of the regulatory minimum amount. We examine this possibility creating a dummy to capture those banks that are holding capital in excess of 10.0 per cent and then interact it with the spread variable. No evidence was found to support the hypothesis that spreads have an amplified effect on credit growth when banks' capital adequacy ratio is in excess of 10.0percent.

6.5 The Effects of US Monetary Policy

Given the EC quasi-currency arrangement and the fixed exchange rate regime it is expected that changes in US monetary policy stance, overtime, should have an influence on general economic and financial conditions in the currency union. The effects of US monetary policy is investigated by employing the use of two dummy variables. One of the dummies captures the tightening of US monetary policy stance, as indicated by increases in Fed funds rate over the year, while the other dummy captures loosening of the policy stance. This approached was chosen because of the concern that in a cross-country context, both the level and changes in the interest rate could have significantly different magnitudinal effects (Nier and Zicchino, 2008).

According to the results presented in tables 4 below, changes in US monetary policy stance have a significant negative impact on credit growth in the ECCU. Moreover, the effects for both policy stances are of similar magnitude. For example a 100 basis points reduction in the rates over the course of the year will lead to a 0.2 percentage point increase in credit growth.

Table 4: Effects of US Monetary Policy

Dependent Variable: Private Sector Credit Growth				
Independent Variables	(1)	(2)	(3)	(4)
Credit Growth (-1)	0.188**	0.188**		
	(0.06)	*		
		(0.06)		
Profitability	0.190***			
Profitability (-1).	-0.146***	0.190**		
		*		
Capital leverage	-0.036**	-0.146**		
	(0.04)	*		
Capital leverage (-1)	0.042**			
	(0.02)	-0.036**		
Loan Loss Provisions	-0.036**	*		
	(0.04)	(0.04)		
Loan los Provision(-1)		0.042**		
		*		
Nominal GDP Growth	0.060*	(0.02)		
	(0.10)	-0.036**		
Deposits Growth	0.267***	*		
		(0.04)		
US Monetary Policy Tightening	-0.191*			
	(0.09)			
		0.060*		
US Monetary Policy Loosening		(0.10)		
	Yes	0.267**		
Time specific Dummies(2001-2003)	Yes			
Time Trend		0.191*		
		(0.09)		
		Yes		
		Yes		

Arellano-Bond test for AR(1)[a/]	0.00 0.230	0.00 0.230		
Arellano-Bond test for AR(2)[a/]	0.275	0.275		
Hansen test[a/]	24 611	24 611		
Number of instruments	38	38		
Number of obs				
Number of groups				

Notes:

1. ( ) and a/ give the P-values.

2. ***, **, * denotes coefficient significantly different from zero the 1%,5% and 10% respectively.

Likewise, the magnitude of the effect will be the same for a tightening but with the opposite effect on credit growth. These findings are a priori what was expected and are consistent with findings of other studies such as Kashyap and Stein (2000) and Nier and Zicchino, 2008.

7.0 POLICY ISSUES

The study found that the lending channel is operative in the ECCU. The results holds across the two banking groups used in the study, foreign and domestic banks, and is not contingent on the heterogeneity of the bank characteristics. However, the results suggested that the level of capitalisation of the banks could affect the potency of the channel more so than the size of the banks and their liquidity position.

These results hold important implications for policy makers in the ECCU. The fact that banks play an important role in the transmission of monetary impulses across the ECCU further highlights the more

important role the banking system plays in credit allocation. Policy makers therefore have a role play in managing the effectiveness of the channel. The fact that capital was found to affect the channel means that from a regulatory perspective it important to ensure that the system is well capitalised at all times. Banks that are well capitalised are better able to insult their supply of credit from monetary policy shocks. Therefore, enforcing capital requirement is vital for insuring that banking is system in the ECCU remains sound and healthy. In addition, the development of a vibrant and well functioning money and capital market should facilitate better management of the channel. If the money and capital market is function well it should provide businesses with alternative sources of financing and make them less dependent on bank funding. Furthermore, it should also allow banks to raise non-reservable funds to continue their lending activities when there are contractionary monetary shocks that lead to fall in their core deposits.

