Analysis of Risk-weighted Capital Requirements on the Commercial Banking Sector & Implications of New Capital Requirements in Trinidad and Tobago.

ABSTRACT

Alon Dhanessar, Avinash Ramlogan, Akeem Rahaman[1]

This paper seeks to investigate whether Basel I capital adequacy rules, which had been adopted in 1994 to manage the health of the domestic banking sector, adversely impacted the level of economic activity in Trinidad and Tobago. The paper first utilizes detailed bank balance sheet data to provide a preliminary empirical assessment, followed by a formal assessment employing a cointegrating vector error correction model using macroeconomic and aggregate commercial bank data over the period 1994 – 2014. We find that capital rules under Basel Accord I adversely affected overall credit supply and the level of economic activity. However the result shows that the impact was largely insignificant, mainly due to the highly capitalized nature of the commercial banking sector. Considering that the nation is poised to adopt the Basel II rules in the near future, the effect of more stringent requirements is not likely to have any major adverse effects on private sector credit availability and by extension, investments in the local capital markets.

[1] The authors are economists in the Research Department of the Central Bank of Trinidad and Tobago. The views expressed in this paper are those of the authors and not necessarily those of the Central Bank of Trinidad and Tobago.

Contents

1. Introduction ... 3
2. Literature Review ... 4
3. Capital Adequacy Ratio (CAR): Supervision Framework and Recent Trends in Trinidad and Tobago ... 8
4. Data and Methodology ... 15
5. Results ... 27
6. Conclusion ... 31
7. Appendix ... 33
8. References ... 41

1. Introduction

In 1988, the Bank for International Settlement (BIS) met with major internationally active banks in G-10 countries to discuss ways to improve their resilience to financial crises. The outcome was a recommendation that banks need to hold capital to reflect the level of riskiness of assets they hold on their balance sheets – and the creation of risk-weighted capital rules called Basel I.

Risk-weighted capital rules have been the subject of debate ever since the 1988 Basel Accord was proposed by the Basel Committee on Banking Supervision. Originally intended for major internationally active banks in G-10 countries, the Basel Accord became increasingly adopted by financial regulators in many emerging and developing economies around the world as a minimum standard capital requirement. Although the Basel Accord was intended to create a level playing field for big banks, its use as a model for capital regulation for national banking systems has grown in both emerging market and developing economies.

Over time however, widespread concerns arose in emerging and developing economies about the possible negative consequences capital rules are likely to have on the level of economic activity in these economies. Primarily, these concerns stem from the fact that tighter rules can stifle the availability of credit by banks which could impact economic activity in these countries.

These concerns are further exacerbated by the fact that countries adopting Basel's capital rules are likely to also face tighter capital requirements as the Basel Committee on Banking Supervision update these rules over time. The new Basel III is already a concern in the international banking community, that tighter and more demanding capital rules could stifle the progress of recovery of the global economy by restricting credit supply and ultimately the level of economic activity.

In Trinidad and Tobago, the financial system is essentially bank centric. It has been almost two decades since Trinidad and Tobago adopted the Basel Accord for its banking sector. The Basel rules, legislated in the Prudential Criteria Regulations Act of 1994, have certainly strengthened the banking sector over the years but it is important to investigate how this policy has impacted economic activity in Trinidad and Tobago. It should be noted that the commercial banking sector is a major constituent of the Finance, Insurance, Real Estate, and Business Services sub-sector under the broader Services sector. Over the period examined, this sub-sector represents between 12 to 16 per cent of real GDP, currently being closer to the higher end of the range. The historic trend of this sub-sector can be seen in Appendix 1.

This paper empirically tests the impact of Basel I capital rules on the level of credit supply and economic activity in Trinidad and Tobago. The paper is divided into six sections. Section two reviews the literature related to the impact of Basel capital requirements on the level of economic activity. Section three provides a review of trends in capital rules in Trinidad and Tobago. Section four describes the empirical framework and model to be used. Section five discusses some preliminary results and the final section concludes.

2. Literature Review

This section of the paper reviews the literature on capital rules and their impact on macroeconomic activity.

There is some evidence that in the United States, certain sectors, particularly real estate, may have been affected by constraints on bank capital. For instance Hancock and Wilcox (1997) examine the impact of unexpected reductions in banks' capital on credit availability and real sector activity in the United States real estate markets. Further, the authors also examine the impact of bank capital shocks on credit availability on the small business sector. These sectors have traditionally relied on bank lending. In their study, Hancock and Wilcox (1997) employed a simple regression model to estimate a state level bank portfolio adjustment model that relates state-wide growth in real estate lending (for single family and commercial real estate) to a measure of banks capital pressures (the average shortfall/surplus to an assumed 4.75 per cent standard leverage ratio), indicators of national economic conditions, state-wide economic conditions, and other variables. They find that commercial real estate lending is much more vulnerable to negative capital shocks than is single family residential mortgage lending.

Peek and Rosengren (1995) also conduct a similar examination on pooled time-series and cross-sectional panel of balance sheet and income statement data where they determine a correlation between bank shrinkage and capital ratios as a result of voluntary actions by undercapitalized banks seeking to improve their capital ratios. Peek and Rosengren (1997a) also examine the commercial real estate sector. They find that lending by US branches and subsidiaries of Japanese banks over the period 1988 – 1995 was highly sensitive to the parent's regulatory capital positions, and in particular the concentrations of problem loans in the bank's portfolio. They conclude that Japanese banks with high concentrations of problem loans reduced their lending to the commercial real estate market. This suggests that capital constraints are important elements in the reduction in lending and not a slippage in loan demand or the credit worthiness of borrowers.

Consistent with the above, there is evidence which suggests that the distribution of capital among banks, and not the aggregate capital ratio, can have an important effect on macroeconomic activity. Evidence also exists to support borrower relationships with specific banks in US and Japan can create strong linkages between bank lending and the performance of the macro economy. Further, some studies show that a reduction in lending by capital constrained banks has had macroeconomic effects (Oliner and Rudebusch, 1996 and Hancock and Wilcox, 1998).

Researchers have been rather less successful in assessing the impact at the aggregate level, although some papers have identified linkages between pressures to meet capital requirements and economic output. Given that adverse shocks to capital requirements can potentially affect macroeconomic activity through their effects on lending, a number of studies have focused on this area. These studies have mainly investigated whether bank lending have affected proxies for macroeconomic activity, such as GNP or GDP.

Some studies support the view that regulation of the banking industry through capital rules under Basel would yield a number of benefits including an improvement in bank soundness, which in turn can promote economic activity and growth (Demirgüç-Kunt, Detragiache, and Tressel, 2008). Conversely, others (such as Alexander and Baptista, 2006) attempt to show that holding minimum capital levels may not necessarily help in decreasing fragility of banks but rather encourage banks to engage in 'regulatory capital arbitrage' where banks reduce the amount of capital required by increasing the risk in their trading portfolios. Some authors suggest that the reason for the US recession in the early 1990s is to be found in a capital crunch rather – a special type of credit crunch. The introduction of new Basel rules in the US consequently led to a failure of US banking sector to play its important role of transmitting monetary policy (sizeable cuts in interest rates) to promote growth the in US economy.

Some studies show that stricter capital requirements can alter banks' behavior. In particular, the introduction of new capital rules can cause banks to alter their portfolios away from heavily risk weighted assets, such as loans and corporate bonds, to low or zero risk weighted assets such as government bonds. For instance, Montgomery (2005) finds that in Japan, international banks with low core capital ratios tended to shrink their overall assets and shift their asset portfolios out of heavily weighted risky to zero weighted assets, post-Basel period. Thakor (1996) and Passmore and Sharpe (1994) demonstrate that an increase in a risk-based capital requirements can cause a bank to shift from loans to securities. Furlong and Keeley (1989) argue that a value maximizing bank will not increase its asset risk under more stringent capital requirements. Furfine (2000) also shows that a shift in banks' asset portfolio occurred in the United States following the institution of the Basel Accord in 1988. Banks simultaneously reduced their investment in riskier commercial lending in favor of less-risky government securities, such that the share of total bank credit in commercial and industrial loans fell from 23 per cent in 1989 to under 16 per cent in 1994, while at the same time the share of total bank credit invested in US government securities increased from 15 per cent to 25 per cent over the same period.

In assessing the macroeconomic impact of the transition to stronger capital and liquidity requirements, Parcon-Santos and Bernabe (2012) utilized an unrestricted VAR model in their analysis of the macroeconomic effects of Basel III implementation in the Philippines. The authors examine the relationship with bank capital, lending wedge (difference between borrowing and lending rates), aggregate bank loans to consumers and firms in the form of loan portfolios and economic output (real GDP). The authors find that the Basel III higher capital requirements may only have an initial temporary negative effect on the Philippine economy and therefore monetary policy response to this may be unnecessary. In addition the authors indicate that the temporary negative effect may be due to the fact that Philippine banks are very well-capitalized. In a similar yet more intricate study, Akram (2012) investigated the macro effects of higher bank capital requirements on the Norwegian economy by developing a vector error correction method (VECM) containing systems and single-equation dynamic models for ten financial and real variables specific to the Norwegian economy. The author's results indicate that higher capital requirements considerably affect credit growth and house prices, however only moderately affect GDP. Conversely, the author does not find statistically significant direct effects of the change in capital adequacy requirements on credit to households and firms. Evidence from Parcon-Santos and Bernabe (2012), and Akram (2012) therefore suggest a shock to capital adequacy requirements can have varying effects on economies ranging from a reduction in credit supply to a temporary effect on economic output.

Eichberger and Summer (2005) analyze the impact of capital adequacy regulation on bank insolvency and aggregate investment. They apply an intricate model of the banking system, characterized by the interaction of many heterogeneous banks with the real sector and interbank credit relations as a consequence of bank liquidity management and an insolvency mechanism. They determine that the effects of capital adequacy regulation for financial stability are uncertain and systemic risk might actually increase as a result of imposing capital constraints on banks.

Alternatively, other studies attempt to determine the optimal capital adequacy ratio a banking system should strive to achieve in order to maximize profitability. This in turn would provide the banking system with sufficient defense against financial crisis while allowing optimal gains for shareholders. One such study by Färe, Grosskopf, and Weber (2004) utilize complicated mathematical optimization techniques to analyze profit inefficiency as a value normalized difference between maximum profit and observed profit. Their results indicate that risk-based capital standards have a significant effect on bank allocative efficiency which is a large source of profit or loss. Risk-based capital requirements therefore considerably reduce estimated profit efficiency due to banks selecting a non-optimal mix of assets and liabilities. The study suggests that when the banking sector implements capital rules, profitability can be affected through the inefficient allocation of private sector loans which in turn can negatively affect economic output.

Many studies with sophisticated methodologies are prepared in order to determine the effect of stricter capital requirements on banking systems and the macro economy through credit channels. These scholarly works all indicate that economic activity is either positively or negatively impacted by capital adequacy policy through either improving or restricting credit supply. Considering that data may be limited in order to effectively replicate some of the studies outlined, we choose to employ the VECM Johansen cointegration analysis. This method is less complex than others and is an ideal starting point in analyzing the effect of capital adequacy rules on the Trinidad and Tobago economy. The methodology implemented in this paper is discussed further in section 4.

3. Capital Adequacy Ratio (CAR): Supervision Framework and Recent Trends in Trinidad and Tobago

This section of the paper describes the framework and recent trends in capital adequacy ratio for the commercial banking system[2] in Trinidad and Tobago. A key part of the Central Bank of Trinidad and Tobago's prudential supervision of local banking sector institutions is the setting of capital adequacy guidelines under which these institutions must follow. A bank's capital can be regarded as evidence of the shareholders willingness to commit their personal resources to cushion against future losses.

