Market Interest Rate and Commercial Banks Profitability: An Empirical Study

Dahlia Daley
And
Dianna DaCosta*
Kobe University, Japan

Abstract

Significant integration and liberalization of financial markets worldwide have led to increased volatility in the world economy. As a result, a number of economists and policy makers are interested in the impact of market rate fluctuations on bank profitability. If this is known, then evaluating the trade-off between interest rate stability and other policies becomes more likely. With this kind of evaluation, policy makers will be able to place appropriate weights on interest rate policies, in relation to others. Consequently, this paper investigates the effect of market interest rate[1] risk on bank profitability using a modification of Flannery's (1981 & 1983) model with similar assumptions for the period 2000-2008 in Jamaica for the National Commercial Bank (NCB) and Bank of Nova Scotia (BNS) Jamaica Ltd. The results indicate that market interest rates, in particular, Treasury bill rates have a small effect on bank profitability, across the two major banks in Jamaica. Also, interest rate risk (volatility) has a very small, but negative impact on bank profitability.

JEL Classifications: C3, GO, G21.
***Key Words*:** Bank Profitability, Interest Rates, Volatility, Interest Rate Risk.

1. Introduction

Significant integration and liberalization of financial markets worldwide have led to increased volatility in the world economy. As a result, a number of economists and policy makers are interested in the impact of market rate fluctuations on bank profitability. If this is known, then evaluating the trade-off between interest rate stability and other policies becomes more likely. With this kind of evaluation, policy makers will be able to place appropriate weights on interest rate policies, in relation to others. Consequently, this paper investigates the effect of market interest rate[2] risk on bank profitability using a modification of Flannery's (1981 & 1983) model with similar assumptions for the period 2000-2008 in Jamaica for the National Commercial Bank (NCB) and Bank of Nova Scotia (BNS) Jamaica Ltd.

Interest rate risk, which is caused by unexpected and unfavourable changes in interest rates, is a major contributor to the increased volatility that accompanies globalization. To measure how these rate changes affect a bank's profitability, English (2002), posits that the overall impact of interest rate fluctuations on the bank's economic value may be assessed; or an assessment of the implications of interest rate risks on future cash flows may be done. This study tests the impact of market interest rate risk on commercial banks' profitability in Jamaica, using the former approach. This is done through the use of a Seemingly Unrelated Regression technique.

2. Literature Review

Interest rate risk[3] is the exposure of a bank's financial condition to adverse movements in interest rates. Studies have shown that banks' net interest margin (NIM) is the most sensitive to fluctuations in interest rate. Samuelson (1945) argues that under general market conditions, bank profits increase with rising interest rates. He states: "The banking

[1] Market interest rate refers to the interest rate set by demand and supply in the money market.

[2] Market interest rate refers to the interest rate set by demand and supply in the money market.

[3] The Basel Committee on Banking Supervision research (2004).

system as a whole is immeasurably helped rather than hindered by an increase in the interest rates…and commercial banks would profit more than savings banks" (Samuelson, 1945). Hancock (1985) found supporting evidence for this argument when she tested the conjecture that banks benefit from high rather than low interest rates, even though at the aggregate level, increases in interest rates reduce output and employment.

An analysis of the sensitivity of banks' net interest margin and profitability to interest rates, credit and term structure shocks across product specializations (Hanweck and Ryu, 2005) reveals that net interest margins associated with banks' portfolios are the most sensitive to interest-rate changes. These results support the Basel Committee 2004 research. The Basel committee 2004 research finds that changes in bank net interest margin is negatively related to interest rate volatility, but it displays a positive relationship with increases in the yield curve, even though the magnitude of the effect depends on the bank's composition of assets and liabilities.

A study by English (2002) corroborates the findings of Hanweck and Ryu (2005). English (2002) argues that the most popular view among financial market observers (including academics and journalists) is that fluctuations in the interest rate and the slope of the yield curve have significant effects on banks' net interest income. It is said that, returns on bank liabilities are closely tied to short-term interest rates and adjust quickly to changes in the market interest rates. On the other hand, returns on bank assets are seen as more closely tied to longer-term rates and are slower to adjust to changes in the market rates. As a result, bank net interest margins are expected to be higher when the yield curve is steeper for a sustained period, since a steeper yield curve implies higher rates on assets relative to those on liabilities.

