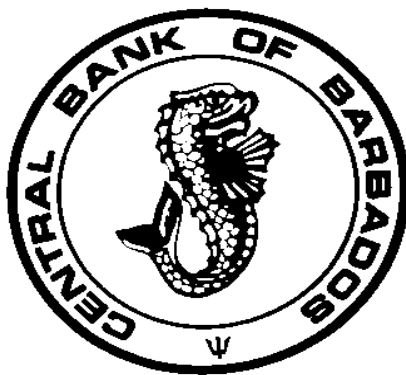


**THE IMPACT OF MACROECONOMIC RISK ON COMMERCIAL
BANK LENDING BEHAVIOUR IN BARBADOS**

BY

RYAN BYNOE



CENTRAL BANK OF BARBADOS
Research Department

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Ryan Bynoe

Draft

Abstract

This paper investigates the relationship between macroeconomic uncertainty and the allocation of commercial bank lending in Barbados. Using an empirical framework that describes the relationship between macroeconomic uncertainty and commercial bank portfolio holdings, it was found that there is a statistically significant negative relationship between macroeconomic uncertainty and the cross-sectional dispersion of the loan-to-asset ratios of commercial banks.

1. Introduction

The banking system in Barbados is the main source of financing for business activity in Barbados. As well as extending loans to the business sector, lending is also extended to meet the demands of the personal sector and the public sector and the banking system can duly be regarded as “the most important lenders in the Barbadian financial system.”¹ It is therefore of interest to examine how the portfolio of those commercial banks in the Barbados have developed over time. Some of the factors identified in the literature as influencing the evolution of bank’s portfolios over time include such institutional specific factors as the ownership structure of banks, differences in bank size, and the impact of capital requirements, as well as macroeconomic factors inclusive of government activity, households’ activity and the general macroeconomic environment that exists in a country. Haas et al. (2010) suggests that large banks may have a comparative advantage in lending to large customers, while small banks may have a comparative advantage in lending to small customers. Baum et al. (2009) went even further by exploring how banks’ portfolio decisions are influenced by the presence of macroeconomic uncertainty.

Banks’ management of their portfolios will have an impact on the economic growth, and in turn will be influenced by developments in the macroeconomy. Banks, which are an integral component of any well-functioning financial system, perform an intermediary role in the economy, linking potential borrowers to lenders, a role that is important to the development of firms and businesses and so their influence is vital to real economic growth. Commercial banks are also important to the transmission of monetary policy in an economy. These relationships are dependent on the focus displayed by banks in the management of their portfolios, and in turn will influence how asset portfolios are managed.

This paper performs an assessment of the response of commercial bank’s loan holdings to macroeconomic uncertainty in Barbados. To achieve this goal a measure of the cross-sectional dispersion of the ratio of total loans to total assets is regressed on a measure of

¹ Craigwell et al. (2005)

macroeconomic uncertainty, with the cross-sectional variation of the loans-to-assets ratio measured over time being representative of the level of cross-sectional dispersion. This paper was motivated by work done by Baum et al. (2009), who presented a testable framework within which macroeconomic uncertainty is expected to impact upon commercial bank lending behaviour. The empirical framework established by Baum et al. has been tested for the United States, the United Kingdom and Canada, and one of the aims of this paper is to examine if the relationship described in those previous studies will hold in the case of Barbados. The model is estimated by generalised method of moments (GMM) in order to account for any measurement error that may exist in the proxy variable of macroeconomic uncertainty and any non-linearity in the relationship. The findings of this paper show that there appears to be a negative relationship between macroeconomic uncertainty and the dispersion of commercial banks' loans-to-asset ratios. That is, evidence suggests that in times of increased macroeconomic uncertainty, commercial banks display a measure of what Quagliariello (2009) referred to as herding behaviour in their portfolio holding decisions.