In 1994, the Central Bank of Trinidad and Tobago introduced a new approach to the supervision of commercial banks and non-bank financial institutions regulated under the then Financial Institutions Act (FIA) 1993. Under this new system, an allowance is made for differences in the classes of banks assets[3]. The Bank's approach is broadly consistent with the framework proposed by the Basel Committee on Banking Supervision in July 1988 as a basis for measuring capital of banks. Although the Accord was revised on two occasions (Basel Accords II, and III), the current prudential framework in operation in Trinidad and Tobago is the Basel I.

The initial focus of capital adequacy in Trinidad and Tobago was on credit risk only, but this was expanded in 2008 to include market risk. Credit risk, is the potential risk that a borrower from a bank may default on its obligations. Market risk is the potential risk that increases in market interest rate adversely affects the value of assets on a bank's balance sheet. In terms of credit risk, the capital adequacy arrangements requires that all credit exposures (on- or off-balance sheet) be risk-weighted according to three broad categories of counterparties (that is government, banks, and all others) – the higher the credit risk associated with the asset the more capital

[2] Note that this study is on the commercial bank sub-sector and not the consolidated banking system which includes both the commercial banks and non-bank sub-sectors. It should also be noted that both sectors were impacted by the new Basel rules.
[3] Details of the Central Bank of Trinidad and Tobago's Capital Adequacy Framework can be found in the Prudential Criteria Regulations 1994.

backing required. Under the Basel framework there are five types of risk weights, 0, 10, 20, 50, and 100 per cent. These rules apply to both commercial banks and their affiliated subsidiaries and other non-bank financial institutions regulated under the FIA 2008[4].

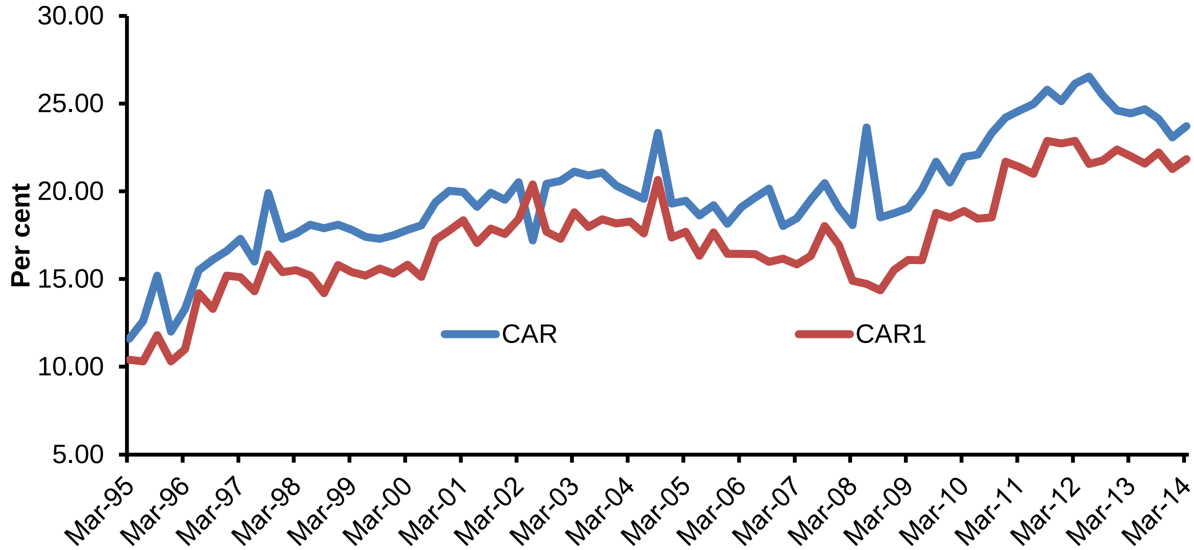
For supervisory purposes, Basel Accord I capital is disaggregated into two tiers. Tier 1 (also called 'core' capital), comprises of the richest quality capital resources such as paid-up ordinary shares, non-repayable share premium account, general reserves, retained earnings, non-cumulative irredeemable, preference shares, and minority interests in subsidiaries. Tier 2 (also called non-core or supplementary) capital, includes other elements which do not rank as high in terms of quality to be considered as core capital, but still contributes to the strength of the bank. Tier 2 capital is further sub-divided into two tranches, depending of the degree of permanence associated with the type of capital instrument. The upper Tier 2 tranche consists of general provisions for doubtful debts, asset revaluation reserves, cumulative irredeemable preference shares, perpetual subordinated debt, and mandatory convertible notes and other similar instruments. The lower Tier 2 tranche comprises limited life redeemable preference shares and term subordinated debt. The lower Tier 2 capital cannot exceed 50 per cent of Tier 1 capital, and total Tier 2 capital cannot exceed Tier 1 capital. Trinidad and Tobago also follow international standards which require local banks to hold a ratio of capital to risk-weighted assets of at least 8 per cent, and 4 per cent in core capital.

[4] The FIA 1993 was upgraded in 2008.

Chart 3.1

Commercial Banking sector: Trends in CAR and CAR1

Per cent



Source: Central Bank of Trinidad and Tobago
Note:

$$CAR\ 1 = \frac{Tier\ 1\ Capital}{Risk\ Weighted\ Assets} \qquad and \qquad CAR = \frac{Tier\ 1 + Tier\ 2\ Capital}{Risk\ Weighted\ Assets}$$

The chart above shows the aggregate risk-weighted capital ratios for the local commercial banking sector for the period Q4:1994 – Q1:2014. Figures for the end of Q1:2014 indicate a capital adequacy ratio of 23.7 per cent, which is well above the 8 per cent regulatory minimum. It is also apparent that there had been no significant rise in Tier 2 capital, but a strong rise in the Tier 1 capital over the period 1994 – Q1:2014. Chart 3.1 also illustrates that Tier 1 to risk weighted assets alone was significantly over the 8 per cent regulatory minimum. The Chart further indicates that while there was a general rise in the capital adequacy ratio through last nineteen years, there were some years in which the ratio either stagnated or declined. We further analyze the capital adequacy ratio by looking at its components.

According to the literature, there are three main channels through which banks can make adjustments to their capital adequacy ratios. Firstly, banks can influence their capital base by increasing or decreasing their core or non-core capital. A second strategy involves changes to the assets side of their balance sheets. Thirdly, banks can seek to reduce their risks-weighted assets by replacing riskier (higher-weighted) loans with safer ones, or with government securities.

Table 3.1 below decomposes changes in the capital adequacy ratio of the banking sector according to the three major strategies which can be adopted. The table further splits the entire period 1994 – Q1:2014 into three sub-periods to determine if the strategies adopted by the banking sector varied according to the changes in the growth prospects in the domestic economy.

As shown in the table, growth of the capital adequacy ratio over the last nineteen years or so may have been due to several factors. Firstly, we note that since the introduction of fixed capital rules in line with the Basel Accord, there was a steady rise in the capital base of the system.

Table 3.1

Decomposition of the Average Annual Change in CAR (%), 1994 – Q1: 2014

	1994 - 2002	2003-2008	2009-2013	1994 - Q1: 2014
Change in Capital Adequacy Ratio	3.03	-0.15	1.30	1.57
Due to Change in Capital	7.28	6.04	3.08	5.60
Due to Change in Total Assets	4.63	6.38	2.09	4.60
Due to Change in Risk	-0.48	-0.17	-0.32	-0.61

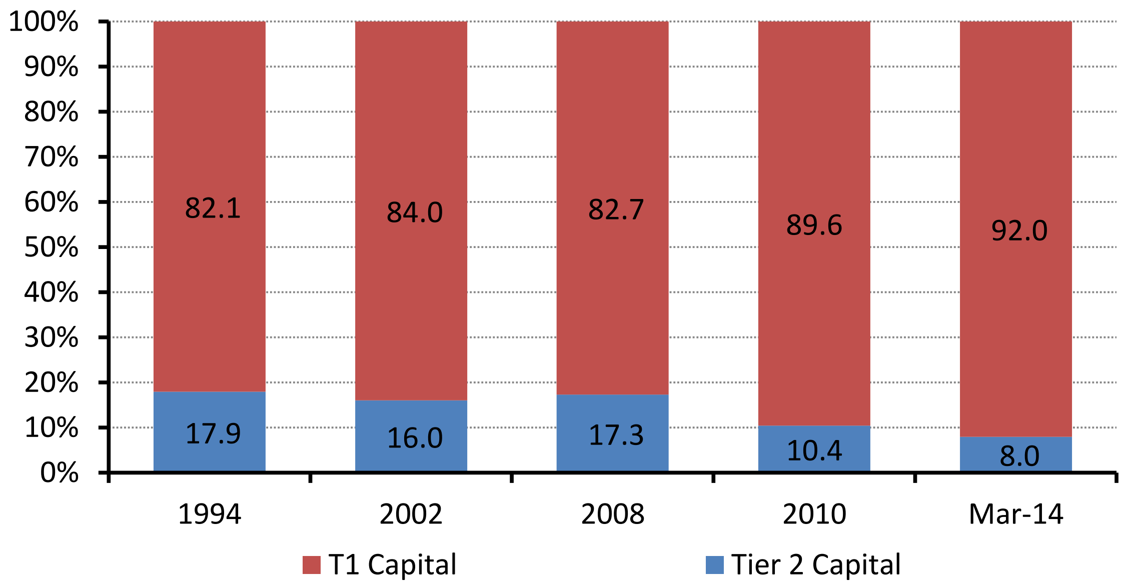
Source: Central Bank of Trinidad and Tobago.
Note:
$\frac{\Delta\, CAR}{\text{CAR}} = \frac{\Delta\, K}{K} - (\frac{\Delta\, A}{A} + \frac{\Delta\, RISK}{RISK})$ Roy P.V. (2008)

During the period, the capital adequacy ratio rose on average 1.57 per cent annually. The bulk of the adjustment to the capital adequacy ratio came from an expansion in the capital base, which grew on average by 5.6 per cent annually. Charts 3.2 and 3.3 below provide a breakdown of regulatory capital for the banking sector. It could be seen that the banking sector used retained earnings to build its capital base. Appendix 2, point to an expansion in the capital base of the banking sector from $1,311.4 million at end-1994 to $14,663.8 million at end-Q1:2014.

Chart 3.2

Commercial Banks: Decomposition of Regulatory Capital

/Per cent/

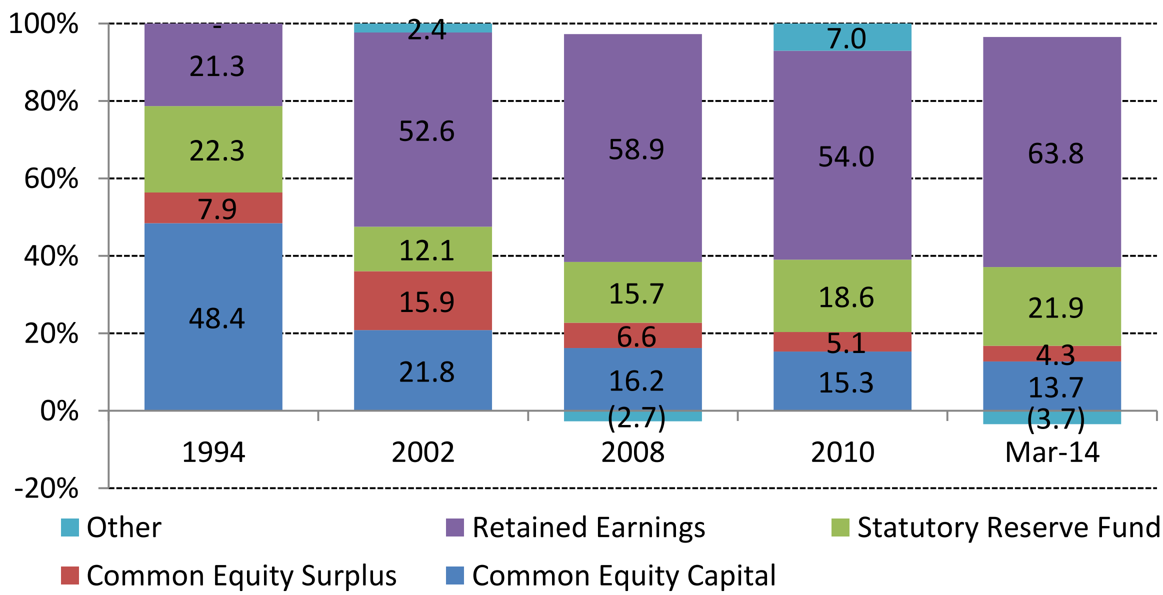


Source: Central Bank of Trinidad and Tobago.