In addition, for a given yield curve slope, an increase in both short term and long-term interest rates is expected to temporarily reduce net interest income, reflecting the more rapid adjustment of yields on liabilities than yields on assets. English's (2002) study of commercial banks net interest margin and market interest rates in 10 countries find support for the conventional view on the relationship between changes in market interest rates and the slope of the yield curve on banks' net interest margins.

Saunders and Schumacher (2000) apply the dealer model[4] to six European countries and the United States, using data for 614 banks for the period 1988 to 1995. They find that regulatory requirements and interest-rate volatility have significant effects on banks interest-rate margins across these countries.

Flannery (1981) uses the Seemingly Unrelated Regression (SUR) to conduct a study using 15 banks with asset holdings of over $35 billion at year end in 1978 for the period 1959-1978 in his analysis of the effect of market interest rates on commercial bank profitability in both the long and short run. He finds that four of fifteen banks' interest margins were significantly affected by market rate changes before taxes in the long run. But after adjusting for taxes, net current operating expense (NCOE) is only affected by market changes in the long run for two banks, in that, net earnings increase when the market interest rate increases. The evidence also indicates that the large banks in

[4] The dealer model was developed by Ho and Saunders (1981), it shows that bank uncertainty results from an asynchronous and random arrival of loans and deposits. "A banking firm that maximizes the utility of shareholder wealth selects an optimal markup (markdown) for loans (deposits) that minimizes the risks of surplus in the demand for deposits or in the supply of loans" (Ho and Saunders, 1981). They controlled for idiosyncratic factors that influence the net interest margins of an individual bank, and derived a "pure interest margin," which is assumed to be universal across banks. They found that this "pure interest margin" depends on the degree of management risk aversion, the size of bank transactions, the banking market structure, and interest-rate volatility, with the rate volatility dominating the change in the pure interest margin over time.

Flannery's study were well-hedged against market rate fluctuations and that despite the long run results, bank failures could still occur if market rate fluctuations cause large negative cash flows in the short run.

3. Data & Methodology

This section details the methodology used in the empirical investigation of market interest rate risk and bank profitability. It also mentions the data used and data sources. To reiterate, this paper investigates the effect of market interest rate risk on bank profitability using a modification of Flannery's (1981 & 1983) model with similar assumptions for the period 2000-2008 in Jamaica for two commercial banks.

3.1 The Model

The economic value of a bank is captured using this valuation formula: $V_t = \sum_{t=1}^{\infty} \frac{R_t - C_t}{(1+r_t)^t}$ (1)

Where,

V_t= current market valuation of bank equity

R_t= total interest income

C_t= total interest expense

r_t= discount rate[5] in period t (money market rate)

If banks "borrow short and lend long", then positive shocks to the market rate may result in short term insolvency, which could lead to bank failure, depending on the amount of long term illiquid assets held by the bank. On the other hand, there may be similar durations for asset and liability portfolios, but depositors and borrowers may have different elasticities of substitution between bank securities and open market securities. In this case, the impact of market interest rate on R_t and C_t will be different. That is, if the depositor or borrower has an inelastic rate of substitution, then banks will have greater power in the loan and deposit markets and therefore, more power over economic bank value. The opposite will apply if the depositor or borrower has an elastic rate of substitution between bank securities and open market securities. This paper implicitly includes the former theory on bank valuation and consumer behaviour.

The level and volatility of market rates around their means affect the level of revenue and costs that a bank faces. It is assumed that a significant percentage of commercial banks' business includes small investors and borrowers. Therefore, changes in the level of market rates would lead to significant changes in customer demand and supply of money. Revenue and cost for a bank may also depend on interest rate variability, that is, the level of uncertainty in the money market.

Computation and definition of variables

R_t = net interest income from loans and securities

C_t = interest expense

$R_t - C_t = NCOE$= profit made from interest bearing activities

TA = total assets

[5] Discount rate refers to the rate at which commercial banks borrow from the Central Bank.

