Excess reserves in Jamaican Commercial Banks: The implications for Monetary Policy

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Abstract

High levels of excess reserves have been a persistent feature of Jamaica's commercial banking system within the past two decades. These reserves provide a positive impact in terms of the institutions' ability to respond to liquidity shocks. Notwithstanding this, questions have been raised as to whether or not such high levels of excess reserves present challenges to the Central Bank in its pursuit of price stability. For example, banks have been able to easily find the wherewithal to extend credit, even when the Central Bank adopts an extremely tight monetary policy stance. In this context, this paper examines the trends in excess reserves of commercial banks in Jamaica during the period 1998 to 2010 and the challenges encountered by the Central Bank in the implementation of monetary policy. The paper estimates the demand for excess reserves using the autoregressive distributed lag (ARDL) bounds test approach developed by Pesaran et al. (2001). The empirical results show that the major determinants of the excess reserves of commercial banks in Jamaica in the long-run and short-run are the reserve requirements, fluctuations in the currency-to-deposit ratio, the deviation of income from trend, the volatility of income, the deficit of the Central Government and the interest rate offered on the BOJ's 180-day security.

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[1] The views expressed in this paper are those of the author and in no way represent an official position of the Bank of Jamaica.

1.0 Introduction

All deposit-taking institutions in Jamaica are mandated to meet statutory reserve requirements. These minimum reserve requirements came into effect in 1964 when the required reserve ratio for commercial banks was set at 15.0 per cent. The introduction of this requirement was among a set of direct policy tools implemented by the Central Bank shortly after its establishment to control money and credit in an attempt to minimize the fluctuations in prices, employment and the exchange rate. The law governing the institutions therefore stipulates that the entities are required to hold a portion of their prescribed liabilities as liquid assets. The prescribed liabilities include deposits, funds borrowed from other institutions and the interest accrued and payable on these liabilities. In Jamaica, the liquid assets of commercial banks include notes and coins, the cash reserves and other deposits at the Bank of Jamaica (BOJ), Government of Jamaica (GOJ) securities maturing within 270 days, Treasury Bills and any other security designated by the Ministry of Finance. This ratio, which is set by the central bank, therefore includes a cash component as well as a non-cash component.

In 1984, the Bank of Jamaica Act was amended to allow the Central Bank to vary the percentage of prescribed liabilities that commercial banks are required to maintain as liquid assets.[2] The reserve requirement reached the maximum of 50.0 per cent in July 1992 shortly after the liberalization of the financial sector which resulted in the removal of foreign exchange, trade, credit, capital and interest rate controls. Subsequently, the reserve requirement for commercial banks was significantly reduced in the context of a shift in the implementation of monetary policy towards the use of indirect tools. Following a sustained period of stability in the ratio, the requirement was increased in response to the adverse impact from the global financial crises and was 26.0 per cent as at end-December 2010, the cash component of which was 12.0 per cent.

During the 12-year period ended December 2010, reserves in commercial banks have averaged $57.9 billion in comparison to the average requirement of $38.7 billion. While

[2] This percentage shall not be less than 15.0 per cent or more than 50.0 per cent. Amendments in December 1991 further allowed the Bank of Jamaica the flexibility to set different rates for different banks.

these reserves provide a positive impact in terms of the institutions' ability to respond to liquidity shocks, questions have been raised as to whether or not such high levels of excess reserves present challenges in the Central Bank's pursuit of price stability. For example, commercial banks have been able to easily find the wherewithal to extend credit, even when the Central Bank adopts an extremely tight monetary policy stance.

Agenor et.al (2008) posited that the level of excess reserves might be of interest to central bankers as an abundance of liquidity may hamper the ability of monetary policy to influence the level of inflation and economic activity. [3] Ganley (2004) supported this view and noted that the rapid accumulation of excess reserves could lead to monetary growth outside the central bank's target range which may be reflected in higher domestic consumption and undesirable increases in inflation. Given these views, a number of studies have attempted to model the empirical determinants of commercial bank excess reserves, however only a few have attempted these models for a developing country. This paper is an addition to the empirical studies on developing countries and is the first of its kind attempted for Jamaica.

Jamaica provides an interesting case study since a relatively large portion of excess liquid assets in Jamaica consist of interest-bearing BOJ and Government securities, items that are attractively remunerated. This paper therefore seeks to explore the factors influencing the level of excess reserves held by commercial banks, a phenomenon which has not been explored for the country.