The second question which the paper addressed concerned the determinants of loan growth. The following are some the major findings:

- Higher capital ratios have a contemporaneously negative effect on credit growth with a positive impact after two years.
- Loan losses results in a reduction of credit growth and the reduction is larger for banks that are not well capitalised.

- Past credit growth, profitability and deposit growth have the largest impact on credit extended to the private sector.
- Domestic banks are more dependent on deposit funding to meet their credit demand and are more constrained in their lending activities by their level of capital and loan losses when compared to their foreign incorporated counterparts.
- Widening domestic spreads lead to a reduction in credit growth along with tightening of US monetary policy. On the other hand a loosening of US monetary policy leads to an increase in credit growth.

Theses finding have important implication for policy makers. One of the consistent findings coming out of the study has to do with the importance of deposits in facilitating credit growth. This suggests that policy makers should play particular attention to the structure of bank's liabilities. Studies have shown that core deposits- demand and saving deposits have permitted banks to insulate their credit activities from monetary shocks. Berlion and Mester (2008) argued that banks with more core deposits tended to smooth firms borrowing cost when there is an adverse credit shock. Therefore, central bank policy makers must be careful that they do not implement measures and guidelines that would encourage banks to change their liability structure in a way that places less emphasis on these kinds of

deposits. At the public policy level it also important the tax polices and other measures do not result in a similar out come.

Another key implication which should concern policy makers, is the effect of loan losses, as well as its feedback effect with capital, on credit growth. The findings imply that the level of capitalisation of the financial system is critical for ensuring financial stability. Shocks to capital in the form of loan losses reduces credit growth and is amplified when banks are not well capitalised. Policies aimed at building the risk assessment and underwriting capabilities of the banks are crucial for mitigating the negative effects that loan losses could have on the stability of the financial system.

The effect of spreads is also another issue which should interest central bank policy makers. Widening spreads between lending and deposits rate is often indicative of a financial sector that is not performing efficiently, especially with regards to it intermediation function. It has been argued that interest rate controls such as minimum saving rate as well as fragmentation of the market are major contributors to high spreads. Hence, policies aimed at removing controls and consolidating the market should help to facilitate reduction in the spread overtime.

8.0 CONCLUSION

This paper attempted to answer two broad research questions using annual bank-level data for the ECCU for the period 1990-2007. Firstly, the paper investigated the existence of the bank lending channel through a direct approach that involved testing for the identification of the loan supply function. This is an important condition that must be met in the BB model for the bank lending channel to be operative. An individual bank level loan supply function, derived from the BB model, produced a testable hypothesis as it relates to perfect substitutability between loans and bond in the banks portfolio. If there is perfect substitutability between both assets then the loan supply function cannot be defined which implies the bank lending channel does not exist. In addition, the basic model was extended to assess the impact of bank characteristics such as capitalisation, liquidity and size on the results.

The study found that the lending channel is operative in the ECCU. The results holds across the two banking groups used in the study, foreign and domestic banks, and is not contingent on the heterogeneity of the bank characteristics. However, the results suggested that the level of capitalisation of the banks could affect the potency of the channel more so than the size of the banks and their liquidity position.

The paper also analysed the factors that influenced credit growth in the ECCU over the period 1990-2007. The study found that past credit growth, profitability and deposit growth were the most important factors affecting growth in domestic private sector credit. In addition, it was found that past credit growth, profitability, deposit and GDP growth all had a contemporaneous positive relationship with credit growth. In contrast shocks to capital in the form of loan defaults negatively impacted credit growth. Furthermore evidence were found suggesting that banks with high capital ratio are better able to cushion the impact of loan losses on their ability to extend credit relative to banks that are not well capitalised.

