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The Impact of Macroeconomic Uncertainty on Bank Lending Behaviour in Jamaica

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Abstract

This paper investigates the role that macroeconomic uncertainty plays in banking sector lending behaviour in Jamaica using a portfolio model recently proposed in the literature. The econometric results of the bounds cointegration testing procedure proposed by Pesaran et al. (2001) show that there is no long-run relationship between bank lending and the indicators of macroeconomic uncertainty. However, macroeconomic uncertainty does affect bank lending in the short-run. Specifically, the volatility of the benchmark interest rate, which is affected by fiscal and monetary policy, was found to be the most critical macroeconomic variable. Therefore, concerns about the sustainability of the current macroeconomic economic environment could partly explain the current weak levels of credit. The results imply that, in the drive to stimulate credit, policy makers also need to focus on the factors that will enhance confidence about long-term macroeconomic stability in addition to the bank/market specific characteristics.

JEL Classification: C52, E44, G21,

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[1] The views expressed are those of the author and does not necessarily reflect those of the Bank of Jamaica.

1.0 Introduction

Following the global financial crisis in 2009 and the resulting economic recession, there has been increasing interest in the analyses of the linkages between the macroeconomic environment and the behaviour of the banking system. Therefore, the goal of this study is to assess the effect of macroeconomic uncertainty on banks' lending behaviour.

Typically, the volume of loans granted by a bank is thought to be a function of its internal characteristics such as size, deposit base, liquidity, credit policy and other internal factors. These factors are, for the most part, within the control of the bank. However, these factors, to a large extent, are influenced by the general macroeconomic environment. Therefore, the general loan behaviour of most banks will be a reflection of the signals from the aggregate economy. It is expected that if banks perceive the macroeconomic environment to be stable, they form expectations that borrowers will be better able to repay loans because of their improved ability to accurately predict income stream over the life of the loan.

In a world with perfect information, only the key indicators of macroeconomic performance such as GDP growth, interest rates and inflation would be needed to evaluate the outcome of a stimulus to the supply of credit. However, given that banks rarely exhaust their lending capacity, this study seeks to ascertain whether the issues stemming from asymmetric information induced by macroeconomic volatility is a major determinant of the banking sector's willingness to lend these available funds. In the presence of uncertainty, it is likely that not only the first moments (such as the rate of GDP growth, the level of interest rates, or the level of inflation) but also the second moments (measures of uncertainty about those magnitudes) will matter. There is also the likelihood that firms' demand for loans may be responsive to variations in macroeconomic uncertainty, as they affect the expected return on investment projects.

Baum et al (2004), suggests that since banks must acquire costly information on borrowers before extending loans to new or existing customers, uncertainty about economic conditions (and the likelihood of loan default) would have clear effects on their lending behaviour and affect the allocation of available funds. Therefore, as uncertainty increases, the loan–to–asset ratios should decline as greater economic uncertainty hinders banks' ability to foresee the investment opportunities (returns from lending). Conversely, when uncertainty is lower, incomes will be more predictable leading to a higher loan-to-assets ratio as managers take advantage of more precise information about different lending opportunities.

A study by Talavera et al (2006) concluded that banks make more loans during periods of boom and reduced level of macroeconomic uncertainty and curtail lending when the economy is in recession. Thus, the economic environment is a systematic risk component that affects every participant within the economy. Typically, the state of the economy is measured by macroeconomic aggregates, which include the gross domestic product (GDP), employment level, industrial capacity utilization, inflation, money supply and changes in the exchange rate. This would suggest that banks should adjust their lending behaviour in response to the signals from these factors. Additionally, banks' loan portfolio including volume, tenor and structure may be generally influenced by their expectations of the performance of the economy both in terms of stability and quantum/level of performance.

Based on the importance of this issue to policy, this paper seeks to analyze the response of credit to macroeconomic volatility or uncertainty. The bounds testing cointegration procedure proposed by Pesaran et al. (2001) is utilized in this exercise. This approach allows for the simultaneous determination of both the long-run and short-run relationship between macroeconomic uncertainty and bank lending. It extends the empirical research on this topic with respect to Jamaica, and seeks to add to the evidence reported by Urquhart (2008). Urquhart (2008) employed the GMM approach proposed by Arellano and Bond (1991) to examine the importance of the bank lending channel to monetary policy. However, Urquhart (2008) focused on monetary policy and as such did not incorporate aggregate demand or supply variables. In light of this concern, we use the autoregressive distributed lag (ARDL) framework (Pesaran et al., 2001) to test the impact of macroeconomic uncertainty, which is proxied by the impact of changes in key macroeconomic indicators on bank lending. The advantage of using the ARDL approach is that it allows testing for cointegration irrespective of whether the regressors are purely I(0), purely I(1) or fractionally cointegrated. Additionally, this method is attractive for modeling because of its small sample properties.

The subsequent sections of this study are organized as follows: section 2 presents a brief review of the literature; section 3 presents the empirical and data specification, section 4 discusses the econometric technique; the penultimate section presents the discussion and findings and the final section presents the conclusion.