σ_t = volatility of market interest rate (Treasury bill rate (tbill) or money market rate (mm))

tb_t= 6 month Treasury bill rates

In keeping with the work of Flannery (1981 &1983), bank valuation is expected to depend upon the level of market interest rate, variability of market interest rate and total assets. It is also expected that bank revenue adjusts with a lag, since a subset of the earning assets may be allocated in the short run. These expectations are combined with the current economic valuation of a bank (eq. 1), in order to investigate the impact of market rates on bank profitability. The following model shows the specification of the model used to empirically test the effect of market interest rate on bank profitability.

$$\left.\frac{\frac{(NCOE_t)}{(1-r_t)^t}}{TA_{t-1}}\right. = \propto_0 + \propto_1 \left(\frac{\frac{(NCOE_t)}{(1-r_t)^t}}{TA}\right)_{t-1} + \propto_2 tb_t + \propto_3 \sigma_{tbill(t)} + \propto_4 \left[r_t\left(\frac{TA_t - TA_{t-1}}{TA_{t-1}}\right)\right] + \propto_5 \sigma_{mm(t)} + \hat{\epsilon}_t \quad (2)$$

Equation 2 specifies that bank valuation (based on a portfolio of 'old' assets) is a function of past valuation (based on its total assets), the level of market interest rate, the variability of the market rate around its mean and interest earned on the change in assets (based on the portfolio of 'old' assets). That is, equation 2 shows the difference between the current return on new earning assets, and the return on previously invested earning assets, that were reinvested.

Expectations on the coefficients are as follows: $0 \leq \propto_1 \leq 1$; $\propto_2 > 0$ (since in Jamaica, with high treasury bill rates commercial banks tend to purchase a lot of government bonds, as opposed to allocating more loans for investment. Also, when treasury bill rates are low, less will be invested in them and other less profitable methods are used to generate bank revenue); $\propto_3, \propto_5 <> 0$; and $\propto_4 > 0$.

3.2. Estimation Techniques

Zellner's Seemingly Unrelated Regression is used to estimate equation 2 for both commercial banks. Since the banks under investigation are similar institutions, it is expected that unobserved explanatory variables omitted from the equation for one bank are similar to those omitted from the equation for the other bank. Therefore, the error terms of the equations for each bank are expected to be correlated. This provides justification for the use of the Seemingly Unrelated Regression (SUR) estimation technique. Also, the Bank of Nova Scotia (BNS) may be considered a price leader, since their interest rates on deposits are usually higher than that of the National Commercial Bank (NCB). This may be corroborated by checking both banks' financial statements. If BNS were to increase its rates, it is expected that NCB will follow its lead. This adds to the justification for the use of the SUR technique in this study as well as justification for the restriction placed on money market rate for BNS[6]. The Seemingly Unrelated Regression Estimation technique will produce smaller standard errors than a regular Ordinary Least Squares (OLS) technique. The LM test for heteroskedasticity, Durbin-Watson test for autocorrelation and an Augmented Dickey Fuller test for the stationarity of the estimated error terms are conducted post regression to ensure proper model specification. Pre-regression, unit root tests were conducted on each variable, as a check for stationarity (see Table 1.1 for a summary of these tests). The models presented in this paper passed all these tests.

[6] The impact of the volatility of money market rate on the Bank of Nova Scotia is assumed to be zero, based on the premise that BNS is a price leader. This seems to be a reasonable restriction for the specification of the SUR model.

3.3 Data

Quarterly data on two of the commercial banks in Jamaica, NCB and BNS, are used for the period 2000 to 2008. The data is solicited from the National Commercial bank, the Bank of Nova Scotia and the International Financial Statistics (IMF) databank. A 180-day treasury bill and the interbank overnight lending rate are used to represent medium term and short term interest rates, respectively. A 3-quarter moving average is also calculated, in order to capture interest rate risk / volatility.