This study can be viewed as a first step towards developing a knowledge base on the exact role played by commercial banks in the transmission of monetary shocks in the ECCU. Future research focusing on the loan supply function should examine more closely the effects of the function on economic activity at both the ECCU and country level. This will require identifying the loan supply function in a broader macroeconomic model. This approach may also allow for a better analysis of US monetary policy on the loan supply function. In addition, there is also a need for more empirical work on the role of foreign banks in the financial system.

APPENDIX A

SUMMARY STATISTICS

Table 5: Descriptive Statistics: Identification of Loan Function in the ECCU

__	**Mean**	**Min**	**Max**	**Std. Dev**	**Obs.** **No of banks**
Spreads	5.86	-4.24	11.65	1.62	592 38
Log Loans	11.50	7.4	13.87	0.94	675 38
Log Deposits	11.92	9.55	14.04	0.83	675 38
Bank Size (deviations)	8.89	-1.90	1.53	0.53	675 38
Liquidity (deviations)	-9.04	- 34.81	84.84	19.74	664 38
Capitalisation(deviations)	-5.93	-30.83	24.24	6.41	675 38

Table 6: Descriptive Statistics: Determinants of Credit Growth (Baseline)

__	**Mean**	**Min**	**Max**	**Std. Dev**	**Obs.** **No of banks**

Loan Growth	0.78	-14.36	9.80	1.51	665
Profitability	38				
Capital	2.34	-24.76	11.96	2.36	656
Loan Loss	38				
Provisions	6.57	-24.26	30.81	6.41	675
GDP Growth	38				
Deposit Growth	3.034	0	64.31	4.5	675
	38				
	6.25	-18.36	28.48	5.5	684
	38				
	0.84	-4.76	7.22	1.0	669
	38				

Table 7: Summary Statistics Private Credit Growth: Actual Vs Trend

Periods	Avg. Actual Growth	Standard Deviation	Avg Trend Growth	Standard Deviation
91-94	6.2	2.80	7.12	0.07
95- 00	9.0	1.88	6.75	0.38
01-05	3.2	3.94	7.04	0.94
06-07	14.7	2.76	10.02	0.75

Table 8: Commercial banks' assets as a percentage of total assets

Period Ended	Cash	Statutory Reserves & Deposits	Other Local Banks	Other ECCB Area Banks	Loans and Advances	Treasury Bills	Gov't Securities	Foreign Assets	Other Assets
2000	1.42	4.90	0.44	4.35	67.65	1.98	1.98	10.87	6.39
2001	1.46	6.06	0.69	3.27	64.81	2.74	1.64	13.15	6.20
2002	1.35	6.15	0.75	4.00	61.76	2.73	2.06	14.89	6.30
2003	1.35	6.04	0.52	4.59	57.46	2.87	2.27	17.54	7.36
2004	1.17	6.47	0.21	5.61	54.10	2.59	2.70	18.78	8.36
2005	1.22	4.74	0.40	8.33	53.78	2.11	2.72	18.77	7.93
2006	1.01	5.03	0.06	8.45	56.43	1.77	2.54	17.63	7.07
2007	1.07	4.60	0.08	9.03	57.16	1.24	2.09	16.81	7.91
Averages	1.26	5.50	0.39	5.95	59.15	2.26	2.25	16.05	7.19

Table 9: Commercial banks' liabilities as a percentage of total liabilities

Period Ended	Demand	Time	Savings	Foreign Currency Deposits	Total Deposits	ECCB	Other Local Banks	Other ECCB Area Banks	Foreign Liabili-ties	Other Liabili-ties
2000	10.84	28.57	28.13	12.54	80.08	0.46	0.45	4.08	4.59	10.34
2001	11.14	28.99	27.79	12.01	79.92	0.39	0.61	2.98	4.78	11.31
2002	11.23	27.67	28.02	12.49	79.42	0.14	0.85	3.66	4.80	11.14
2003	11.96									
2004	13.92	22.75	29.06	11.93	77.66	0.07	0.20	5.20	4.78	12.09
2005	13.05	20.45	27.68	11.65	72.83	0.06	0.24	8.41	5.56	12.90
2006	12.35	19.28	27.25	12.89	71.77	0.05	0.06	8.54	6.50	13.08
2007	12.35	18.21	24.82	11.87	67.26	0.21	0.07	9.25	8.72	14.49
Averages	12.10	23.70	27.54	12.20	75.56	0.20	0.35	6.02	5.68	12.19