Chart 3.3

Commercial Banks: Decomposition of Tier 1 Capital

/Per cent/



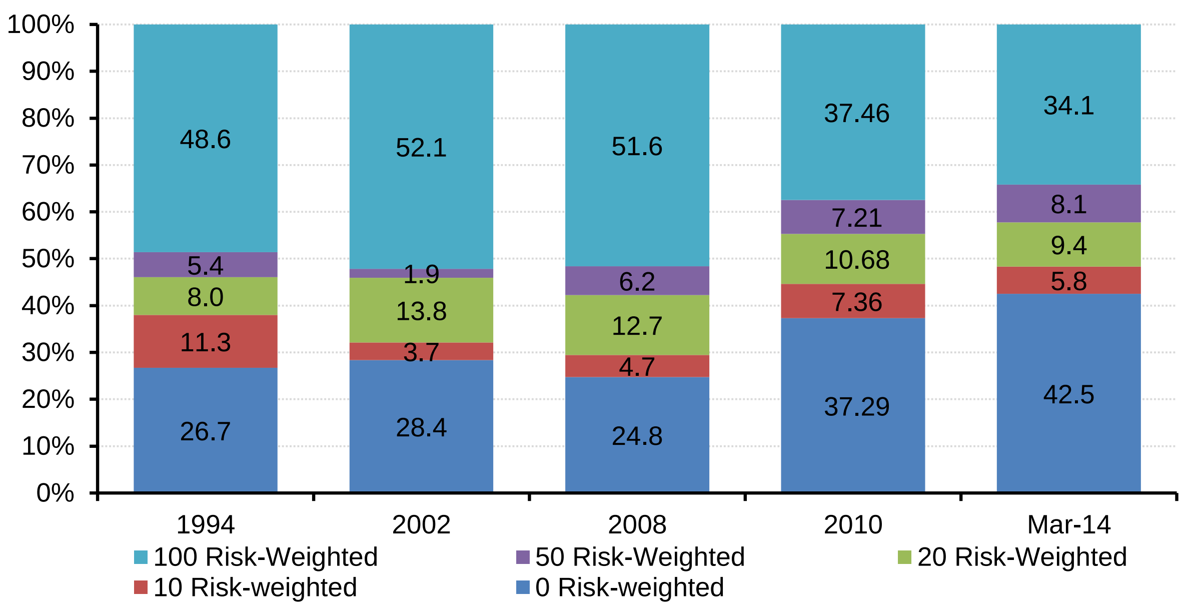
Source: Central Bank of Trinidad and Tobago.

It is apparent that a reduction in risk-taking played a much smaller role in the upward adjustment in capital adequacy ratio observed over the period. Table 3.1 indicates that credit risk-weighted assets of the baking sector declined by 0.61 per cent per annum between 1994 – Q1: 2014. Key sources of reductions in the level of risk-weighted assets over the period includes fluctuations in credit demand, and changes in the mix of banks' business. As shown in Chart 3.4 below, the proportion of 100 per cent risk-weighted assets held in the banking sector's balance sheet rose from 48.6 per cent at the end of 1994 to 51.6 per cent in 2008, before declining to 34.1 per cent by March 2014. Simultaneously, 0 per cent risk-weighted assets which had been trending downwards over the period 1994 to 2008, reversed course since from 2009. At the end of March 2014, this category of assets rose to 42.5 per cent of total risk assets in the balance sheet of the banking sector.

Chart 3.4

Commercial Banks: Decomposition of Risk-Weighted Assets

/Per cent/



Source: Central Bank of Trinidad and Tobago.

Note: Chart includes on-balance sheet assets only.

Chart 3.5 which displays the trends in private sector credit to GDP, capital-to-assets and capital-adequacy ratios for the commercial bank sub-sector in Trinidad and Tobago shows some interesting results. It appears that the behavior of credit and capital adequacy is influenced by the growth prospect of the economy which in turn was affected by developments in the energy sector and shocks to international energy prices. Higher energy output and prices which boosted revenues for the central government provided for higher public sector expenditure. During this period disposable income of households began to rise and private sector firms also enjoyed greater profits. These developments fuelled consumption and investment spending in the domestic economy and credit demand in the local banking sector. It is also important to note that during this period inflationary pressures in the domestic economy began to rise which prompted the Central Bank of Trinidad and Tobago to tighten monetary policy. The chart shows that over the period 2004 – 2008 the commercial banking system saw a slight fall-off in its capital adequacy ratio. During this period private sector credit grew faster than GDP as indicated by the private sector credit to GDP ratio which increased from 26.4 per cent in 1995 to 46.4 per cent by 2008.

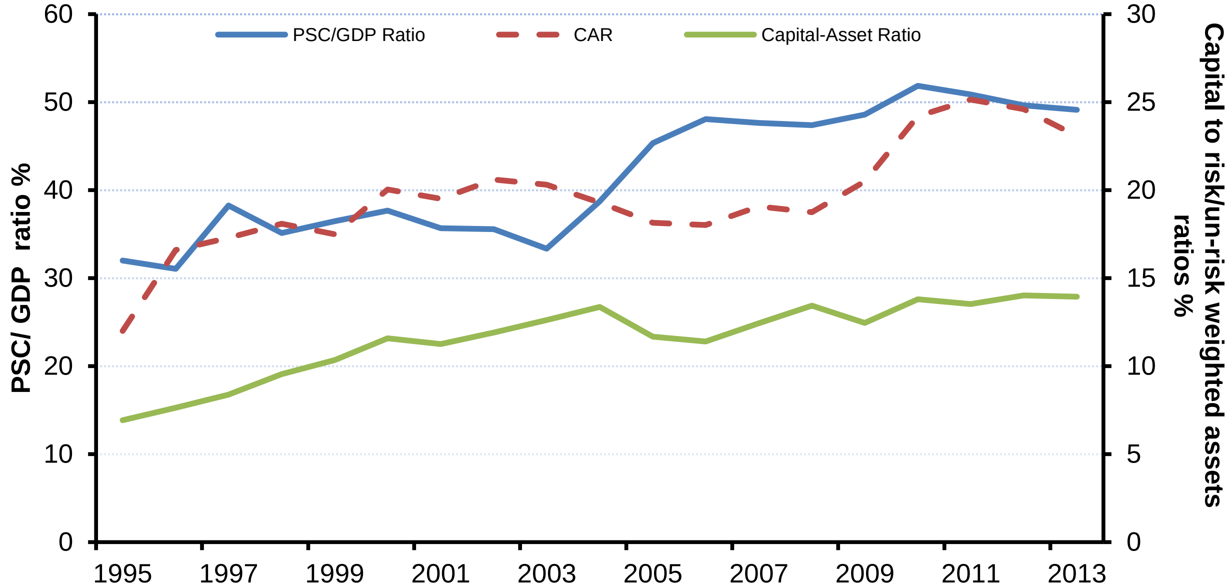
A collapse in energy prices during 2009 adversely impacted the Trinidad and Tobago economy. A fall in energy revenues forced the government to reduce its expenditure programmes between 2009-2011. Concerns about employment conditions resulted in households lowering their demand for goods and services and their demand for credit from the local banking sector. Private sector firms also began to deleverage, reduce or postpone their spending on plant and equipment. This also led to a fall-off in demand for business credit in the local banking sector. In order to stimulate the domestic economy the government began to borrow (via domestic and international) to boost its expenditure levels. In addition, to stimulate non-energy growth, the Central Bank also began to lower its policy rate to encourage borrowing especially for investment by the local private sector. These developments coincided with a pick-up in the capital adequacy ratio for the banking sector.

During the last two years or so 2012 – 2013, the Trinidad and Tobago economy recovered some lost ground but is yet to witness a sustainable pace of expansion. Although GDP has been rising, private sector credit is currently lagging behind. This could be seen in the credit to GDP ratio which dipped from 50.9 per cent at the end of 2011 to 49.1 per cent by the end of 2013.

Chart 3.5

Trends in Lending, Economic Growth and Capital Adequacy: 1995 – Q1: 2014

/Per cent/



Source: Central Bank of Trinidad and Tobago.

Note:
1. GDP = Non-Energy GDP

4. Data and Methodology

The unrestricted VAR model framework suggested by the Macroeconomic Assessment Group (MAG 2010a) and utilized by Parcon-Santos and Bernabe (2012) examined the relationship with bank capital, lending wedge (difference between borrowing and lending rates), aggregate bank loans to consumers and firms and economic output (real GDP). The VAR specification employed by Parcon-Santos and Bernabe in 2012 was as follows:

$$\Delta Y_t = c + \sum A_p \, \Delta Y_{t-p} + v_t \qquad (1)$$

where Y_t is the vector of endogenous variables DLCAPITAL, DLWEDGE, DLLOANPORT, and RGDPGR. The variable A_p represents the matrix of coefficients, c represents the intercept vector of the VAR and v_t represents the generalization of white noise process.

To assess the impact of Basel I and specifically capital adequacy requirements on the level of economic activity in Trinidad and Tobago we utilize a model similar to that of MAG (2010) and Parcon-Santos and Bernabe (2012) by using a Vector Error Correction Estimates model (VECM). This type of model is a restricted VAR that has cointegrated restrictions built into the specification and designed for use with non-stationary variables. We utilize aggregate commercial banking balance sheet data plus macroeconomic variables which are capital, loans and investments to the private sector credit. In addition we use lending spread as the difference between the weighted average interest rates on all loans and deposits of the commercial banking sector. Finally we utilize the Index of Domestic Production (IDP) excluding the energy sector as a proxy for economic output. The first four variables were sourced from the Central Bank's quarterly regulatory returns while the fifth was taken the Central Statistical Office and all data spanned the period Q4:1994 to Q1:2014.

The use of the VECM allows for the identification of long-run equilibrium relationships as well as identification of the short-run dynamics between the variables under consideration. The VECM therefore considers how a unit change in capital adequacy ratio, affects the variables of concern in the long-run with short-run underlying forces. A major advantage of this approach is that it does not require any prior modelling of statistical relationships among the variables of interest as with other modelling approaches. However, a key disadvantage is that we use a limited number of variables in the model so that the results should be viewed as an approximation to a larger structural system.

Similar to other studies (MAG 2010) we assume that capital funding costs are fully passed on to lending rates thereby increasing lending spreads. As a consequence, firms and consumers are adversely affected and reduce their demand for commercial bank credit, which lowers consumption and investment spending financed via debt, which eventually lead to a reduction in economic output. Based on this, we develop one main model and three sub-models to determine the effect of capital adequacy ratios on the various credit types in the banking system. The first model (2A) will examine the effect on overall total private sector credit, while the other three sub-models will examine the effects on business credit (2B), consumer credit (2C) and mortgage availability (2D). The variables of lending spread and index of domestic production will remain standard in all models. In addition, the model will include the exogenous variable of West Texas Intermediate (WTI), as a benchmark in oil pricing.