The rest of this paper is structured as follows. In section 2, the model used by Baum et al. is presented. A brief literature review is presented in section 3. Section 4 describes the econometric methodology and results of the empirical investigation, and section 5 concludes the paper.

2. Section 2

The impact of the business cycle on commercial banks' performance has been examined in terms of the response of banks to different risk factors. Most of this analysis has been attributed to a growing emphasis on financial stability, which has grown out of a greater awareness of the fragility of the global financial system. The study of the impact of economic activity on commercial banks is important to policy makers in their goals to build a resilient global financial system, of which banks are an integral institutional body.

There are a number of variables that have been suggested as having an influential relationship on banks portfolio changes. Many studies have examined the relationship of commercial banks to portfolio management by looking at the pro-cyclicality of commercial bank lending, or on the impact of banks' idiosyncratic risk on lending decisions. Additionally, a framework which looks at how banks manage their portfolios in response to macroeconomic uncertainty has been developed by Baum (2009). Baum et al. (2009) argued that the uncertainty that exists in the macroeconomic environment should have implications on the lending strategies of commercial banks. The authors suggested "that higher uncertainty will hinder the ability of bank managers to accurately predict returns from available lending opportunities." Baum et al. (2009) claimed that in times of high macroeconomic uncertainty, banks are likely to act more homogeneous in their portfolio decisions while in periods of low macroeconomic uncertainty, the lending behaviour of banks may be more heterogeneous.

The relationship between macroeconomic uncertainty and banks' portfolio holdings has its groundings in the realization that bank managers are exposed to two types of risk, market risk and default risk. It is assumed that bank managers can overcome asymmetric information in the economy, however this ability is hindered by the non-sharing of private information to which individual banks are privy. Baum et al. (2009) proposed that in times of economic tranquility, more information is available to banks on which they can make base their decisions on, and it is expected that the loan-to-asset ratios of banks should be more diversified. On the other hand, as macroeconomic uncertainty increases, bank managers behave more homogeneous in their loan-to-asset ratios. A testable model of how macroeconomic uncertainty impacts on banks' portfolio decisions has been developed by Baum et al. (2009), which they acknowledged as a variation of the island model introduced by Lucas (1973).

The derivation of the model as proposed by Baum et al. (2009) is as follows. In their model, it is assumed that banks maximize profit by allocating total assets to either loans or securities. Securities are assumed to provide a risk free rate of return ($r_{f,t}$) while the return on loans is determined by a time-varying risk premium which can be represented

as $r_{i,t} = r_{f,t} + \text{premium}_{i,t}$. The expected risk premium is $E(\text{premium}_{i,t}) = p$ and its variance is $\text{Var}(\text{premium}_{i,t}) = \sigma_{\varepsilon,t}^2$. The return on risky loans is:

$$r_{i,t} = r_{f,t} + p + \varepsilon_{i,t}, \text{ where } \varepsilon_{i,t} \sim N(0, \sigma_{\varepsilon,t}^2)$$

It is assumed that bank managers cannot observe the risk premium. They however do observe a noisy signal of the risk premium which can be represented as $S_{i,t} = \varepsilon_{i,t} + v_t$, where v_t denotes the noise and is normally distributed as $v_t \sim N(0, \sigma_{v,t}^2)$ and is independent of $\varepsilon_{i,t}$. It is further assumed that although each bank manager observes a different signal, that the noise component of the observed signal is identified in all cases, which proxies for the degree of macroeconomic uncertainty. The inclusion of v_t as a proxy for macroeconomic uncertainty is due to a lack of information sharing among banks. The risk exposure of banks is subject to the ability of banks to assess all information available. However because banks do not share their private information the noise component v_t exists.

Baum et al suggested that “ in times of greater turmoil in the economy, a higher variance of v will render bank managers’ estimates of the time returns on risky loans less accurate and vice versa.”