2.0 Literature Review

Assessing bank lending behaviour and its interaction with macroeconomic uncertainty will inform policy makers of the extent to which developments in the macroeconomy affects banks' performance. Consequently, this topic has received significant attention in recent years particularly in light of the present recession which began in 2008 and the resulting credit crunch. Baum, Caglayan and Ozkan (2005) investigated the relationship between macro-economic uncertainty and bank lending behaviour of US banks using quarterly data from 1979 – 2003. They found that bank loans constituted about 55% of bank total assets. The study measured bank lending behaviour as the dispersion of banks' loans to total assets ratio around their mean values using standard deviation as a measure of cross-sectional dispersion of bank loans. The conditional variance in quarterly industrial production and the change in the consumer price index (CPI) –inflation were used as measures of macroeconomic instability. Using a GARCH model the study found that one-year cumulative effect of a 100 per cent increase in uncertainty, captured by the conditional variance of industrial production (IP) and inflation leads to somewhere between a 9-11 per cent (5-7 %) reduction in the dispersion of bank loans-to-asset ratio for total loans, real estate loans and household loans. This finding supports the view that macroeconomic uncertainty distorts the efficient allocation of funds across potential borrowers.

Talavera, Tsapin and Zholud (2006) studied the behaviour of bank lending and macroeconomic uncertainty in Ukraine. Using a proxy of the conditional variance of consumer or producer inflation or volatility in money supply (M1 and M2) and its component (demand and time deposit) for macroeconomic uncertainty, they found a negative relationship between bank loan to capital ratio and macroeconomic uncertainty. They found that banks increased their lending ratios when macroeconomic uncertainty decreases. However, the study found that the reaction of banks to changes in uncertainty is not uniform and depends on bank-specific characteristics, in particular, bank size and profitability. For the bank-specific factors, changes in monetary aggregates which can be related to macroeconomic policies are relatively more important for large banks than for small banks. This finding suggests that small banks are less able to change their behaviour over time in response to changes in monetary policy and their lending depends to a much greater extent on capital. Also, uncertainty emanating from monetary policy is significant for bank lending behaviour in the case of more profitable banks but less significant for the less profitable.

The relationship between bank lending behaviour and economic uncertainty was also examined by Eickmeierwe *et al* (2006) for Germany and the Euro Area. Utilizing a vector-autoregressive (VAR) model and imposing aggregate demand, supply and monetary policy shocks through short-run sign restrictions on impulse responses, the authors estimated the joint dynamic behaviour of real GDP, the price level, the short-term nominal interest rate and the stock of outstanding bank loans. The results suggest that the dynamic responses in the two areas are broadly similar. However, there are some differences in the relative contribution of the three shocks to output, prices, interest rates and bank loans over time. To assess the role of bank lending in the transmission of macroeconomic shocks, specifically the distributional implications of potential credit market frictions, the authors performed counterfactual simulations and analyzed the dynamic responses of German loan sub-aggregates. The results suggest that there is no evidence that loans amplify the transmission of macroeconomic fluctuations or that a "financial accelerator" via bank lending exists.

Quagliariello (2007) studied the role that macroeconomic uncertainty plays in banks' decisions regarding optimal asset allocation. Using a portfolio model, the paper investigated the determinants of Italian banks' choice between loans and risk-free assets when macroeconomic uncertainty increases. The results confirmed that macroeconomic uncertainty is a significant determinant of banks' investment decisions, after controlling for bank specific factors such as nonperforming loans. In periods of increasing turmoil, banks' ability to accurately forecast future returns is hindered and herding behaviour tends to emerge, as witnessed by the reduction of the cross-sectional variance of the share of loans held in portfolio.

Somoye and Ilo (2009) investigated the impact of macroeconomic instability on banking sector lending behaviour in Nigeria using data on commercial banks and macroeconomic instability from 1986 to 2005. The study employed a cointegration and VECM framework to show that bank lending has a long-run relationship with macroeconomic instability. Using the money supply, exchange rate of the Naira to the US dollar, and the inflation rate as well as bank specific control variables, the authors set out to explore the dynamics of this relationship for the Nigerian economy. This study showed that while increases in broad money supply and inflation induced banks to curtail lending, exchange rate depreciation induced the industry to increase lending in the long-run. Additionally, the deposit mobilization capacity of banks and bank size were the most important bank characteristics that explained their lending behaviour given the vagaries of the macroeconomic environment.

As it relates to the Jamaican economy, Urquhart (2008) examined the relevance of the bank lending channel to the conduct of monetary policy in Jamaica. Using a GMM approach as proposed by Arellano and Bond (1991), the bank lending channel of monetary transmission was estimated. The findings showed that the bank lending channel is impacted by informational asymmetries that exist between institutions. Specifically, asset size, capitalization and liquidity influence the magnitude of monetary policy impact on loans issued by banking institutions. Adding to the work of Urquhart (2008) which focused on the relevance of the bank lending channel to the conduct of monetary policy, this paper proposes to explore the impact of macroeconomic uncertainty on bank lending behaviour through the utilization of demand variables as well as monetary variables. Additionally, rather than focusing on the bank lending channel this paper will assess the lending behaviour of banks, that is, how do banks react to macroeconomic uncertainty through loan allocation.

3.0 Model Selection

This paper utilizes the framework developed by Beaudry et al. (2001) and employed by Baum et al. (2005), in which a model was designed to describe how banks set the optimal composition of their portfolios. In this model, bank managers operate in a risky environment and, in each period, can invest deposits into either loans or securities.