4. Results

Estimation Method: Seemingly Unrelated Regression
Linear estimation after one-step weighting matrix

	Coefficient	Std. Error	t-Statistic	Prob.
$\propto_0$	0.000291	0.001470	0.197626	0.8440
$\propto_1$	0.947545	0.049139	19.28308	0.0000***
$\propto_2$	-0.000155	0.000109	-1.421781	0.1604*
$\propto_3$	0.000218	9.79E-05	2.226978	0.0298**
$\propto_4$	0.000225	0.000636	0.354332	0.7244
$\propto_5$	0.000323	0.001445	0.223163	0.8242
$\propto_6$	0.950822	0.049878	19.06280	0.0000***
$\propto_7$	-0.000159	0.000108	-1.472083	0.1463*
$\propto_8$	0.000208	0.000105	1.985958	0.0517*
$\propto_9$	0.000220	0.000623	0.353687	0.7248
$\propto_{10}$	6.88E-06	2.76E-05	0.249224	0.8041

Determinant residual covariance 3.68E-16

Equation[7]: BPROFITTA=$\propto_0$+$\propto_1$*BPROFITTA1+$\propto_2$*TBILL+$\propto_3$ *STD_TBILL+$\propto_4$*TBCTA

Observations: 35

R-squared	0.937001	Mean dependent var	0.017935
Adjusted R-squared	0.928601	S.D. dependent var	0.006180
S.E. of regression	0.001651	Sum squared resid	8.18E-05
Durbin-Watson stat	2.020930		

Equation: NPROFITTA=$\propto_5$+$\propto_6$*NPROFITTA1+$\propto_7$*TBILL+$\propto_8$ *STD_TBILL+$\propto_9$*TNCTA+$\propto_{10}$*STD_MM

[7] Where NPROFITTA is the profit/total assets (lagged 1 period) for NCB, NPROFITTA1 refers to the lagged ratio of Profit to total assets, TBILL is the 6 month treasury bill rate, STD_TBILL refers to the volatility of the Treasury bill rate and TNCTA refers to the change in total assets at NCB over two periods multiplied by the interest rate. For BNS, BPROFITTA represents the profit/total assets (lagged 1 period), BPROFITTA1 measures the lagged ratio of profit to total assets at BNS, TBCTA refers to the change in total assets at BNS multiplied by the interest rate. Also std_mm refers to the volatility of the money market rate.

Observations: 35			
R-squared	0.937211	Mean dependent var	0.017935
Adjusted R-squared	0.926385	S.D. dependent var	0.006180
S.E. of regression	0.001677	Sum squared resid	8.15E-05
Durbin-Watson stat	2.022142		

Results of the conducted diagnostic tests indicate that the above models were well specified. That is, the Durbin Watson test for autocorrelation is 2.02 in both regressions, indicating the absence of significant serial correlation. The mean of the residual series from both equations is zero, which indicates that the results are efficient and the LM test for heteroskedasticity showed no significant results for heteroskedasticity in the model. Therefore, the results obtained above are suitable for drawing reliable inference. In addition, the determinant of residual covariance is rather small, illustrating that the residuals of the equations of the two banks, exhibit insignificant correlation.

The a priori expectations for all coefficients, except one, were met. Regression results indicate that Treasury bill rates have a negative impact on bank profits. In the regression for BNS the coefficients, $\propto_1$and $\propto_3$ are significant at the 1 percent level and 5 percent level, respectively. Also, in the regression for NCB, the corresponding variables, $\propto_6$and $\propto_8$ display significance at the 1 percent level and 10 percent level, respectively. In addition, Treasury bills are significant at a lower rate of significance for both banks; $\propto_2$ is significant at the 17 percent level of significance and $\propto_7$ is significant at the 15 percent level of significance.

The SUR results for the Bank of Nova Scotia indicate that a unit change in last period's profit has approximately a 0.95 unit impact on current profits (in relation to last period's total assets). Also, a unit change in the volatility of the Treasury bill rate (interest rate risk) leads to approximately a 0.02% change in bank profits. For the National Commercial Bank, a unit change in last period's profits has about a 0.947 unit effect on present bank profits and a unit change in volatility of the Treasury bill rate results in a percentage change in bank profits by 0.02%. A unit change in Treasury bill rate affects the profits of BNS by -0.0002 units and for NCB, a unit change in Treasury bill rate decreases profits by the same figure.