The optimal forecast of the return from risky loans is

$$E_t(\varepsilon_{i,t} | S_{i,t}) = \lambda_t S_{i,t}$$

where

$$\lambda_t = \frac{\sigma_{\varepsilon,t}^2}{\sigma_{\varepsilon,t}^2 + \sigma_{v,t}^2}.$$

Therefore total conditional expected returns takes the form

$$E(\bar{Y}_{i,t} | S_{i,t}) = x_{i,t}(r_{f,t} + p + \lambda_t S_{i,t}) + (1-x_{i,t})r_{f,t}$$

where \bar{Y} denotes total returns. The conditional variance of returns will be

$$\text{Var}(\bar{Y}_{i,t} | S_{i,t}) = \lambda_{i,t} \sigma_{i,t}^2 x_{i,t}^2$$

Assuming that risk averse banks have the following utility function:

$$E(\bar{U}_{i,t} | S_{i,t}) = E(\bar{Y}_{i,t} | S_{i,t}) - \alpha/2 \text{Var}(\bar{Y}_{i,t} | S_{i,t})$$

which is increasing in expected returns and decreasing in the variance of returns conditional on the signal $S_{i,t}$, and α is the coefficient of risk aversion. The i^{th} bank's loan-to-asset ratio is represented as:

$$x_{i,t} = \frac{p + \lambda_t S_{i,t}}{\alpha \lambda_t \sigma_{v,t}^2}$$

The cross-sectional dispersion of the loan-to-asset ratio is

$$\text{Var}(x_{i,t}) = \frac{\sigma_{\varepsilon,t}^2}{\alpha^2 \sigma_{v,t}^4}$$

A testable relationship is derived by taking the first derivative of $x_{i,t}$:

$$\frac{\partial \text{Var}(x_{i,t})}{\partial \sigma_{v,t}^2} = \frac{2\sigma_{\varepsilon,t}^2}{\alpha^2 \sigma_{v,t}^6} < 0$$

which says that as macroeconomic uncertainty increases, then the cross-sectional variance of the loan-to-asset ratio decreases. The relationship between uncertainty and the loan-to-asset ratio is the relationship that will be tested in the rest of the paper.

3. Literature Review

Haas et al. (2010) examined how bank characteristics and the institutional environment influence the composition of banks' loan portfolios. The variables that they suggest will have the most significant impact on the composition of bank's loan portfolios were bank ownership, bank size and the legal environment that is faced by the banks in a country. Haas et al. found that small banks lend more to small and medium sized enterprises compared to large banks, which had an advantage in lending large clients. The authors also found that foreign banks dominated in terms of lending to foreign firms.

Leahy and Whited (1995) examined the effect of uncertainty on firm investment for the United States. The authors used a panel of firms and found that an increase in uncertainty decreases investment. Mazzoli (2001) was interested in determining whether the largest category of loans in the Italian banking system was demand driven. He postulated that if the largest category of loans was demand driven then bank credit would be hierarchy allocated according to the size of loans.

Rossi et al. (2009) made an assumption that bank managers are not risk neutral. The authors noted that managers who display characteristics of risk aversion may at times be more selective in terms of their portfolio holdings. In their study, Rossi et al. (2009) found that diversification reduces the realized risk faced by bank.

Baum et al. (2009) empirically investigated whether there was a relationship between macroeconomic uncertainty and the cross dispersion of commercial bank loans for the United States commercial banking sector. Their priori assumption was that the cross-sectional dispersion of the loan-to-asset ratios of commercial banks should narrow as economic uncertainty increases, and that tranquility will lead to a widening of the cross dispersion of banks' loan-to-asset ratios. Using quarterly data for the period 1979 – 2003, the measure of cross-sectional dispersion used was the cross-sectional standard deviation of the loan-to-asset ratios of US commercial banks. Baum et al. estimated two general

specifications of their model, where they used two different measures of macroeconomic uncertainty obtained by estimating the conditional volatility in GARCH models of inflation and industrial production growth. The results from the econometric analysis confirmed that as macroeconomic uncertainty increases, the cross dispersion of the loan-to-asset ratios decreases.