In the model, loans to customers entail the exposure to two different sources of risks: market risk and default risk. Market risk is the risk that the value of an investment will decrease due to moves in market factors, these market factors may emanate from risk associated with the overall status of the economy, while default risk is due to the probability that the specific customer will default in the future without repaying the debt. In contrast, securities are assumed to be free of default risk, but involve some market risk since the value of the securities may change as a result of varying market conditions. Market risk is assumed to be more predictable and can be managed and hedged against financial market and macroeconomic shocks. The return of such an investment is therefore assumed to be the risk free rate (r_f).

In any given period t, an individual bank *i* that invest in risky loans will earn a risk free return (r_f) and a risk premium (r_{pi}). This return provided by the loan is known as the stochastic return (r_i), which is equal for all loans assumed to be homogeneous and does not depend on the riskiness of the single borrower:

$$r_i = r_f + rp_i \qquad (1)$$

The risk premium is assumed to have an expected value $E(rp_i)=\rho$ and a variance $Var(rp_i)=\sigma^2\varepsilon$. Thus, the return on risky loans can be expressed as:

$$r_i = r_f + \rho + \varepsilon_i \tag{2}$$

where ε_i is a random component distributed as N($0, \sigma^2\varepsilon$). It is also assumed that each bank has a specific portfolio with different risk structures and, hence, the random components of return across different intermediaries are not correlated ($E[\varepsilon_i\varepsilon_j] =0$).

Within this model, banks' managers deal with a portfolio optimization problem in which the composition of their assets are rearranged in an effort to obtain the preferred combination of risk and expected return. According to their utility functions, they have to choose the shares α_i and ($1-\alpha_i$) of their assets to invest in loans and securities, respectively. However, before taking the decision, banks observe neither the actual risk premium nor the random component ε_i, but only a noisy signal of them:

$$S_i = \varepsilon_i + v \tag{3}$$

where v is a random variable independent of ε_i with a normal distribution $N(0, \sigma^2_v)$. Also, it is assumed that the noise component (v) of the observed signal banks receive is identical, while the overall signals remain different across intermediaries because of ε_i. Additionally, the cross-sectional differences in the banks private information set remain, although all banks are believed to have the ability to overcome asymmetric information problems. In theory, v may be observed and uncertainty eliminated if all banks would share their private information. However, information sharing is unlikely to hold in the credit market.

The noise v can be interpreted as the degree of uncertainty on future macroeconomic conditions. Its impact on all banks is homogeneous, regardless of the managers' ability to predict the random component of loan return ε_i. In fact, in times of greater macroeconomic uncertainty, a higher variance of v makes the estimates of the true return of loans less accurate. On the contrary, when the macroeconomy is more tranquil, the return from bank lending will be more predictable.

To determine the expected return on loans (r_i), bank managers have to predict the value of ε_i. Without observing the noisy signal, a bank's (unconditional) forecast of ε_i would be the mean of its distribution, i.e. zero. However, banks do observe the signal and can extract additional information from it. The expected value of the return from loans conditional upon S_i, $E[\varepsilon_i / S_i]$, is assumed to be a constant proportion (λ) of the signal, where λ represents a linear regression coefficient of ε_i on S_i:

$$\mathrm{E}\left[\varepsilon_i / S_i = \lambda S_i = \lambda(\varepsilon_i + \nu)\right] \tag{4}$$

where

$$\lambda = \frac{\sigma_\varepsilon^2}{\sigma_\varepsilon^2 + \sigma_\nu^2}$$

The conditional expected return of the i^{th} bank's portfolio $\mathrm{E}[R_i / S_i]$ is therefore given by the following expression:

$$\begin{aligned}\mathrm{E}[R_i / S_i] = \alpha_i\left(r_f + \rho + \mathrm{E}[\varepsilon_i / S_i]\right) + (1-\alpha_i) r_f = \alpha\left(r_f + \rho + \lambda(\varepsilon_i + \nu)\right)\\ + (1-\alpha) r_f\end{aligned} \tag{5}$$

And the conditional variance Var[R_i / S_i] is:

$$Var[R_i / S_i] = \alpha_i^2 \lambda \sigma_\nu^2 \tag{6}$$

Banks that are risk averse are assumed to have the following utility function:

$$\mathrm{E}[U_i/S_i] = \mathrm{E}[R_i/S_i] - \frac{\omega}{2}\mathrm{var}[R_i/S_i] \tag{7}$$

which is increasing in expected return and decreasing in return volatility (and ω is the coefficient of risk aversion).

Employing the portfolio's mean/variance equations, the optimal loan-to-asset ratio (α_i) for bank *i* and the associated cross-sectional dispersion can be derived as:

$$\alpha_i = \frac{\rho + \lambda S_i}{\omega \lambda \sigma_\nu^2} \tag{8}$$

$$Var(\alpha_i) = \frac{\sigma_\varepsilon^2}{\omega^2 \sigma_\nu^4} \tag{9}$$

The variance of the cross-sectional distribution of the loan-to-asset ratio is negatively correlated to the level of macroeconomic uncertainty σ_ν^2. Taking the first derivative of the variance of α_i with respect to σ_ν^2 yields:

$$\frac{\partial Var(\alpha_i)}{\partial \sigma_\nu^2} = -\frac{2\sigma_\varepsilon^2}{\omega^2 \sigma_\nu^6} < 0 \tag{10}$$

Equation (10) provides a testable implication of the hypothesis that the cross-sectional variance of the loan-to-asset ratio narrows as macroeconomic uncertainty increases.