The vector error correction representation for all models is given as:

$$\Delta Y_t = \mu + \alpha\beta' Y_{t-p} + A_1 \Delta Y_{t-1} + \ldots + A_{p-1}\Delta Y_{t-p+1} + \delta X_t + \varepsilon_t \qquad \text{(2: A to D)}$$

Where, Y_t is the vector of non-stationary endogenous variables, and X_t is the vector of exogenous variables. Y_t will therefore be a 4×1 vector matrix vector of endogenous variables. The α represents adjustment coefficients, while β represents the matrix of long run coefficients with $k \times r$ dimensional matrices. The variable k symbolizes the number of variables in the vector of endogenous variables while r represents the number of cointegrating relationships in each model. The factor A_i where $i = 1 \ldots .(t-p+1)$ characterizes the cumulative impact parameters and ΔY_t is the vector of stationary variables. In addition, the variables α and β must be stationary in order for ε_t, the error term, to be stationary.

$$Y_t' = [LSPREAD_t, LRTPSC_t, LIDP_t, LCAR_t] \quad \text{and} \quad X_t' = [LRWTI_t] \qquad \text{(2A)}$$

$$Y_t' = [LSPREAD_t, LRBC_t, LIDP_t, LCAR_t] \quad \text{and} \quad X_t' = [LRWTI_t] \qquad \text{(2B)}$$

$$Y_t' = [LSPREAD_t, LRCC_t, LIDP_t, LCAR_t] \quad \text{and} \quad X_t' = [LRWTI_t] \qquad \text{(2C)}$$

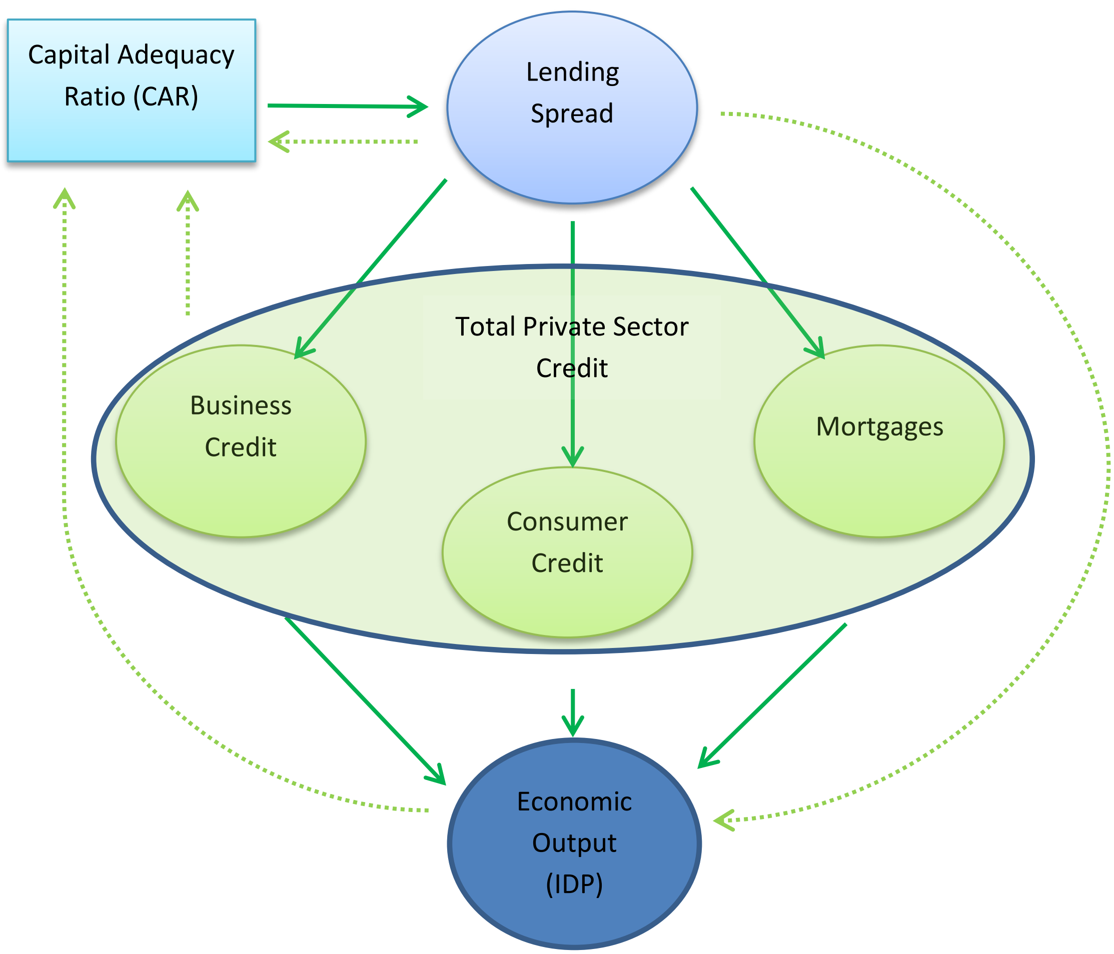
$$Y_t' = [LSPREAD_t, LRMORT_t, LIDP_t, LCAR_t] \quad \text{and} \quad X_t' = [LRWTI_t] \qquad \text{(2D)}$$

The vector of endogenous variables includes lending spreads (LSPREAD), total private sector credit (LRTPSC), Index of Domestic Production (LIDP) and capital adequacy ratio (LCAR). The sub-models divide the total private sector credit into business credit (LRBC), consumer credit (LRCC), and mortgages (LRMORT). These variables will take into account interest rate and credit channels, and its subsequent effect on productivity.

The ordering of the VAR variables are as follows: LSPREAD, LRTPSC, LIDP, and LCAR. The ordering is similar to that of MAG (2010) and Parcon-Santos and Bernabe (2012). Since our interest is to test the impact of an increase in capital adequacy ratio on the macro economy, LCAR is positioned at the end of the ordering. The order begins with lending spreads, followed by total private sector credit, and Index of Domestic Production. Capital adequacy ratio is placed last in the ordering to allow the variable to have the maximum opportunity to take effect through several channels in the following period. Again with the sub-models, the order remains the same apart from the change in real total private sector credit into the sub-credit variables. The ordering of the model as seen in diagram 4.1 is based on a simplified version implemented by Akram (2012).

Diagram 4.1

Model Transmission Channels



Source: A. Ramlogan, A. Dhanessar

The model is based on the notion that banks have specific strategies they can implement to increase their capital adequacy ratio. The first strategy being a rights issue to shareholders requesting increased capital through the issue of new equity or reducing the share of profits distributed to shareholders. This strategy is highly unlikely as issuing more equity will decrease current shareholders value in the firm, and decreasing dividend distribution may result in the loss of investors. The second strategy is a reduction in risk-weighted assets by replacing with better quality assets. This scenario is somewhat minimal due to the limited investment potentials available in Trinidad and Tobago with respect to the availability of safe-haven government securities, however, Chart 3.4 shows that over the period 1994 to 2014 commercial banks holdings of risk-weighted assets has declined from 48.6 per cent to 34.1 per cent for 100 per cent risk-weighted assets while holdings of zero per cent risk-weighted assets have increased from 26.7 to 42.5 per cent. A third strategy will be for banks to reduce risk-weighted assets (RWA) by reducing the amount of available loans that classify as high rated RWA's or even slowing lending growth. This scenario is possible, however, banks will rely on income from rates charged on loans and therefore may not be viable. The final strategy will be for banks to increase the spread between rates charged on loans and rates paid on deposits. This scenario is the most likely one since an increased spread will result in greater retained earnings and therefore greater supply of Tier 1 and Tier 2 capital.

Once banks begin increasing the rates earned relative to rates paid, the overall system lending spread will begin to rise. At this point, the effect on credit availability and demand is examined. Theoretically, an increase in lending rates on various types of credit should decrease the demand for such credit. However, Birchwood and Nicholls (1999) and Ramlogan et al (2009) find that the demand for credit in Trinidad and Tobago is particularly responsive to changes in economic activity. The authors determine that a long-run demand-following relationship exists between these two variables. Therefore, the cost of credit in Trinidad and Tobago does not heavily influence the demand for credit. The final transmission effect goes towards the index of domestic production. It is assumed, that the transmission of these variables essentially negatively affects spending and investment by households and firms and therefore is a potential damper on economic growth.

In an attempt to investigate the long-run relationships utilizing a VECM model, a necessary prerequisite is that all variables be integrated of order one, I(1), or non-stationary. In the VAR model, stationary variables are used since it examines the short-run memory process, hence the differenced variables used in the models of MAG (2010) and Parcon-Santos and Bernabe (2012). The formal method for determining stationarity of the variables is the Augmented Dickey-Fuller test which tests the null hypothesis that the variable has a unit root or is non-stationary. The alternative hypothesis is that the series is stationary and hence not suitable for a VECM type model. The variables stationarity was also confirmed using the Phillips-Perron test which uses the same null and alternative hypothesis (Table 4.1). The tests indicate that the variables have a unit root, are non-stationary at level and are stationary at the first differenced.

Table 4.1

Stationarity Testing

MacKinnon (1996) one-sided p-values.					
Variable	**Augmented Dickey-Fuller (level)**	**Augmented Dickey-Fuller (first differenced)**	**Phillips-Perron (level)**	**Phillips-Perron (first differenced)**	**Inference**
LCAR	0.0353 *	0.0000	0.0633 *	0.0001	I(1)
LSPREAD	0.7413 **	0.0000	0.5937 **	0.0000	I(1)
LRTPSC	0.9896 **	0.0000	0.9698 **	0.0000	I(1)
LIDP	0.9998 **	0.0000	0.9960 **	0.0000	I(1)
LRBC	0.9887 **	0.0000	0.9912 **	0.0000	I(1)
LRCC	0.9417 **	0.0000	0.9253 **	0.0000	I(1)
LRMORT	0.4439 **	0.0000	0.4433 **	0.0000	I(1)

* and ** indicates the acceptance of the null hypothesis at the 1% and 10% significance levels, respectively.
Source: Eviews 7.0, Quantitative Micro Software, LLC

Given that all the variables being tested are non-stationary, the next step in the procedure is to determine the appropriate lag length for the models. According to Ozcicek and McMillin (1999), a critical element in the specification of VAR models is the determination of the lag length of the VAR. The authors further state that estimates of a VAR whose lag length differs from the true lag length are inconsistent as are the impulse response functions and variance decompositions derived from the estimated VAR. Furthermore, the lag length for a restricted VAR or cointegrating VECM model is known to be one less than that suggested for a VAR (Brooks, 2008).

The appropriate lag length for the models can then be determined using the various lag length selection criterion such as Likelihood Ratio (LR) statistic, Final Prediction Error (FPE), Akaike Information Criterion (AIC), Schwarz information criterion (SC), and Hannan-Quinn Information Criterion (HQ). The lag length criterion for the main model (2A) is seen in table 4.2

Table 4.2

Lag Length Criteria (Model 2A)

Lag Length	**LR**	**FPE**	**AIC**	**SC**	**HQ**
0	NA	4.65E-08	-5.532992	-5.283903	-5.433627
1	551.7456	2.15E-11	-13.21447	-12.46720*	-12.91637*
2	23.73893	2.29E-11	-13.15295	-11.90751	-12.65613
3	36.13473*	1.96e-11*	-13.32277*	-11.57915	-12.62722

* denotes the lag length selected by each of the criterion.
Source: Eviews 7.0, Quantitative Micro Software, LLC

According to the results, the LR, FPE, and AIC suggest a lag length of 3 while the SC and HQ suggest 1 lag lengths for a VAR specification. According to Kilian (2001) using lower lag length criteria or under-fitting models can underestimate the true subtleties of the data and may result in disingenuous tight confidence intervals. Therefore, it is better to have an over-fitted model rather than under-fitted one. Therefore for model 2A, the respective lag length for a VAR (p), where p = 3 and a VECM (p-1) or VECM specification lag length of 2. The results and selection of the lag length criteria for all models can be seen in Table 4.3. The specific results of the lag length criteria of the sub-models (2B, 2C, and 2D) of our analysis can be seen in Appendix 3.