Quagliariello (2009) conducted a study on the impact of uncertainty on banks' lending decisions for Italy. Similar to Baum (2009), the author also investigated the role of macroeconomic uncertainty in banks' lending decisions. The author used a similar model to Baum et al. (2009), albeit with a few innovations. The measure of dispersion used was the cross-sectional coefficient of variation rather than the cross-sectional standard deviation used by Baum et al. (2009). Quagliariello also included a variable to measure idiosyncratic uncertainty, which allowed him to examine the impact of idiosyncratic risk on banks' lending decisions. The results of the analysis confirmed a negative relationship between the macroeconomic uncertainty and the dispersion of commercial banks loan-to-assets ratio, while also showing evidence of a positive relationship between idiosyncratic uncertainty and the cross-sectional dispersion of banks loans-to-assets ratios.

4. Data, Methodology and Results

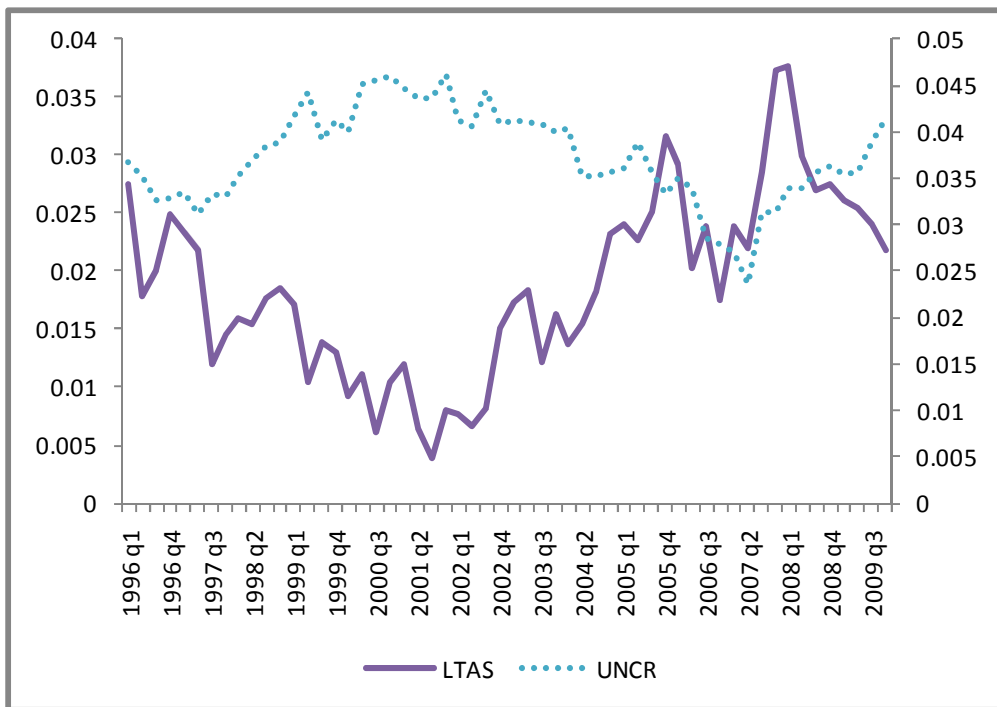
Data

The principle variable of interest in this paper is the cross-sectional dispersion of banks' loans-to-total assets ratios. It must be noted here that a population size of just six banks is far from an ideal number to obtain a measurement of cross-dispersion. The obvious reason is the susceptibility of the measurement of cross variability to the presence of any outlier that may occur in the data. This issue of small size is a valid concern; nevertheless, it has been observed that though the data for the banking system in Barbados does vary significantly, there is a general absence of any shocks of note to any one particular bank, which would have exacerbated the problem of small size. In this paper, macroeconomic uncertainty is proxied by the four-year average mean absolute

error of a first order autoregressive model of seasonally adjusted tourist arrivals. The errors generated from a forecasting model of tourist arrivals are used in this case because of the importance of the tourism sector to Barbados. All of the data are measured at a quarterly frequency and were sourced from databases maintained by the central bank of Barbados for the estimation period 1996Q1 to 2009Q4.