Quagliariello (2006) extended this model by including a component for bank specific variables. He assumed that the variance of α_i would widen when the variance of the bank specific component increases. This is expressed as:

$$\frac{\partial Var(\alpha_i)}{\partial \sigma_\varepsilon^2} = \frac{1}{\omega^2 \sigma_\nu^2} > 0 \tag{11}$$

Therefore it is essential to control for this component when testing for the impact of macroeconomic uncertainty.

4.0 Data and Empirical Specification

4.1 Model Specification

To investigate the relationship between macroeconomic uncertainty and bank lending as outlined in the previous section, the following model will be tested:

$$LTA_{i,t} = a + \beta_i X_t + \Theta_i \Gamma_t + u_t \tag{12}$$

where $LTA_{i,t}$ is the loan-to-asset ratio at time t; Γ_t represents a vector of indicators of macroeconomic uncertainty evaluated at time t; X_t is the vector of the bank specific variables and u_t is the error term. Θ_i is the parameters of macroeconomic volatility factors to be estimated, and β_i is the parameters of bank specific factors to be estimated. The *LTA* indicates the proportion of the bank's assets represented by loans which should naturally constitute the major earning asset of banks and therefore capture lending behaviour. However, this ratio is expected to vary from time to time for each bank and across the industry depending on factors that are bank specific and those that are systemic, especially the macroeconomic factors.

The data used to estimate the model consist of seasonally adjusted monthly time series data from 1997:01 to 2010:09 for the commercial banks operating in Jamaica as well macroeconomic variables. The source of the data is the Bank of Jamaica.

4.2 Description of Variables

In order to determine the sensitivity of bank lending to macroeconomic uncertainty, bank specific variables and indicators of macroeconomic uncertainty are constructed. Consistent with the literature, macroeconomic uncertainty is proxied by the standard deviation of the change in the exchange rate of the Jamaica Dollar to the US dollar and the monthly inflation rate as well as the standard deviation of the 180-day Treasury bill rate.

Following Somoye and Ilo (2009) and Quagliariello (2007) the bank specific variables that will be used in this study are deposit to capital ratio (*D/K*) of bank *i* at time *t*, non-performing loans to total loans (*NPL*), and the Herfindahl (*H*) index.

NPL is a measure of the credit/default risk faced by banks. It assesses the willingness and ability of borrowers to repay their loans.

D/K shows the extent to which a bank relies on customer's deposit for funding. The higher this ratio is the greater the capacity of the banks to offer loans. Banks would normally determine their optimal loan to capital ratio within the framework specified by the central bank guideline. This ratio is a measure of risk and indicates the level of bank equity exposed to credit risk. Generally, banks with high equity capital have greater latitude to make huge amount of loans as they are not under serious pressure from capital constraint or regulation.

H is a measure of market concentration and is calculated as the sum of the squares of market shares for each firm. Essentially, it gauges the degree to which an industry is oligopolistic and the concentration of market control held by the largest firms in the industry. *H* ranges from a low of 0, indicating perfect competition, to a high of 10 000, indicating complete monopoly. Greater values mean greater concentration, less competition and more market control held by individual firms. For example, a value of 1 800 to 10 000 is high and signifies a tendency towards monopoly, 1 000 to 1 800 is medium and 0 to 1 000 is low. As the *H* increases it signifies a tendency towards monopolistic behavior and as such should increase the ability of banks to lend, the reverse is also true.

4.3. Descriptive Statistics of Bank Performance Measurement and Macroeconomic Uncertainty Indicators in Jamaica

Table 1 below presents the descriptive statistics of each variable used in the study. It also shows the correlation of each variable with the loan-to-assets ratio. The mean for the loan-to-asset ratio for the period under review was 32.5 per cent, indicating that on average loans comprised less than half of the commercial banks asset base. The ratio of deposit-to-capital had a mean of 578.0 per cent. This shows that on average deposits were over five times greater than the capital base of the commercial banks. The table also shows that the mean for the Herfindahl index was 2 694.9. This mean points to an industry that is highly concentrated, since a Herfindahl index of 1 800 and above is indicative of a highly concentrated industry. Further, a highly concentrated industry is one that exhibits characteristics of a monopoly. The average monthly inflation rate and Treasury bill rate were 0.84 per cent and 16.12 per cent, respectively. Additionally, the exchange rate exhibited a very high level of variability as shown by the relatively high value of the standard deviation of 14.45 per cent.

The table also shows the correlation between the variables and the loans-to-asset ratio. It shows that all the variables were moderately correlated with the loan-to-asset ratio, with the exception of the Treasury bill rate, which showed the lowest correlation of 0.29. This outcome may have emanated from the fact that the majority of the asset base for the banking sector is risk free, or has a low level of risk. It is important to note that the deposit-to-capital ratio and the Herfindahl index are both negatively correlated to the loan-to-asset ratio. However, theory suggests that these variables should have a positive relationship with the loan-to-asset ratio. For example, as the deposit-to-capital ratio increases it means that deposit is increasing or capital is declining. When deposits increase banks are capable of lending (i.e. allocating more loans) and as such loan-to-asset ratio should increase. The negative correlation can be expected if banks have a low capital base. In this context, this negative relationship could imply that lending is being negatively affected by capital-constrained banks (See Beatty and Gron (2001)).