5. Conclusion

The results indicate that market interest rates, in particular, Treasury bill rates have a small effect on bank profitability, across the two major banks in Jamaica. Also, interest rate risk (volatility) has a very small, but negative impact on bank profitability. This suggests that NCB and BNS are well hedged against interest rate risk. Last period's profits, as a share of its total assets influences current profits by a huge figure. This, coupled with the fact that the industry is now of the opinion that non-interest income plays a bigger role in bank profitability than interest income, suggests that the non-interest income shocks and information from last period are also more predictive of bank profitability in the current period as well. Therefore, this study lays the foundation for further research about the impact of non-interest income on bank profitability in Jamaica.

In terms of policy implementation, given the small effects of interest rates and their volatility on bank profitability, though it is advisable to place some amount of emphasis on interest rate stability policies, more emphasis should be placed by regulators on the non-interest income aspect of commercial banking in Jamaica.

References

Allen, L. (1988). The determinants of bank interest margins: A note. *Journal of Financial and Quantitative Analysis 23*(2), 231–35.

Basel Committee on Banking Supervision. (2004). *Principles for the Management and Supervision of Interest Rate Risk.* Bank for International Settlements. Retrieved from http://www.bis.org/publ/bcbs108.pdf?noframes=1 on February 21, 2009.

English, W.B. (2002). Interest Rate Risk and Bank Net Interest Margins. *BIS Quarterly Review*.

Flannery, M. J. (1981). Market Interest Rate and Commercial Bank Profitability: An Empirical Investigation. *The Journal of Finance*, 36(5), 1085-1101.

Flannery, M.J. (1983). Interest rates and bank profitability: additional evidence: A note. *Journal of Money, Credit and Banking*, 15(3), 355-362.

Greene, W.H. (2003). Econometric analysis. Prentice Hall, Upper Saddle River, New Jersey.

Hancock, D. (1985). Bank profitability, interest rates and monetary policy. *Journal of Money, Credit and Banking*, 17(2), 189-202.

Hanweck, G. A and Ryu, L. (2005). The sensitivity of bank net interest margins and profitability to credit, interest-rate, and term-structure shocks across bank product specializations. *Working paper*, retrieved from http://www.fdic.gov/bank/analytical/working/wp2005/WP2005_2.pdf.

Hanweck, G. A. & Thomas, E. K. (1984). Bank Profitability and Interest Rate Risk. *Journal of Economics and Business*, 36(1), 77–84.

Hill, R.C., Griffiths, W.E. & Judge, G.G. (2001). Undergradute econometrics. Prentice Hall, Upper Saddle River, New Jersey.

Samuelson P. A. (1945). The effect of interest rate increases on the banking system. *American Economic Review,* 35, 16 -27.

Thomas S. Y. Ho & Saunders, A. (1981). The determinants of bank interest margins: Theory and empirical evidence. *The Journal of Financial and Quantitative Analysis*, 16(4).

Appendix

LM test for Heteroskedasticity in the SUR residuals

Null Hypothesis: There is no heteroskedasticity in the residuals

Test statistic: R-square

Critical value:

($0.05,24$)

Decision rule: Reject the null hypothesis if (n*R-square) > Critical value

Conclusion: Since the critical value is 36.415 and the test statistic is 32.802, we fail to reject the null hypothesis of no heteroskedasticity in the residuals.

Table 1.1: Summarizing the results of the ADF tests

Unit root test in levels	
Variables	ADF
	T.Statistics
BNSNCOE/TA(-1)	2.847885*
BNSNCOE(-1)/TA(-1)	2.666068*
NCBNCOE/TA	3.102858**
T.bill	2.868496*
Std_tbill	1.403222**
tbcta	3.134052**
Tncta	3.098781**

The tables display information on the unit root tests of the relevant time series used in this study. For the ADF test, *, ** and *** represent Mackinnon critical values for the rejection of the null hypothesis of a unit root at the10%, 5% and 1% level of significance, respectively.