Section II of the paper will examine challenges which excess reserves pose to monetary policy in Jamaica for the period March 1998 to December 2010. Section III will review the literature on excess reserves, particularly levels of excess reserves in developing countries and its impact on the implementation of monetary policy in these countries. An empirical model of the demand for excess reserves in Jamaica is estimated and discussed

[3] Excess reserves and excess liquidity are used interchangeably throughout the paper. The term excess reserves refers to the measurement of excess liquid assets.

in Section IV. The final section summarizes the main findings of the paper and presents some policy conclusions.

2.0 Review of Literature

Excess reserves in commercial banks have been of interest to researchers for several years. In this regard, several studies have proposed various theories to explain why profit-maximizing banks hold excess reserves and the factors which influence the demand for these reserves. Dow (2001) noted that the standard approach to modeling the demand for excess reserves was to view it as part of a bank's liquidity management decision. He stated that faced with an uncertain flow of funds, banks held reserves to avoid overdraft or reserve deficiency penalties on their accounts at the central bank. Dow stated that his model found support for two basic relationships identified in the general model of the precautionary demand for reserves developed by Poole (1968). The first relationship identified was that the quantity of excess reserves demanded should vary inversely with short-term interest rates which, assuming that excess reserves pay no interest, are the opportunity cost of holding reserves. The second proposition was the demand for excess reserves should increase with uncertainty as these reserves provided a buffer from shocks.[4]

Agénor, Aizerman and Hoffmaister (2004) assessed the extent to which the fall in credit in the East Asian countries during the 1990s was supply or demand-driven by exploring the precautionary motive for holding non-remunerated excess liquid assets.[5] They developed a model that identified the determinants of excess liquid assets of commercial banks as the ratio of required reserves to total deposits, the volatility of the cash to deposit ratio, the deviation and volatility of output from trend, the discount rate as well as lagged values of excess reserves. The reserve to deposits ratio was used to capture the impact of reserve requirements while the coefficients of variation of the cash to deposit ratio and the deviation of income from trend measured liquidity risk and output volatility

[4] This model of excess reserve demand assumed that uncertainty increased proportionately with the level of transactions deposits.

[5] This is in contrast to Jamaica where excess liquid assets are interest-bearing.

related to the banks' precautionary motives. The deviation of income from trend was used as a proxy for changes in the demand for cash. In a cyclical downturn banks were expected to anticipate lower transactions-related demand for currency by the public and would therefore decrease their holdings of excess reserves. Agénor et.al noted that the penalty rate may be proxied by either the discount rate which represented the last resort facility for banks or the money market rate which reflected the cost of liquidity in the market.

Agénor et.al (op cit) found that the estimation results were in general consistent with the *a priori* expectations. These results showed that the required reserve to deposit ratio had a negative impact on excess reserves. The volatility of the cash to deposit ratio as well as the effect of an increase in the penalty rate was found to have a positive effect on excess reserves. The deviation of output from trend was found to be positively related to excess reserves; however the volatility of the income from trend was incorrectly signed and did not significantly influence excess reserves.

In the context of the Caribbean, Maynard and Moore (2005) estimated the demand for excess liquid assets in Barbados between 1974 and 2004. They noted that the main factors which explained a bank's demand for reserves could be linked to its customer characteristics, the macroeconomic environment as well as the monetary policies and fiscal strategies. Maynard and Moore extended the model developed by Agénor et.al (2004) and accounted for the impact of fiscal strategies on the demand for excess liquid assets by including the net domestic assets of the banking system. They noted that a bank needed to hold liquid assets to meet the cash requirements of its customers which could be captured by fluctuations in the cash-to-deposit ratio. In the absence of resources to satisfy customers' demand, financial institutions borrowed funds from the inter-bank market or from the central bank which incur an interest penalty. Maynard and Moore noted that the actions of the monetary authorities influenced the demand for liquid assets primarily through changes in the statutory requirement and employed the use of the required reserve ratio, the discount rate and the treasury-bill rate to capture the impact of monetary policy in the paper. An increase in required reserves, ceteris paribus, was

expected to reduce the demand for liquid assets, since the revenue foregone from holding these low or zero interest-bearing assets was expected to increase. The interest rate variables were expected to have similar but opposite effects on the demand for excess liquid assets. An increase in the penalty rate, for example, was expected to increase the costs of a liquidity shortfall and should therefore increase the demand for excess reserves, while an increase in the Treasury bill rate increases the opportunity cost of holding liquidity assets and should result in lower holdings of excess reserves by commercial banks. [6]