Table 1: Average Monthly Bank Variables and Macroeconomic Uncertainty (1999:12-2010:09)

Bank Variables	Mean	Maximum	Minimum	Standard Deviation	Kurtosis	Correlation with LTA
Loans to Asset	32.46	45.82	18.21	8.92	1.85	1.000
Deposit to Capital	578.00	777.79	445.03	79.09	2.57	-0.93
Herfindahl Index	2694.98	3160.51	2294.972	249.22	2.00	-0.85
NPL	4.57	13.97	1.99	3.23	4.63	-0.69
Inflation	0.84	4.04	-0.33	0.79	5.25	0.46
Ex. Rate	63.25	89.73	41.27	14.45	2.24	0.96
Tbill	16.12	33.47	7.99	4.46	5.29	0.29

Source: Authors' Computations

5.0 Estimation Technique

The methodology utilized in this research follows the technique applied by Somoye and Ilo (2009). In their study the authors utilized the error-correction model to capture the long-run relationship between the variables. The error-correction term provides an additional channel through which the impact of macroeconomic uncertainty on the loan-to-asset ratio may be assessed. This is so because the error-correction term tells how fast lending behaviour in the banking system, measured by the loan-to asset-ratio, adjusts to equilibrium following a shock caused by macroeconomic uncertainty. However, given the order of integration of the variables in this research, the autoregressive distributed lag (ARDL) approach to cointegration was applied. The ARDL approach deals with single cointegration and is introduced originally by Pesaran and Shin (1999) and further extended by Pesaran et al. (2001) who showed that the existence of a level relationship between a dependent variable and a set of regressors can be tested when it is not known with certainty whether the regressors are trend or first-difference stationary. They proved that once the order of the ARDL has been determined, OLS may be used for the purpose of estimation and identification. The presence of a unique long-run relationship is crucial for valid estimation and inference. Such inferences on long and short-run parameters may be made, provided that the ARDL model is correctly augmented to account for contemporaneous correlations between the stochastic terms of the data generating process included in the ARDL estimation. Hence, ARDL estimation is possible even where explanatory variables are endogenous. Other econometric advantages of the ARDL method include: (i) the simultaneous estimation of long- and short-run parameters of the model; (ii) the inability to test hypotheses on the estimated coefficients in the long-run associated with the Engle-Granger method are avoided; (iii) all variables are assumed to be endogenous. Whereas other methods of estimation require that the variables in a time-series regression equation are integrated of order one, i.e., the variables are I(1), only that of Pesaran et al. could be implemented regardless of whether the underlying variables are I(0), I(1), or fractionally integrated.

The ARDL framework is implemented by modeling equation 12 as follows:

$$\begin{aligned}\Delta lltasa_t &= a_0 + \sum_{i=1}^{m} a_{1i}\Delta lltasa_{t-i} + \sum_{i=0}^{m} a_{2i}\Delta \ln plsa_{t-i} + \sum_{i=0}^{m} a_{3i}\Delta ldtksa_{t-i} + \sum_{i=0}^{m} a_{4i}\Delta lhsa_{t-i} + \sum_{i=0}^{m} a_{5i}\Delta lstdxr_{t-i} \\ &+ \sum_{i=0}^{m} a_{6i}\Delta lstd\inf_{t-i} + \sum_{i=0}^{m} a_{7i}\Delta lstdtbill_{t-i} + a_8 lltasa_{t-i} + a_9 ldtksa_{t-i} + a_{10}\ln plsa_{t-i} \\ &+ a_{11} lhsa_{t-i} + a_{12} lstdxr_{t-i} + a_{13} lstd\inf_{t-i} + a_{14} lstdtbill_{t-i} + \varepsilon_t \end{aligned} \tag{13}$$

where a_{1i} to a_{7i} represents the short-run coefficients related to bank lending behavior, bank specific variables and macroeconomic uncertainty variables and a_8 to a_{14} are the level effects. The long-run coefficients are computed as $(a_9, a_{10}, a_{11}, a_{12}, a_{13}, a_{14})/a_8$ and represent the speed of adjustment to the long-run relationship. The term ε_t is the classical disturbance term with the usual assumptions of zero mean and independent, distribution. To investigate the presence of a long-run relationship amongst the variables of Eq. (13) the bounds testing procedure of Pesaran *et al* is utilized. The bounds testing procedure is based on the F or Wald-statistics, which has a non-standard distribution. The bounds testing procedure involves applying a joint significance test that implies no cointegration, that is,

$$(H_0 : a_9 = a_{10} = a_{11} = a_{12} = a_{13} = a_{14} = a_{15} = a_{16} = 0).$$

Two sets of critical values are computed by Pesaran *et al* for a given significance level. One set assumes that all variables are I(0) and the other set assumes they are all I(1). If the computed F-statistic exceeds the upper critical bounds value, then H_0 is rejected. If the F-statistic falls into the bounds then the test becomes inconclusive. Lastly, if the F-statistic is below the lower critical bounds value, it implies no cointegration.