APPENDIX B

RESULTS: IDENTICATION OF LOAN SUPPLY FUNCTION

Table 10: Identification of Supply Function by Banking Groups

Dependent Variable Spreads ((π-*i*)	Foreign	Domestic

Spreads (-1)	0.45***	0.464***
	(0.00)	(0.00)
Loans	-1.35**	-0.884*
	(0.03)	(0.06)
Loans (-1).	1.19*	1.145***
	(0.06)	(0.01)
Deposits	4.12**	0.889***
	(0.02)	(0.03)
Deposits (-1)	-3.96*	-1.144**
	(0.03)	(0.02)
Bank Size		
Liquidity		
Capital		
Capital (-1)		
Time specific	Yes	
Dummies(2001-2003)	Yes	
Time Trend		
Arellano-Bond test for	0.000	0.000
AR(1)[a/]	0.606	0.611
Arellano-Bond test for	0.858	0.819
AR(2)[a/]	0.000	0.000
Hansen test[a/]		
Wald test[a/]	13	15
	553	553
Number of instruments	38	38
Number of obs		
Number of groups		

Notes:

1. ( ) and a/ give the P-values.

2. ***, **, * denote coefficients significantly different from zero the 1%,5% and 10% respectively.

Table 11: Determinant Credit Supply Foreign Banks (Baseline Regression)

Dependent Variable Growth in Loans	Coef.	Std. Err.	P>|z|
Growth in Loans (-1)	.268	.089	
	0.003		
Profitability			
Profitability(-1)	.246	.053	
	0.000		
Capital	-.1538	.056	
Capital(-1)	0.007		
Loan Loss Provision	-.003	.002	
Loan Loss Provision(-	0.237		
1)	.003	.003	
	0.209		
Nominal GDP			
Nominal GDP(-1)	-.013	.019	
	0.499		
Deposit Growth	-.051	.034	
Deposit Growth(-1)	0.131		
Time Trend	.0141	.008	
	0.075		
	-.001	.0086	
	0.884		
	.2061	.110	
	0.060		
	.257	.081	
	0.002		
	Yes		

Arellano-Bond test for AR(1) in first differences: z = -2.38
Pr > z = 0.017
Arellano-Bond test for AR(2) in first differences: z = 0.84
Pr > z = 0.399
Hansen test of overid. restrictions: chi2(11) = 14.93 Prob > chi2 = 0.186

Number of instruments = 23
Number of obs = 611
Number of groups = 38

Table12: Determinant Credit Supply Domestic Banks (Baseline Regression)

Dependent Variable Growth in Loans	Coef.	Std. Err.	P>|z|
Growth in Loans (-1)	-.168	.090	0.063
Profitability			
Profitability(-1)	.263	.067	0.000
Capital	-.165	.067	0.014
Capital(-1)			
Loan Loss Provision	.030	.015	0.047
Loan Loss Provision(-1)	.013	.033	0.697
Nominal GDP			
Nominal GDP(-1)	-.099	.039	0.012
Deposit Growth	.052	.056	0.358
Deposit Growth(-1)			
Time Trend	.006	.004	0.125
	.002	.005	0.604
	.446	.059	0.000
	.083	.093	0.371
	Yes		

Arellano-Bond test for AR(1) in first differences: z = -2.34
Pr > z = 0.019
Arellano-Bond test for AR(2) in first differences: z = -0.90
Pr > z = 0.366
Hansen test of overid. restrictions: chi2(4) = 2.61 Prob > chi2 = 0.625

Number of instruments = 16
Number of obs = 611
Number of groups = 38

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