Table 4.3

Lag Length Criteria Results and Selection

VEC Model		Lag Length Suggested	
		VAR	**VECM**
2(A)	LSPREAD, LRTPSC, LIDP, LCAR	3	2
2(B)	LSPREAD, LRBC, LIDP, LCAR	3	2
2(C)	LSPREAD, LRCC, LIDP, LCAR	3	2
2(D)	LSPREAD, LRMORT, LIDP, LCAR	3	2

Source: Eviews 7.0, Quantitative Micro Software, LLC

Following this, we then test for cointegration using the Johansen's Maximum Likelihood cointegration approach which determines the rank of cointegrating vectors. Johansen proposes two likelihood ratio tests of the significance of the linear combination between the variables that yields the highest correlation, and thereby the reduced rank of the coefficient matrix (Hjalmarsson and Österholm, 2007). These are the Trace test and Maximum Eigenvalue test, shown in the following equations.

$$J_{Trace} = -T \sum_{i=r+1}^{n} ln\,(1 - \hat{\lambda_i}) \qquad (3)$$

$$J_{Max} = -T\, ln(1 - \hat{\lambda}_{r+1}) \qquad (4)$$

In the above Johansen's Maximum Likelihood tests, T is the sample size and $\hat{\lambda_i}$ is the ith largest canonical correlation. The Trace test assesses the null hypothesis of r cointegrating vectors against the alternative hypothesis of n cointegrating vectors. On the other hand, the Maximum Eigenvalue test, tests the null hypothesis of r cointegrating vectors against the alternative hypothesis of $r + 1$ cointegrating vectors. The following table shows the Trace and Maximum Eigenvalue statistic for the main model (2A) of the paper. The Johansen's Maximum Likelihood test results for the sub-models can be seen in Appendix 4.

Table 4.4

Cointegration Test using Trace and Maximum Eigenvalue Statistics – Model 2A

Ho	Trace Statistic	5% Critical Value	Max-Eigen Statistic	5% Critical Value
None	85.23 *	54.08	33.47 *	28.59
At most 1	51.76 *	35.19	22.29	22.30
At most 2	29.46 *	20.26	19.22	15.89
At most 3	10.24 *	9.16	10.24	9.16

* indicates rejection of the null hypothesis at the 5% levels.
Source: Eviews 7.0, Quantitative Micro Software, LLC

As seen from the cointegration tests of model 2A, the Trace statistic indicates at four cointegrating equations exists while the Maximum Eigenvalue statistic indicates only one. Although both statistics result in differing results, according to Lütkepohl et al (2000), in a comparison of small samples, they found that the Trace tests have a superior power performance compared to the Maximum Eigenvalue and in particular, the Trace is advantageous if there are at least two more cointegrating relations than specified by the null hypothesis. For the remainder of the analysis, we therefore utilized the Trace statistic for estimating the number of cointegrating equations. For the main model 2A, three cointegrating equations were used followed by 3, 3, and 1 for models 2B, 2C, and 2D respectively.

Subsequent to the cointegrating equations analysis, we proceeded with the Vector Error Correction Estimates and the necessary residual examination. Firstly, we conducted a test of misspecification of the VAR residuals for serial correlation using the Autocorrelation Lagrange Multiplier (LM) test. The LM statistic is useful in identifying serial correlation not only of the first order but of higher orders as well, allowing the test to be more statistically powerful than alternate serial autocorrelation tests. Table 4.5 below shows the test results for the main model 2A, again the results for the sub-models can be seen in Appendix 5. As seen from the results, for all lag lengths, the VEC residuals are not serially correlated at a 5 per cent level of confidence. For the sub-models, the same is found at the 5 per cent confidence levels for 2B, 2C, and 2D respectively.

Table 4.5

LM Test for Serial Correlation in VEC Residuals – Model 2A

Lag-Length	LM-Statistic	P-value
1	21.49935	0.1601
2	20.56488	0.1958
3	20.02672	0.219
4	11.34141	0.7879
5	4.94954	0.996
6	15.41671	0.4944
7	22.52301	0.1271
8	9.839192	0.8749
9	15.56309	0.4838
10	29.61659	0.0201

Source: Eviews 7.0, Quantitative Micro Software, LLC

Supplementary analysis of the VEC residuals for autocorrelation was done using the Portmanteau tests for autocorrelation. Table 4.6 shows the results for the Portmanteau tests on model 2A. The results for the sub-models are located in Appendix 6. The resulting Portmanteau Q-statistic, which tested the residuals up to 10 lags for each model rejected the null hypothesis at the 10 per cent level indicating that for all models there were no material correlation left behind. The Portmanteau analysis and Autocorrelation Lagrange Multiplier (LM) test therefore both confirm the lack of serial autocorrelation within the examined models.

Table 4.6

VEC Residual Portmanteau Tests for Autocorrelations – Model 2A

Lags (h)	Q-Statistic	P-value	Adjusted Q-Statistic	P-value
3	25.9428	0.3036	26.8736	0.2614
4	37.5155	0.5376	39.1075	0.4650
5	42.8963	0.8823	44.8783	0.8332
6	59.1251	0.8417	62.5390	0.7530
7	83.0800	0.5991	88.9967	0.4205
8	93.2054	0.7449	100.3494	0.5556
9	108.7388	0.7395	118.0336	0.5078
10	136.6402	0.4443	150.2946	0.1741

Source: Eviews 7.0, Quantitative Micro Software, LLC

Further analysis of the VECM residuals normality testing revealed the following:

Table 4.7

VEC Residual Tests for Normality – Model 2A

Cholesky (Lutkepohl) VEC Residual Test	Test Statistic	P-value
Joint Skewness	0.2307	0.9938
Joint Kurtosis	6.0206	0.1976
Jarque-Bera	6.2513	0.6191

Source: Eviews 7.0, Quantitative Micro Software, LLC

The result of the residual normality tests on model 2A indicates the absence of skewness and kurtosis and therefore the acceptance of the null hypothesis that the residuals are multivariate normal at the 10 per cent significance level. Model 2B displayed some kurtosis, therefore rejecting the null hypothesis and concluding that the model residuals are not multivariate normal. Model 2C revealed the model was multivariate normal at the 10 per cent significance level, and model 2D exhibited the presence of skewness and kurtosis and therefore not multivariate normal. The results of the sub-model normality tests can be seen in Appendix 7.

We then examined the model residuals to determine whether the residual variances possessed different variability, or if the models were heteroskedastic. We determined this using the VEC Residual Heteroskedasticity tests with no cross terms. The results of the analysis for model 2A can be seen in table 4.8.

Table 4.8

VEC Residual Heteroskedasticity Tests: No Cross Terms – Model 2A

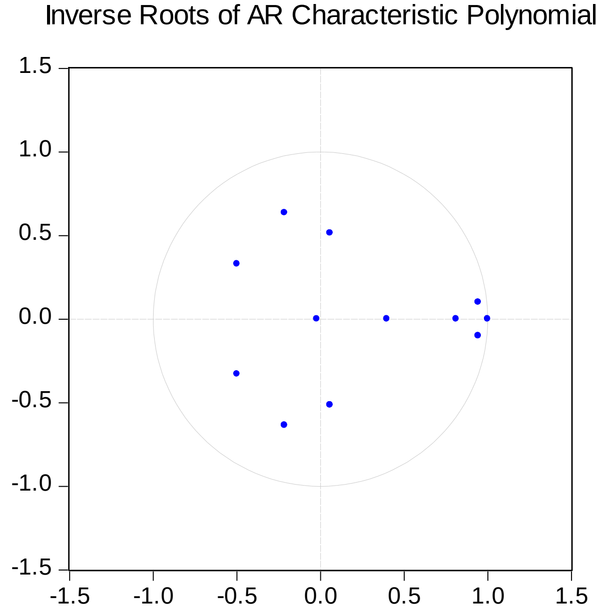
Model	Test Statistic	P-value
Model 2A	257.1989	0.2126 *
Model 2B	252.7669	0.2733 *
Model 2C	265.0847	0.1277 *
Model 2D	236.6446	0.0389 **

* and ** indicates rejection of the null hypothesis at the 10 % and 1% levels.
Source: Eviews 7.0, Quantitative Micro Software, LLC

The resulting heteroskedasticity tests indicate that all of the tested models reject the null hypothesis of the presence of heteroskedasticity at the 1 per cent and 10 per cent confidence level, and are in fact homoscedastic. The tests therefore suggest that the modeling errors are uncorrelated, normally distributed and the variances do not fluctuate.

The final study of the model residuals involved determining the stability of the residuals using the Roots of Characteristic Polynomial. For model 2A, this revealed that there was one unit root with modulus equal to unity with the remainder of the modulus less than unity. The model was therefore determined to be stable (Diagram 4.2). The sub-models were also tested for stability, and the resulting examination indicated that all sub-models were stable with 1, 1, and 3 unit root(s) modulus equal to unity. The detailed results of model 2A and the sub-models can be seen in Appendix 8. Based on the analysis of the residuals for each model of the paper, we determine that the VECM models were all robust, lacking autocorrelation, heteroskedasticity, and possessing stability.