6.0 Results

The empirical analysis begins by examining the time series properties of the data. The standard Augmented Dickey-Fuller (ADF) test for unit roots (Dickey and Fuller, 1979, 1982) is used. However, the power of the ADF can be significantly reduced since it corrects for serial correlation in the error term by adding lagged values of the first difference of the dependent variable. This reduced power can be more of an issue in small samples. As such, the paper also uses the Phillips-Perron, PP, (1988) which, instead of adding differenced terms as explanatory variables to correct for higher order serial correlation, makes the correction on the *t*-statistic of the coefficient of the lagged dependent variable.

The results from the unit root analysis are presented in Table 2 below. The analysis indicates that four of the variables can be considered to be integrated of order one, that is, *I(1),* while four are stationary *I(0)*. Thus, having established the order of the variables as well as the fact that the dependent variable is I(1), the ARDL method was carried out.

Table 2: Unit Root Analysis

Variables	ADF	PP
Llta	-1.115167	-1.128553
Δllta	-12.99566***	-12.89580***
ldtk	-1.242665	-1.056636
Δldtk	-10.06524***	-13.77629***
lnpl	-2.446834	-2.575352
Δlnpl	-3.827995***	-10.35680***
lh	-1.625123	-1.504943
Δlh	-14.38989***	-14.42580***
lstdxr	-5.011438***	-4.145367***
lstdinf	-5.093698***	-5.104364***
lstdtbill	-3.218458***	-4.656950***

Notes: *, ** and *** denotes rejection of the null hypothesis at the 10%, 5% and 1% level, respectively. Δ is the first difference operator and L represents the natural logarithm.

Having established that the dependent variable as well as the bank specific variables are I(1) and the macroeconomic uncertainty variables I(0), the ARDL technique is applied to equation (12). The model was estimated with thirteen lags and the general-to-specific approach (Hendry, 1995) utilized to reduce the model to a parsimonious representation. Thirteen lags are considered to be sufficient since we are working with monthly data. Several diagnostic tests are conducted on the final model including tests for normality, serial correlation, model misspecification, and heteroskedasticity.

The results of the ARDL are shown in Table 3, and the results of bounds test is reported in Table 4. The calculated F-statistics for the model as shown in Table 2 are greater than the upper bound critical value at 5% level. Thus, the null hypothesis of no cointegration is rejected. Thus, there is a cointegration relationship among the variables as presented in Equation (13).

Table 3: The Estimated ARDL Model of Bank Lending Behaviour

$$\Delta llta = 0.395 - 0.159 * \Delta llta_{t-1} + 0.180 * \Delta llta_{t-9} - 0.247 * \Delta ldtk - 0.119 * \Delta ldtk_{t-6}$$

(6.68) (-2.58) (2.97) (-4.41) (-5.23)

$$- 0.119 * \Delta ldtk_{t-11} + 0.210 * \Delta \ln pl + 0.112 * \Delta \ln pl_{t-6} + 0.192 * \Delta lh + 0.025 * \Delta lh_{t-8}$$

(-2.43) (5.95) (3.46) (5.52) (2.64)

$$+ 0.019 * \Delta lh_{t-10} + 0.075 * \Delta lh_{t-11} + 0.0049 * \Delta lstdxr_{t-1} + 0.0056 * \Delta lstd\inf_{t-2} -$$

(2.12) (2.59) (2.16) (2.16)

$$- 0.0041 * \Delta lstdtbill_{t-4} - 0.017 * llta_{t-1} - 0.022 * \ln pl_{t-1}$$

(-2.51) (-2.20) (-5.28)

Diagnostics

$\bar{R}^2 = 0.57$	F =12.81 [0.000]	*Norm* = 0.495 [0.781]	*AR* =0.868 [0.4253]	*ARCH* =1.83 [0.1776]
RR = 2.29 [0.081]	*HET* = 1.216 [0.2597]	*DW* = 1.98	AIC= -4.65	SBC= -4.29

Long Run Elasticities of Bank Lending Behaviour:

$\ln pl$ = -1.300

Notes: T-statistics are shown in parentheses. R2 is the fraction of the variance of the dependent variable explained by the model, F is the F-statistics for the joint significance of the explanatory variables, DW is the Durbin Watson statistic, AR is the Lagrange multiplier test for p-th order residual autocorrelation correlation, RR = Ramsey test for functional form mis-specification (square terms only); Norm is the test for normality of the residuals based on the Jarque-Bera test statistic ($\chi 2$ (2)). ARCH is the autoregressive conditional heteroscedasticity for up to p-th order (see Engle, 1982). HET is the unconditional heteroscedasticity test based on the regression of squared residuals on squared fitted value.

Table 4: F-statistic for testing the existence of a long-run relationship for bank lending

Order of lag	F-statistic
13	F(2,135) = 24.073**

Notes: The relevant critical value bounds are obtained from Table CI(iii) (with an unrestricted intercept and no trend; with six regressors) in Pesaran et al. (2001). They are 2.12 – 3.23 at 90% and 2.45 – 3.61 at 95%. **denotes that the F-statistic falls above the 95% upper bound.