Personal lending is the single largest category of commercial credit in the Barbadian banking system and is dominated by mortgage loans. The second most important category is lending to the non-financial business sector, which includes loans to the manufacturing, agriculture, tourism and wholesale and retail business sectors of the Barbados economy.

Figure 1.



* LTAS is plotted against the left axis, and UNCR is plotted against the right axis

Figure 1 shows a plot of the cross-sectional dispersion of the loan-to-asset ratio (LTAS) of Barbadian commercial banks, as well as a plot of the proxy for macroeconomic uncertainty UNCR. It can be seen from the graph that there has been a significant change

in the direction of the dispersion of banks' loan-to assets ratios during the sample. Initially, during the early part of the sample the value was declining towards the end of 2001, after which it rose for the remainder of the sample period, which may have reflected shocks to the economy during that period.

The average mean absolute forecast error, which is the proxy for macroeconomic uncertainty is shown to have increased during the late 1990s and early 2000s reflecting a series of shifts in tourist arrivals during that period. The volatility in tourist arrival moderated after that period, but increased again towards the end of the sample period.

The Model

The estimated model can be represented as follows:

$$LTAS_{i,t} = a + bUNCR_t + v_t \quad (1)$$

where $LTAS_{i,t}$ is the cross-sectional dispersion of the loan-to-asset ratios of Barbados' commercial banks at time t ; measured as the cross-sectional variance of banks' loan-to-asset ratios. $UNCR_t$ is a proxy for macroeconomic uncertainty, measured as the mean absolute error of the residual of a first order autoregressive model of tourist arrivals, and v_t is an error term with zero mean and constant variance.

In accordance with the findings presented by Quagliariello (2009), it is expected that the sign of the coefficient b should be negative, reflecting an inverse relationship between macroeconomic uncertainty and the loan-to-asset ratios of commercial banks. The equation, (1), was estimated by a GMM estimator to account for any measurement bias that may exist in the proxy for macroeconomic uncertainty, and also to account for non-linearity in the data. The uncertainty variable was instrumented by a its one period lag and two period lagged values. Furthermore, to account for the presence of serial correlation in the error, an autoregressive term AR (1) of the dependent variable $LTAS_t$ was also included in the estimated equation.

Table 1. Results for estimation of the loan-to-assets ratio

Regressors	Coefficient	Std. Error
UNCR	-0.386	0.156**
AR(1)	0.795	0.063***
Constant	0.033	0.007***
J-statistic	3.603	
Prob(J-statistic)	0.165	

*, ** and *** denotes significance at the 10%, 5% and 1% level, respectively.

The results of the empirical investigation are summarised in table 1. It is revealed that there is a statistically significant negative relationship at the five percent level between the proxy for macroeconomic uncertainty and the cross dispersion of commercial bank loan holdings. It can therefore be surmised that commercial banks in Barbados do exhibit some level of homogeneity in their holdings of loans as macroeconomic uncertainty increases, a result that is similar to that reported by Quagliariello (2009) and Baum et al. (2009).

5. Conclusion

This paper examines the relationship between macroeconomic uncertainty and the dispersion of commercial banks' loan-to-asset ratios in Barbados. Using an instrumental variables framework estimated by generalized method of moments, it was found that as macroeconomic uncertainty increases, the dispersion in the level of loans to total assets within the banking sector diminished. This result confirms the assertion made by Baum et al. (2009) that commercial banks display herding behaviour as the level of uncertainty reduces the amount of asymptotic information available to individual banks.

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