Diagram 4.2
Roots of Characteristic Polynomial – Model 2A



Source: Eviews 7.0, Quantitative Micro Software, LLC

5. Results

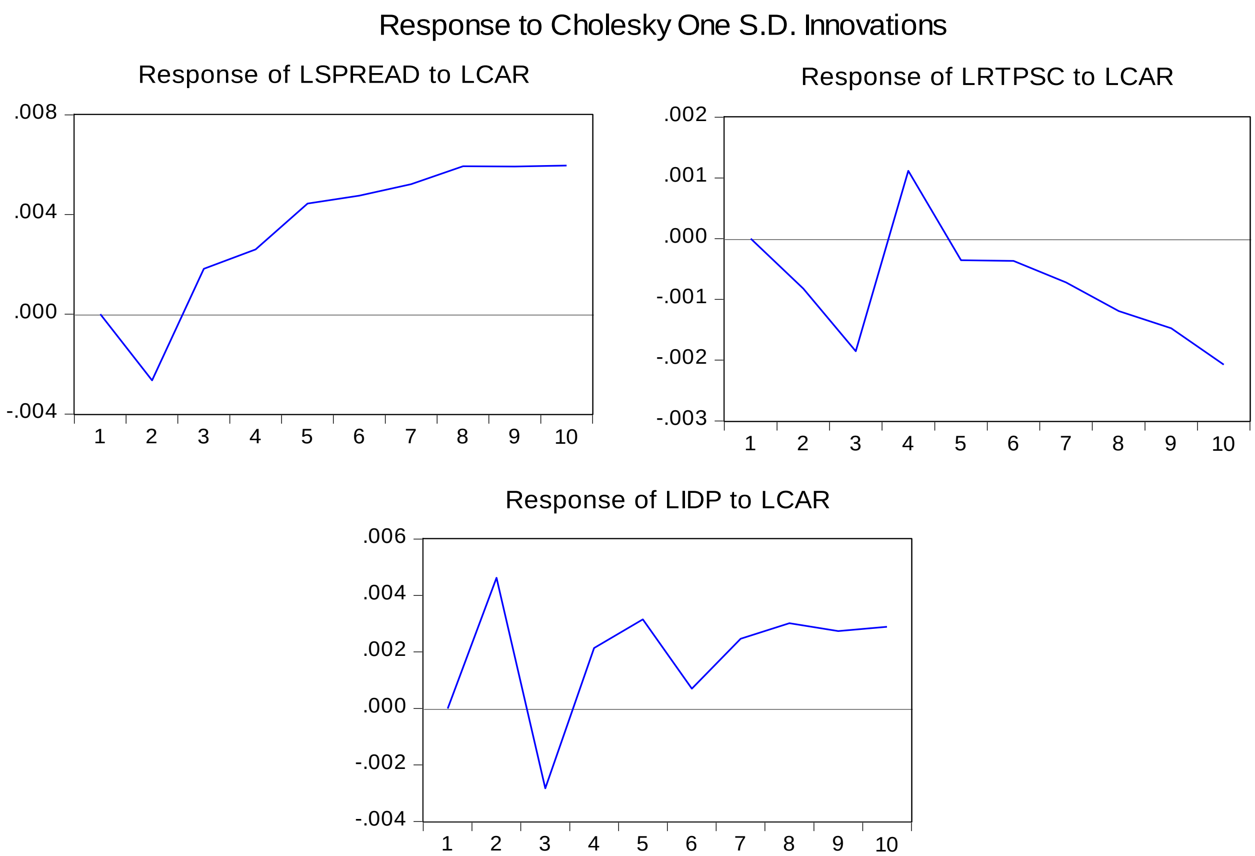
Estimation of the VECM allows for identification of long-run equilibrium relationship in addition to short-run dynamics, however, the interpretation of VAR models is not as specific as that of a simple OLS. To interpret the results of the VECM model, an accumulated impulse response function is required to measure the effect of a one-standard deviation innovation of the capital adequacy ratio variable on the system. In addition, variance decomposition information is utilized to explain the strengths of the respective channels or how much of the variance forecast error of each variable is due to variations in the other variables. In this analysis we first examine how the endogenous variables lending spread (LSPREAD), total private sector credit (LRTPSC), and index of domestic production (LIDP) respond to a shock in the capital adequacy ratio (LCAR). We then further examine the shocks to the sub-models, which includes business credit (LRBC), consumer credit (LRCC) and mortgage availability (LMORT).

Diagram 5.1 shows that a shock to the capital adequacy ratio results in the lending spread initially falling to -0.003 during the first period following an increase to 0.006 by period ten.

However, the overall effect of a shock to capital adequacy ratio on lending spread is only marginally positive. Total private sector credit shows an initial decline in the first three periods to -0.002 prior to a quick recovery to 0.001 followed by a gradual decline over the last six periods to -0.002. The overall result is an insignificant decline in private sector credit. The response of the index of domestic production to a shock in the capital adequacy ratio results in a volatile fluctuation between -0.003 and slightly above 0.004 over the first three periods. After this, the index of domestic production generally stays marginally positive. The result therefore points towards the notion that tighter capital rules may result in an increase in lending rates through lending spreads, and a subsequent decline in private sector credit. However, the adverse effect on economic output seems to be short-lived.

Diagram 5.1

Plot of accumulated impulse response functions of the endogenous variables to a shock in Capital Adequacy Ratios.

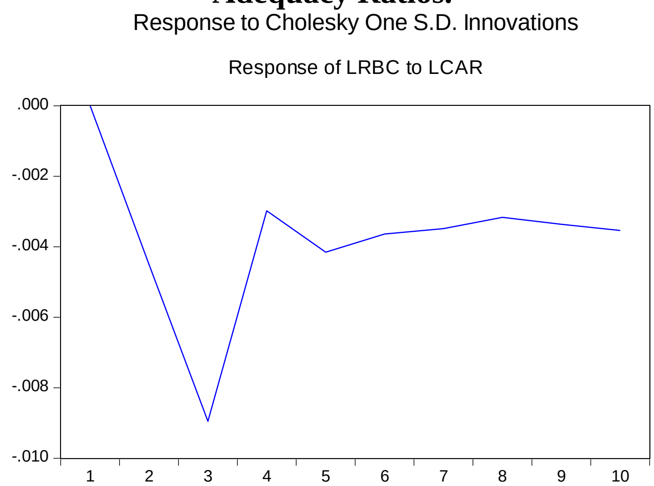


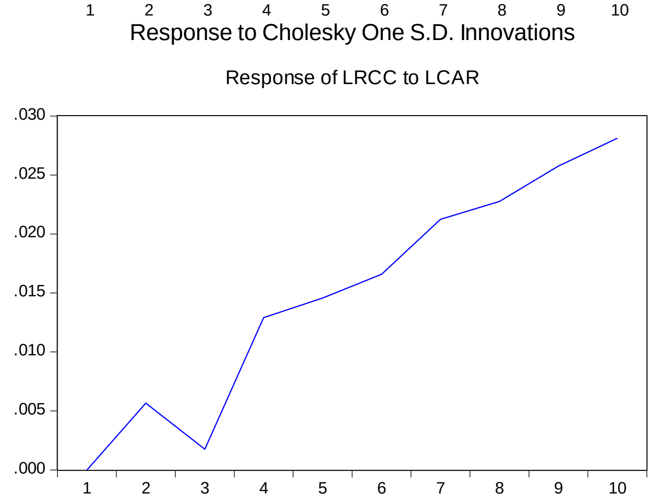
Source: Eviews 7.0, Quantitative Micro Software, LLC

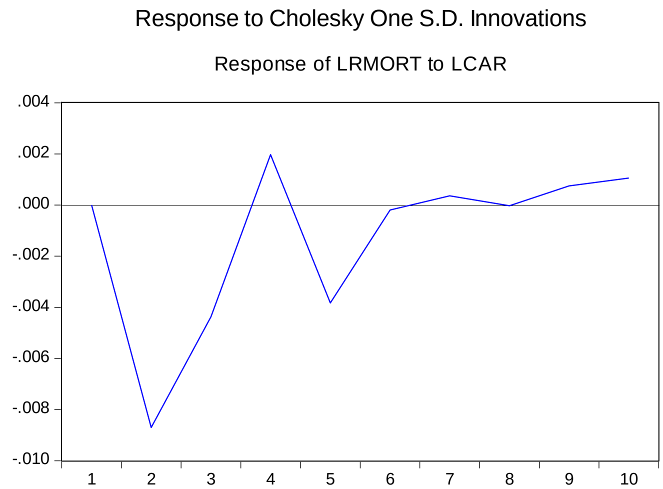
Diagram 5.2 shows the response of the sub-model credit channels to a shock in the capital adequacy ratio. Firstly, business credit exhibits an initial drop to -0.009 by the third period then a slight improvement before it plateaus off at around -0.004. Consumer credit shows a somewhat steady increase to slightly above 0.025 by the tenth period, and mortgage availability displays an initial fall to -0.008 over the first two periods following a rather unstable recovery back to slightly positive territory by the end of the ten periods. Overall, business and mortgage credit demonstrates negative responses to a shock in capital adequacy ratios; however mortgage credit recovers back to baseline by the tenth period possibly due to the credit demand following relationship indicated by Birchwood and Nicholls (1999) and Ramlogan et al (2009). On the other hand, consumer credit shows a positive response to a shock in capital adequacy ratios.

Diagram 5.2

Plot of accumulated impulse response functions of the credit variables to a shock in Capital Adequacy Ratios.







Source: Eviews 7.0, Quantitative Micro Software, LLC

While impulse response functions trace the effects of a shock to the endogenous variable (LCAR) on to the other variables in the VECM (LSPREAD, LRTPSC, and LIDP), the variance decomposition separates the variation in an endogenous variable into the component shocks to the VECM (Eviews 7 User Guide). Thus, the variance decomposition provides information about the relative significance of each random innovation in affecting the other endogenous variables. The following table 5.1 illustrates a 10 period variance decomposition of capital adequacy ratio.

Table 5.1

Variance decomposition of LCAR

Period	S.E.	LSPREAD	LRTPSC	LIDP	LCAR
1	0.059427	0.068157	1.032377	5.735273	93.16419
2	0.060795	2.280707	1.042456	6.523308	90.15353
3	0.067304	11.63722	3.248416	5.833775	79.28059
4	0.072876	17.96213	2.958949	6.624437	72.45448
5	0.077181	24.49493	2.65659	5.968332	66.88014
6	0.083502	33.01669	2.425235	5.184537	59.37354
7	0.089611	40.5358	2.166106	4.510786	52.78731
8	0.095674	46.56848	1.947467	3.970103	47.51395
9	0.101732	51.72752	1.817146	3.601996	42.85334
10	0.107629	56.02087	1.663905	3.315307	38.99992

Source: Eviews 7.0, Quantitative Micro Software, LLC

In period one, the shock in capital adequacy ratio accounted for a marginal 0.07 per cent of the variation in lending spreads. Private sector credit accounted for roughly 1.0 per cent of the forecast error while the index of domestic production accounted for 5.7 per cent. Through the ten periods and apart from the capital adequacy ratio itself, the forecast errors for each endogenous variable continued to increase. Lending spreads increased consecutively, ending at 56 per cent by the tenth period. Private sector credit increased to 3.2 per cent by the third period before falling slightly to 1.7 per cent at the end. The index of domestic production explained 6.6 per cent of the forecast error on the 4^{th} period then fell to 3.3 per cent by the tenth period. The resulting data therefore shows that lending spread shocks are the most important in explaining capital adequacy ratio variability, followed by the index of domestic production and private sector credit correspondingly.

6. Conclusion

Over the past two decades, capital adequacy ratios have become increasingly important in improving the resilience of the banking sectors to financial crunch, globally. As seen in the recent global financial crisis, the importance of reliable and effective banking regulations has become even more crucial. Since implementation of the Basel rules however, concerns have emerged about the potential negative effects these guidelines have on economic development, specifically through credit availability in developing and emerging nations. This paper therefore sought to assess the relationship between the capital adequacy ratio requirement of the Basel rules with commercial bank lending spreads, private sector credit, and economic output via the index of domestic production.

Over the period fourth quarter 1994 to first quarter 2014, the capital adequacy ratio inclusive of Tier 1 and Tier 2 capital increased from 11.6 per cent to 23.7 per cent while peaking at 26.5 per cent in mid-2012. The ratio inclusive of Tier 1 capital only, followed a similar pattern increasing from 10.4 per cent to 21.8 per cent during the same period. The significant increase in the capital adequacy ratio therefore suggests either a decline in risk weighed assets (RWA) or an increase in retained earnings that comprises part of tier 1 capital. On analysis of risk-weighted assets over the period, zero per cent increased from 26.7 per cent to 42.5 per cent while 100 per cent RWA declined from 48.6 per cent to 34.1 per cent. The overall decline in RWA and the strengthening of Tier 1 capital indicates a possible stifling of credit supply.