Having passed all the relevant diagnostic tests, the final model of bank lending behavior in Jamaica is presented in Table 3. This model can be taken as an adequate representation of bank lending behavior in Jamaica, explaining approximately 56 per cent of the bank lending behaviour over the period. The findings indicate that while macroeconomic uncertainty affect bank lending in the short-term, it has no effect on lending behaviour in the long-run. The presence of a long-run equilibrium relationship between bank lending behaviour and its determinants is confirmed based on the result of the 'bounds' test. The computed F-statistic on the exclusion test of the two level variables is 24.073, which exceeds the asymptotic critical upper 'bounds' value of 3.61 in Pesaran et al. (2001), Table CI(iii) for the existence of a cointegrating relationship. As such, the null of no cointegration relationship is rejected at the 5 per cent level of significance. The coefficient on the lagged loan-to-asset term, representing the implicit speed of adjustment towards equilibrium, is negative and highly significant and indicates that approximately 2 per cent of any deviation from the long-run equilibrium lending level is corrected each month, or 24 per cent in a year. Thus, it takes approximately four years for equilibrium to be restored following a shock to bank lending.

The coefficient on the lagged change in the loan-to-asset ratio implies that a one percentage point increase in bank lending in a given month would translate into a 0.021 percentage point increase in bank lending in the following month. The cumulative negative effect of the changes in the deposit-to-capital ratio implies that a one percentage point increase in the short-run results in a 0.49 percentage point decline in bank lending. This finding is contrary to expectation and is puzzling.

Estimates from the model also suggest that in the short-run, a one per cent change in the ratio of non-performing loans to total loans have a positive impact on bank lending in Jamaica. This most likely reflects the fact that banks do not respond immediately to an increase in non-performing loans by lowering lending. However, the results also indicate that over time the impact of non-performing loans on bank lending is negative (-1.3), consistent with the notion that as the non-performing loans ratio rises banks reduce their loan portfolio, given that they use this ratio as a signal for the risk of default.

The estimates also revealed that bank lending is significantly influenced by the Herfindahl index in the short-run but has no effect in the long-run. A one percentage point increase in the Herfindahl index (measure of market concentration) brings about a 0.24 per cent growth in bank lending. We note that as the Herfindahl index increases it signifies a tendency towards monopolistic behaviour and as such should increase the ability of banks to lend, resulting in an increase in the loan-to-asset ratio (see Bergstresser (2005)).

As it relates to the effect of macroeconomic uncertainty; the results from the short-run models show that the response of bank lending to short-run shocks due to macroeconomic uncertainty resulting from the exchange rate and inflation rate stimulates a positive response, while macroeconomic uncertainty resulting from volatility in the 180 Treasury bill rate resulted in a negative response. It is important, however, to note that no macroeconomic uncertainty variable had a long-run impact on bank lending. This suggests that uncertainty about the macro economy does affect bank managers decision regarding lending in the long run. The results with regards to the exchange rate and inflation seem paradoxical but may reflect the hypothesis of Talavera *et al* (2006) if the bouts of high inflation and high rates of depreciation in Jamaica, coincide with periods of recessions. The estimates show that a one per cent increase in uncertainty associated with the exchange rate volatility resulted in a 0.005 per cent increase in the loan-to-asset ratio. This indicates that as uncertainty from the exchange rate increases in the short-run, banks' lending increases. This could be as a result of an increase in the demand for loan as firms require additional Jamaican dollar to meet the payment for import of raw materials, machineries, and finished goods. As it relates to uncertainty regarding inflation, a one per cent increase resulted in a 0.006 per cent increase in bank lending. This result could be reflecting the fact that in a high inflation environment demand for credit could increase given the incentive to purchase real goods and the fact that borrowers tend to gain as against agents who save.

Uncertainty in the Treasury bill rate has the expected impact on bank lending. The estimates also show that a one per cent increase in the uncertainty associated with the interest rate resulted in a 0.004 per cent decline in the loan-to-asset ratio. This is so because as the cost of borrowing increases the demand for loans decline and as such bank lending declines.

In order to control for the possible coincidence of recessions with high inflation and depreciation rates, a similar estimation was conducted including gross domestic product (GDP) (see Table 4). Since monthly GDP is currently not available from the official statistical source, the Statistical Institute of Jamaica, the study employed an interpolation of the quarterly GDP. The interpolation method employed was the quadratic matched average method in Eviews, where the quarterly data available was fitted by a quadratic polynomial for each observation and then used to fill in all observations of the monthly series. The quadratic polynomial is formed by taking sets of three adjacent points from the source series (two for end-points) and fitting a quadratic so that the average of the monthly points matches the actual quarterly data. One advantage of the quadratic matched average method is that it maintains the trend of the source data, making this an acceptable approximation.

Having controlled for aggregate demand, the hypothesis that the paradoxical results for inflation and exchange rate seems confirmed as the exchange rate and the inflation rate no longer appears in the results. The standard deviation of the Treasury Bill rate remained significant with very little change in magnitude. The growth rate in GDP is now the other significant macroeconomic variable, having a negative impact on bank lending in the short-run and a positive impact in the long-run. The estimate shows that a one per cent increase in the growth rate in GDP reduces bank lending by 2.95 per cent in the short-run. This result reflects the fact that as aggregate demand increases in the short- run firms and individuals will be in a better position to finance their expenses and as such will not have to borrow as much. In the long-run, a one per cent increase in GDP increases bank lending by 5.89 per cent. This reflects firms desire to borrow to expand production stemming from the increased demand due to the growth in economic activity. More importantly, an increase in demand could be due to significant improvements in borrowers' balance sheets, which in turn are the consequences of higher collateral values, and higher earnings. As such, firms can improve their balance sheets by increasing effective demand for external finance, particularly bank credit in a bank-based financial system. The results for the bank specific variables remain generally unchanged.