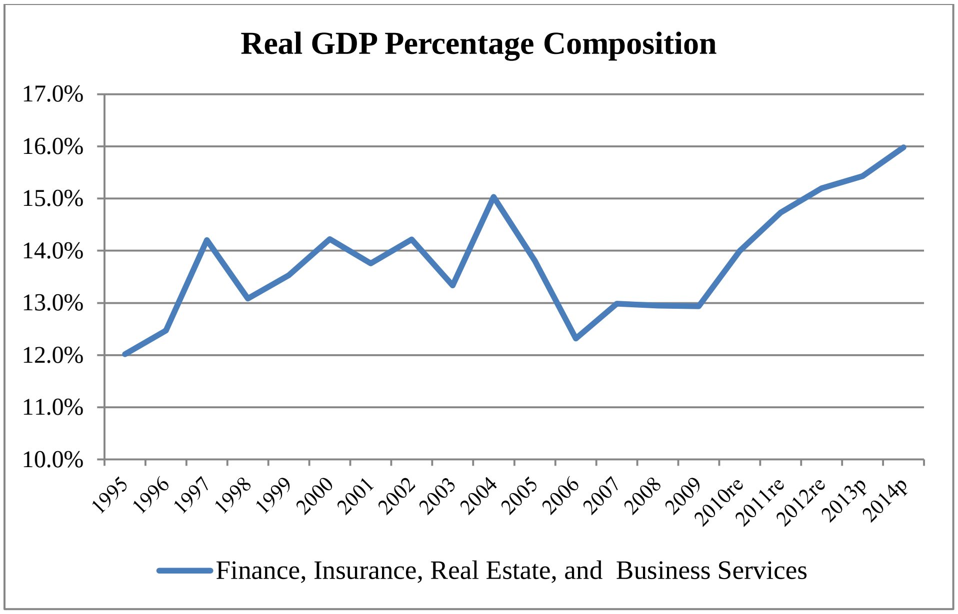
The results of the analysis point towards a long run relationship between the capital adequacy ratio and the endogenous variables in an environment where the CAR is way above its minimum requirement. Against this background, a shock in the CAR in one period results in a marginal increase in commercial bank lending spreads, a subsequent but relative decline in private sector credit, and a short-lived decline in economic output represented by the index of domestic production. The sub-models indicate that business credit experiences a slightly adverse effect, while consumer credit seems to not be negatively affected. Although mortgage credit initially deteriorates during the shock, it quickly recovers back to baseline by the end. This is likely due to the demand following nature of specific credit channels that are observed in the domestic market. Granting that the overall effect is insignificant, this could largely be due to the fact that the current banking sector in Trinidad and Tobago is very well capitalized.

Policy implementation to mitigate the adverse effects of a shock in the capital adequacy ratio may not be required due to highly capitalized nature of the banking sector and the resulting marginal effect. In addition, the Central Bank of Trinidad and Tobago has undertaken a revision of the local capital standards and proposed the adoption and consideration of Basel II and III rules respectively. The suggested Pillar I regulations would result in the minimum capital requirements increasing from 8 per cent to 10 per cent with the minimum Tier 1 ratio increasing to 7 per cent from 4 per cent. Under the current level of commercial bank capitalization these updated regulations should not have any significant negative effect on credit expansion and by extension, economic output.

However, in a situation where the nation's banking sector capital adequacy ratio was closer to that of the minimum 8 per cent requirement stipulated by Basel rules and the Prudential Criteria Regulations Act of 1994, a corresponding shock to the ratio may have produced a more significant adverse effect on economic output. Peek and Rosengren (1995) determined that there was a correlation between bank credit supply and capital ratios specifically with undercapitalized banks seeking to improve their capital ratios. In such a situation, an appropriate policy should be used to diminish any contractionary impact.

7. Appendix

Appendix 1



Source: Central Bank of Trinidad and Tobago

Appendix 2

	CAR1	CAR	Core Capital (TT$ Millions)	Non-core Capital (TT$ Millions)	Total Qualifying Capital (K) (TT$ Millions)	Risk-Weighted Assets (RWA) (TT$ Millions)	Total Assets (A) (TT$ Millions)
Q4 1994	11.2	11.9	1,076.2	235.2	1,311.4	11,029.2	17,422.5
Q4 1995	10.3	12.0	1,197.1	196.1	1,393.3	11,595.4	20,052.6
Q4 1996	15.2	16.6	1,639.5	154.7	1,794.2	10,793.7	22,959.9
Q4 1997	15.4	17.3	2,083.3	254.9	2,338.3	13,508.9	27,194.0
Q4 1998	15.8	18.1	2,274.6	342.4	2,617.0	14,422.2	26,473.5
Q4 1999	15.3	17.5	2,522.8	367.5	2,890.3	16,539.2	28,929.7
Q4 2000	17.8	20.1	3,380.7	429.7	3,810.4	18,991.7	32,933.1
Q4 2001	17.6	19.5	3,773.5	416.7	4,190.2	21,482.5	38,136.8
Q4 2002	17.3	20.6	4,019.5	766.6	4,786.1	23,237.2	40,104.4
Q4 2003	18.2	20.3	4,466.2	532.2	4,998.4	24,602.3	43,225.7
Q4 2004	17.4	19.8	5,394.5	581.2	5,975.7	30,118.4	48,425.9
Q4 2005	16.4	18.2	5,911.7	615.2	6,526.9	35,951.4	58,847.1
Q4 2006	16.2	18.0	6,641.7	760.8	7,402.5	41,085.1	67,906.5
Q4 2007	17.0	19.1	8,020.1	1,002.7	9,022.8	47,322.9	75,745.1
Q4 2008	15.5	20.0	8,116.0	1,698.1	9,814.0	49,173.8	88,073.7
Q4 2009	18.5	20.5	10,185.5	1,102.3	11,287.8	55,071.0	103,984.8

Q4 2010	21.7	24.2	11,440.6	1,330.3	12,770.9	52,755.7	103,693.9
Q4 2011	22.7	25.1	12,306.1	1,311.8	13,618.0	54,167.7	111,077.0
Q4 2012	22.4	24.6	13,271.0	1,315.1	14,586.1	59,278.3	120,472.8
Q4 2013	21.3	23.1	13,755.0	1,175.0	14,930.0	64,697.0	125,821.5
Q1 2014	21.8	23.7	13,496.6	1,167.2	14,663.8	61,828.6	128,047.9

Source: Central Bank of Trinidad and Tobago

Appendix 3

Lag Length Criteria (Model 2B)

Lag Length	LR	FPE	AIC	SC	HQ
0	NA	6.66E-08	-5.173789	-4.924701	-5.074424
1	528.7337	4.31E-11	-12.51685	-11.76959*	-12.21876*
2	23.41189	4.63E-11	-12.45023	-11.20479	-11.95341
3	36.93389*	3.90e-11*	-12.63336*	-10.88975	-11.93781

* denotes the lag length selected by each of the criterion.
Source: Eviews 7.0, Quantitative Micro Software, LLC

Lag Length Criteria (Model 2C)

Lag Length	LR	FPE	AIC	SC	HQ
0	NA	8.71E-08	-4.90502	-4.652057	-4.804315
1	528.5187	4.53E-11	-12.46844	-11.70955*	-12.16632*
2	25.31447	4.72E-11	-12.43229	-11.16747	-11.92876
3	32.29412*	4.27e-11*	-12.54464*	-10.7739	-11.8397

* denotes the lag length selected by each of the criterion.

Source: Eviews 7.0, Quantitative Micro Software, LLC

Lag Length Criteria (Model 2D)

Lag Length	LR	FPE	AIC	SC	HQ
0	NA	4.41E-07	-3.283832	-3.026861	-3.18176
1	474.6113	4.19E-10	-10.24249	-9.471578*	-9.936275*
2	26.94974	4.25E-10	-10.23451	-8.949656	-9.724151
3	27.91372*	4.14e-10*	-10.27583*	-8.477031	-9.561323

* denotes the lag length selected by each of the criterion.
Source: Eviews 7.0, Quantitative Micro Software, LLC

Appendix 4

Cointegration Test using Trace and Maximum Eigenvalue Statistics (Model 2B)

Ho	Trace Statistic	5% Critical Value	Max-Eigen Statistic	5% Critical Value
None	72.93 *	54.08	27.56	28.59
At most 1	45.37 *	35.19	23.12 *	22.30
At most 2	22.24 *	20.26	16.81 *	15.89
At most 3	5.43	9.16	5.43	9.16

* indicates rejection of the null hypothesis at the 5% levels.
Source: Eviews 7.0, Quantitative Micro Software, LLC

Cointegration Test using Trace and Maximum Eigenvalue Statistics (Model 2C)

Ho	Trace Statistic	5% Critical Value	Max-Eigen Statistic	5% Critical Value
None	81.46 *	54.08	28.78 *	28.59
At most 1	52.69 *	35.19	22.84 *	22.30
At most 2	29.85 *	20.26	18.70 *	15.89
At most 3	11.14 *	9.16	11.14 *	9.16

* indicates rejection of the null hypothesis at the 5% levels.
Source: Eviews 7.0, Quantitative Micro Software, LLC

Cointegration Test using Trace and Maximum Eigenvalue Statistics (Model 2D)

Ho	Trace Statistic	5% Critical Value	Max-Eigen Statistic	5% Critical Value
None	66.75 *	54.08	33.32 *	28.59
At most 1	33.43	35.19	17.30	22.30
At most 2	16.13	20.26	10.58	15.89
At most 3	5.55	9.16	5.55	9.16

* indicates rejection of the null hypothesis at the 5% levels.
Source: Eviews 7.0, Quantitative Micro Software, LLC

Appendix 5

LM Test for Serial Correlation in VEC Residuals (Model 2B)

Lag-Length	LM-Statistic	P-value
1	18.47105	0.297
2	8.123652	0.9451
3	16.8741	0.3938
4	5.959732	0.9885
5	12.85153	0.6836
6	17.38697	0.361
7	12.00633	0.7435
8	10.92478	0.8141
9	18.89056	0.2744
10	18.40481	0.3007

Source: Eviews 7.0, Quantitative Micro Software, LLC

LM Test for Serial Correlation in VEC Residuals (Model 2C)

Lag-Length	LM-Statistic	P-value
1	14.98771	0.5255
2	13.26253	0.6535
3	24.2617	0.0839
4	13.99299	0.5992
5	15.50527	0.488
6	10.60993	0.8329
7	18.65862	0.2868
8	10.43398	0.843
9	14.619	0.5527
10	20.73939	0.1887

Source: Eviews 7.0, Quantitative Micro Software, LLC

LM Test for Serial Correlation in VEC Residuals (Model 2D)

Lag-Length	LM-Statistic	P-value
1	12.18662	0.731
2	11.48381	0.7787
3	15.10969	0.5166
4	7.693908	0.9575
5	12.29326	0.7236

6	21.81835	0.1492
7	17.5803	0.349
8	13.60224	0.6283
9	21.08233	0.1754
10	21.95321	0.1447

Source: Eviews 7.0, Quantitative Micro Software, LLC

Appendix 6

VEC Residual Portmanteau Tests for Autocorrelations (Model 2B)

Lags (h)	Q-Statistic	P-value	Adjusted Q-Statistic	P-value
3	21.30227	0.5626	22.04832	0.5173
4	27.598	0.9141	28.7038	0.887
5	40.54546	0.9274	42.58948	0.889
6	58.2631	0.8607	61.87045	0.7719
7	70.98518	0.8937	75.92169	0.796
8	81.9561	0.9373	88.22242	0.85
9	101.3524	0.8774	110.3043	0.7035
10	119.7961	0.8216	131.6298	0.566

Source: Eviews 7.0, Quantitative Micro Software, LLC

VEC Residual Portmanteau Tests for Autocorrelations (Model 2C)

Lags (h)	Q-Statistic	P-value	Adjusted Q-Statistic	P-value
3	27.72308	0.2264	28.73863	0.1891
4	41.8824	0.3469	43.70705	0.2783
5	57.79169	0.3725	60.76918	0.2759
6	68.62574	0.5578	72.55918	0.4263
7	87.62385	0.4611	93.54217	0.2966
8	98.10155	0.618	105.2899	0.4189
9	112.8274	0.642	122.0547	0.4054
10	132.7701	0.5382	145.1135	0.2607

Source: Eviews 7.0, Quantitative Micro Software, LLC

VEC Residual Portmanteau Tests for Autocorrelations (Model 2D)