Table 4:The Estimated ARDL Model of Bank Lending Behaviour Controlled for Demand

$$\Delta llta = \underset{(-3.07)}{-3.676} \underset{(-3.01)}{-0.205*\Delta llta_{t-1}} + \underset{(4.63)}{0.279*\Delta llta_{t-9}} \underset{(-2.98)}{-0.171*\Delta ldtk_{t-6}} \underset{(-2.31)}{-0.131*\Delta ldtk_{t-7}}$$

$$\underset{(-3.54)}{-0.188*\Delta ldtk_{t-11}} \underset{(-2.59)}{-0.159*\Delta ldtk_{t-12}} \underset{(-3.55)}{-0.039*\Delta ldtk_{t-13}} + \underset{(4.40)}{0.165*\Delta \ln pl} + \underset{(2.62)}{0.037*\Delta lh}$$

$$+ \underset{(2.94)}{0.097*\Delta lh_{t-6}} + \underset{(2.48)}{0.087*\Delta lh_{t-7}} + \underset{(2.04)}{0.020*\Delta lh_{t-10}} + \underset{(3.41)}{0.075*\Delta lh_{t-11}} + \underset{(2.17)}{0.071*\Delta lh_{t-12}} -$$

$$\underset{(-2.29)}{0.0039*\Delta lstdtbill_{t-4}} \underset{(-2.42)}{-0.63*\Delta \lg dp_{t-4}} \underset{-2.54)}{-1.183*\Delta \lg dp_{t-7}} \underset{(-2.46)}{-1.146*\Delta \lg dp_{t-13}} -$$

$$\underset{(-3.41)}{0.059*llta_{t-1}} \underset{(-2.22)}{-0.014*\ln pl_{t-1}} + \underset{(3.44)}{0.351*\lg dp_{t-1}}$$

Diagnostics

$\bar{R}^2 = 0.55$	F =9.32 [0.000]	$Norm = 1.371$ [0.5038]	AR =1.272 [0.2837]	$ARCH$ =1.45 [0.2298]
$RR = 2.18$ [0.081]	$HET = 0.649$ [0.8794]	$DW = 1.98$	AIC= -4.56	SBC= -4.11

Long Run Elasticities of Bank Lending Behaviour:

ln pl = -0.239

lgdp = 5.89

Notes: T-statistics are shown in parentheses. R2 is the fraction of the variance of the dependent variable explained by the model, F is the F-statistics for the joint significance of the explanatory variables, DW is the Durbin Watson statistic, AR is the Lagrange multiplier test for p-th order residual autocorrelation correlation, RR = Ramsey test for functional form mis-specification (square terms only); Norm is the test for normality of the residuals based on the Jarque-Bera test statistic ($\chi 2$ (2)). ARCH is the autoregressive conditional heteroscedasticity for up to p-th order (see Engle, 1982). HET is the unconditional heteroscedasticity test based on the regression of squared residuals
on squared fitted value.

Table 4: F-statistic for testing the existence of a long-run relationship for bank lending

Order of lag	F-statistic
13	F(2,128) = 9.359**

Notes: The relevant critical value bounds are obtained from Table CI(iii) (with an unrestricted intercept and no trend; with six regressors) in Pesaran et al. (2001). They are 2.12 – 3.23 at 90% and 2.45 – 3.61 at 95%. **denotes that the F-statistic falls above the 95% upper bound.

7.0 Conclusion

This paper examined the role that macroeconomic variables play in commercial banks decision to allocate loan. Adopting the main idea of the portfolio model proposed by Baum *et al*, and applying the method used by Ilo and Somoye (2004), the paper discusses how Jamaican banks choose between loans and risk-free assets when the uncertainty about macroeconomic conditions increases. Similar to the work of Quagliariello (2007) and Ilo & Somoye (2004) the role of idiosyncratic factors (i.e. bank specific variables) is taken into account.

The ratio of non-performing loan to total loan was found to be the most important bank characteristics that explain their lending behaviour given the macroeconomic environment. The Herfindahl index is also important because it indicates that as the banking industry becomes more concentrated, banks increase lending. Evidence from the ARDL cointegration analysis showed that the macroeconomic uncertainty does not have a long-run impact on bank lending behaviour in Jamaica. Additionally, the paper shows that uncertainty regarding the exchange rate and the inflation rate has a positive effect on bank lending in the short-run. However, uncertainty associated about interest rates has a negative effect.

The significance of concentration and non-performing loans in the results points to the importance of the cost of information gathering and risk assessment in bank lending behaviour. Increase in concentration implies fewer but larger banks, which through economies of scale could acquire information and undertake risk assessment at lower unit costs. The policy implication of this is that initiatives such as the establishment of a credit bureau which would facilitate risk assessment will boast lending.

However in light of the results for the volatility of interest rates, such initiatives that address bank/market specific factors, have to be complemented by policy reforms that will enhance confidence about long-term macroeconomic stability. This policy strategy should engender less volatility/uncertainty in interest rates.

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