Lags (h)	Q-Statistic	P-value	Adjusted Q-Statistic	P-value
3	17.42144	0.9552	18.08195	0.9426
4	25.04332	0.993	26.13936	0.989
5	37.50555	0.9923	39.50466	0.9852
6	59.85711	0.9258	63.82841	0.8586
7	76.22161	0.8968	81.90263	0.7879
8	89.98743	0.9075	97.33704	0.7807
9	108.906	0.8467	118.8752	0.6374
10	129.9125	0.7384	143.1639	0.4333

Source: Eviews 7.0, Quantitative Micro Software, LLC

Appendix 7

VEC Residual Tests for Normality (Model 2B)

Cholesky (Lutkepohl) VEC Residual Test	Test Statistic	P-value
Joint Skewness	3.000	0.5578
Joint Kurtosis	10.2747	0.0360
Jarque-Bera	13.2747	0.1027

Source: Eviews 7.0, Quantitative Micro Software, LLC

VEC Residual Tests for Normality (Model 2C)

Cholesky (Lutkepohl) VEC Residual Test	Test Statistic	P-value
Joint Skewness	2.4526	0.6531
Joint Kurtosis	5.3439	0.2538
Jarque-Bera	7.7965	0.4536

Source: Eviews 7.0, Quantitative Micro Software, LLC

VEC Residual Tests for Normality (Model 2D)

Cholesky (Lutkepohl) VEC Residual Test	Test Statistic	P-value
Joint Skewness	49.8351	0.0000
Joint Kurtosis	653.7424	0.0000
Jarque-Bera	703.5775	0.0000

Source: Eviews 7.0, Quantitative Micro Software, LLC

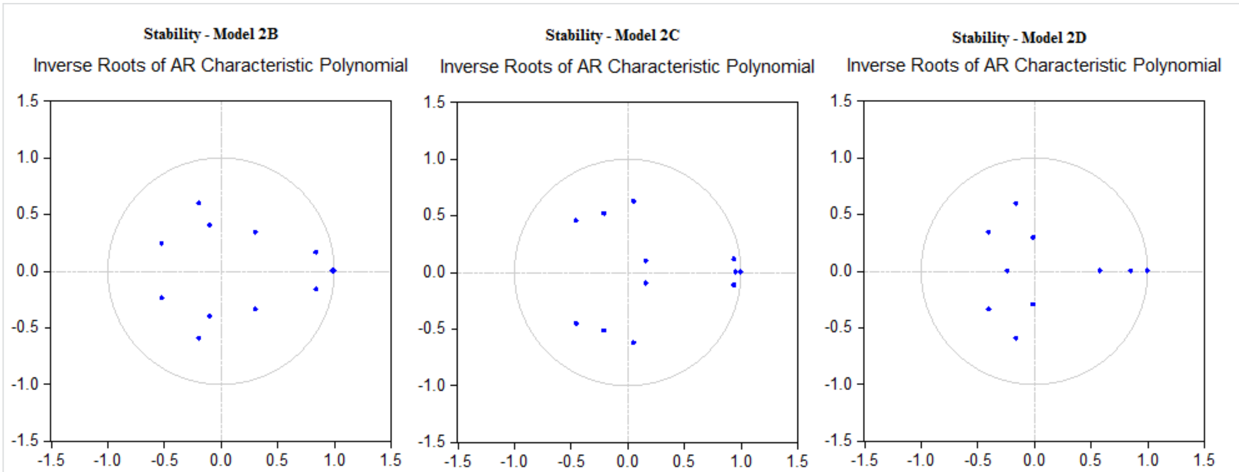
Appendix 8

Roots of Characteristic Polynomial - Tables (Model 2A – 2C)

Stability (Model 2A)		Stability (Model 2B)	
Root	**Modulus**	**Root**	**Modulus**
1.0000	1.0000	1.0000	1.0000
0.943476 - 0.099758i	0.948735	0.98869	0.98869
0.943476 + 0.099758i	0.948735	0.842318 - 0.163101i	0.857963
0.811801	0.811801	0.842318 + 0.163101i	0.857963
-0.214050 - 0.635921i	0.670979	-0.192807 - 0.597420i	0.627762
-0.214050 + 0.635921i	0.670979	-0.192807 + 0.597420i	0.627762
-0.497377 - 0.329253i	0.596483	-0.520357 - 0.239786i	0.572947
-0.497377 + 0.329253i	0.596483	-0.520357 + 0.239786i	0.572947
0.058338 - 0.513857i	0.517158	0.307396 - 0.339320i	0.457854
0.058338 + 0.513857i	0.517158	0.307396 + 0.339320i	0.457854
0.398372	0.398372	-0.096931 - 0.403261i	0.414747
-0.02065	0.020651	-0.096931 + 0.403261i	0.414747
Stability (Model 2C)		**Stability (Model 2D)**	
Root	**Modulus**	**Root**	**Modulus**
1.0000	1.0000	1.0000	1.0000
0.956412	0.956412	1.000000 - 2.88e-16i	1.0000
0.942482 - 0.115292i	0.949508	1.000000 + 2.88e-16i	1.0000
0.942482 + 0.115292i	0.949508	0.853889	0.853889
-0.451177 - 0.454642i	0.640516	-0.158816 - 0.594286i	0.615141
-0.451177 + 0.454642i	0.640516	-0.158816 + 0.594286i	0.615141
0.055425 - 0.625475i	0.627926	0.582794	0.582794
0.055425 + 0.625475i	0.627926	-0.399417 - 0.340587i	0.524913
-0.204719 - 0.517593i	0.556608	-0.399417 + 0.340587i	0.524913
-0.204719 + 0.517593i	0.556608	-0.007970 - 0.296035i	0.296142
0.162310 - 0.098915i	0.190076	-0.007970 + 0.296035i	0.296142
0.162310 + 0.098915i	0.190076	-0.23584	0.235839

Source: Eviews 7.0, Quantitative Micro Software, LLC

Roots of Characteristic Polynomial - Graphs (Model 2B – 2C)



Source: Eviews 7.0, Quantitative Micro Software, LLC

8. References

Aggarwal, R and K Jacques (1997): "A Simultaneous Equations Estimation of the Impact of Prompt Corrective Action on Bank Capital and Risk," in Financial Services at the Crossroads: Capital Regulation in the 21st Century, Conference, 26-27 February 1998, Federal Reserve Bank of New York.

Akram, Farooq Q. (2012): "Macro Effects of Capital Requirements and Macro-prudential Policy", Norges Bank Research – Working Paper.

Alexander Gordon J and Alexandre M Baptista (2006) "Does the Basel Capital Accord reduce bank fragility? An assessment of the value-at-risk approach", Journal of Monetary Economics, vol. 53(7), pp.1631-1660.

Basel Committee on Banking Supervision (BCBS) (2010) "An assessment of the long-term economic impact of stronger capital and liquidity requirements", Bank for International Settlements.

Birchwood, A. and S. Nicholls. (1999). "Credit, Investment and Economic Cycles in thCaribbean", Social and Economic Studies 91-125.

Brooks, Chris (2008): "Introductory Econometrics for Finance, Second Edition", The ICMA Centre, University of Reading, Cambridge University Press.

Dahl, D and R E Shrieves (1990): "The Impact of Regulation on Bank Equity Infusions," Journal of Banking and Finance, 14, pp. 1209-28.

Demirgüç-Kunt, A., Detragiache, E. and Tressel T. (2008) "Banking on the Principles: Compliance with Basel Core Principles and Bank Soundness", Journal of Financial Intermediation, Elsevier, Elsevier, vol. 17(4), pp. 511-542.

Eichberger, Jürgen, Martin Summer (2005) "Bank Capital, Liquidity, and Systemic Risk", Journal of the European Economic Association, Vol. 3, No.2/3, pp.547-555.

Eviews 7 User Guide (1994-2009), Quantitative Micro Software.

Färe, Rolf, S. Grosskopf, and W.L. Weber (2004) "The effect of risk-based capital requirements on profit efficiency in banking", Applied Economics, vol 36, pp. 1731-1743.

Furfine C. (2000): "Evidence on the Response of US Banks to Changes in Capital Requirements". Bank for International Settlements, Working Paper. No. 88.

Furlong, F and M C Keeley (1989): "A Re-examination of Mean Variance Analysis of Bank Capital Regulation: A Note," Journal of Banking and Finance, 13, p. 883-91.

Hancock, D and J A Wilcox (1994): “Bank Capital and the Credit Crunch: The Roles of Risk-Weighted and Unweighted Capital Regulation,” Journal of the American Real Estate and Urban Economics Association, 22, pp. 59-94.

Hancock, Diana and James A Wilcox (1997): “Bank capital, Non-bank Finance, and Real Estate Activity,” Journal of Housing Research, 8, pp. 75-105.

Hancock, Diana and James A Wilcox (1998): “The “Credit Crunch” and the Availability of Credit to Small Business,” Journal of Banking and Finance, forthcoming.

Hjalmarsson, Erik and Pär Österholm (2007):” Testing for Cointegration Using the Johansen Methodology when Variables are Near-Integrated,” International Monetary Fund Working Paper.

Jacques, K T and P Nigro (1997): “Risk-Based Capital, Portfolio Risk and Bank Capital: A Simultaneous Equations Approach,” Journal of Economics and Business, 49, pp. 533547.

Kilian, Lutz (2001):”Impulse Response Analysis in Vector Autoregressions with Unknown Lag Order”, Journal of Forecasting, 20, pp. 161-179.

Lütkepohl, Helmut, Pentti Saikkonen, and CARten Trenkler (2000),”Maximum Eigenvalue Versus Trace Tests for the Cointegrating Rank of a VAR Process.

Macroeconomic Assessment Group (2010): “Assessing the Macroeconomic Impact of the Transition to stronger Capital and Liquidity Requirements,” Bank for International Settlements.

Montgomery, H. (2005): “The effect of the Basel Accord on bank portfolios in Japan”. Journal of the Japanese and International Economies. 19: 24–36.

Oliner, Stephen D and Glenn D Rudebusch (1996): “Is There a Broad Credit Channel for Monetary Policy?” Federal Reserve Bank of San Francisco Economic Review, 1, pp. 3-13.

Ozcicek, Omer and W. Douglas McMillin (1999):” Lag Length Selection in Vector Autoregressive Models: Symmetric and Asymmetric Lags.”

Parcon-Santos, Hazel C. and Eufrocinio M. Bernabe, Jr. (2012): “The Macroeconomic Effects of Basel III Implementation in the Philippines: A Preliminary Assessment,” Center for Monetary and Financial Policy, Bangko Sentral Ng Pilipinas.

Passmore, S. Wayne and Sharpe, Steven A. (1994), “Optimal Bank Portfolios and the Credit Crunch”.

Peek, J and E Rosengren (1995): “Bank Regulation and the Credit Crunch,” Journal of Banking and Finance, 19, pp. 679-692.

Peek, Joe and Eric S Rosengren (1997a): "The International Transmission of Financial Shocks: The Case of Japan," American Economic Review, September, pp. 495-505.

Peek, Joe and Eric S Rosengren (1997b): "Collateral Damage: Effects of the Japanese Real Estate Collapse on Credit Availability and Real Activity in the United States," Working paper, Federal Reserve Bank of Boston, August.

Ramlogan, Avinash, Tanisha Mitchell-Ryan, and Daryl Cheong (2009): "An Assessment of the Impact of the Sectoral Distribution of Commercial Bank Credit on Economic Growth and Development in Trinidad and Tobago," Central Bank of Trinidad and Tobago.

Roy, Patrick Van (2008): "Capital Requirements and Bank Behavior", International Journal of Central Banking, Vol.4, No. 3.

Thakor, Anjan V (1996): "Capital Requirements, Monetary Policy, and Aggregate Bank Lending: Theory and Empirical Evidence," Journal of Finance, 51, pp. 279-324.