The current macroeconomic situation was expected to influence the level of excess reserves held by commercial banks, both in terms of the level of economic activity (given by the deviation of income from trend) and income volatility. Maynard and Moore explained that a cyclical downturn, for example, was expected to lower banks' expected transactions demand for money and therefore lead to decreased holdings of excess liquid assets. In contrast, a rise in economic volatility, since it is usually accompanied by liquidity shocks, could lead to greater holdings of excess reserves.

The fiscal policy stance of government was cited as having a significant influence on the liquidity of commercial banks. Maynard and Moore noted that increased government spending could be attained by issuing debt, increasing taxes or creating money which could be represented by a change in the net domestic assets of the banking system. Increased government spending, when financed through money creation or overseas borrowing was expected to result in greater deposits in the banking system and by extension an increase in bank reserves.

In terms of the empirical results, Maynard and Moore found that all the coefficients were generally in line with *a priori* expectations. The required reserve variable and the volatility of the cash to deposit ratios were found to be negatively related to the holdings of excess cash reserves. However, the coefficient of the required reserve variable was insignificant suggesting that a change in the required reserve ratio did not significantly

[6] This would not apply to Jamaica since Treasury bills are a component of liquid assets. An increase in the Treasury bill rate would ceteris paribus, encourage banks to hold more of these liquid assets.

influence the demand for excess reserves. The estimates also indicated that excess reserves tended to be inversely related to the deviation of income from trend. The volatility of income was incorrectly signed and had a relatively minor effect on the holdings of excess reserves. An increase in interest rates, which represented the opportunity cost of holding excess reserves, was negatively and significantly related to the holdings of excess liquid assets, while higher government spending was found to increase excess reserves.

Saxegaard (2006) examined the pattern of excess liquidity in sub-Saharan Africa (SSA) and its consequences for the effectiveness of monetary policy.[7] He estimated the demand for excess reserves by extending the methodology proposed by Agenor, Aizenman and Hoffmaister (2004) to include variables that accounted for the involuntary build-up of excess reserves.[8] In terms of the estimation of the precautionary demand for excess reserves, he employed the use of variables similar to those used by Agenor as well as the volatility of deposits, both private sector deposits and government deposits, and the ratio of demand deposits to time and savings deposits.[9] All three variables were expected to be positively related to the demand for excess reserves. In terms of the measures of the volatility of deposits, Saxegaard explained that banks were expected to hold a higher level of reserves to protect themselves against unexpected withdrawals if the deposit base was relatively volatile. The ratio of demand deposits to time and savings deposits was included to capture the effect of a high proportion of short-term deposits on the volatility of the banks' liabilities.

[7] Sub-Saharan Africa includes Central African Economic and Monetary Community (CEMAC), Nigeria, and Uganda.

[8] The term involuntary is used by Saxegaard to describe non-remunerated reserves that do not provide a return.

[9] Variables similar to those used by Agenor included the output gap, the discount rate, the reserve requirement, as well as measures of volatility for the cash-to-deposit ratio and the output gap. The ratio of demand deposits to savings and time deposits was included to capture the effect of short-term deposits on the volatility of commercial banks' liabilities

Saxegaard found that for the Central African Economic and Monetary Community (CEMAC), the results suggested that holdings of precautionary reserves may be explained by the volatility of private sector and government deposits.[10] An increase in the volatility of private sector deposits was found to increase commercial banks' holdings of excess liquidity while the increased volatility of government deposits reduced the holdings of excess liquidity. Additionally, a change in the reserve requirement did not have any significant effect on excess reserves.

The results for Nigeria indicated that all the findings were in line with a priori expectations and that the demand for excess reserves for precautionary purposes was mainly due to changes in the required reserve ratio, the ratio of demand to savings deposits and the volatility of the cash to deposit ratio. For Uganda, the results suggest that the demand for precautionary reserves was primarily influenced by the volatility of government deposits. There was also a significant effect from the maturity structure of commercial banks' liabilities as was the case in Nigeria. The volatility in the output gap was important although wrongly signed, relative to *a priori* expectations.

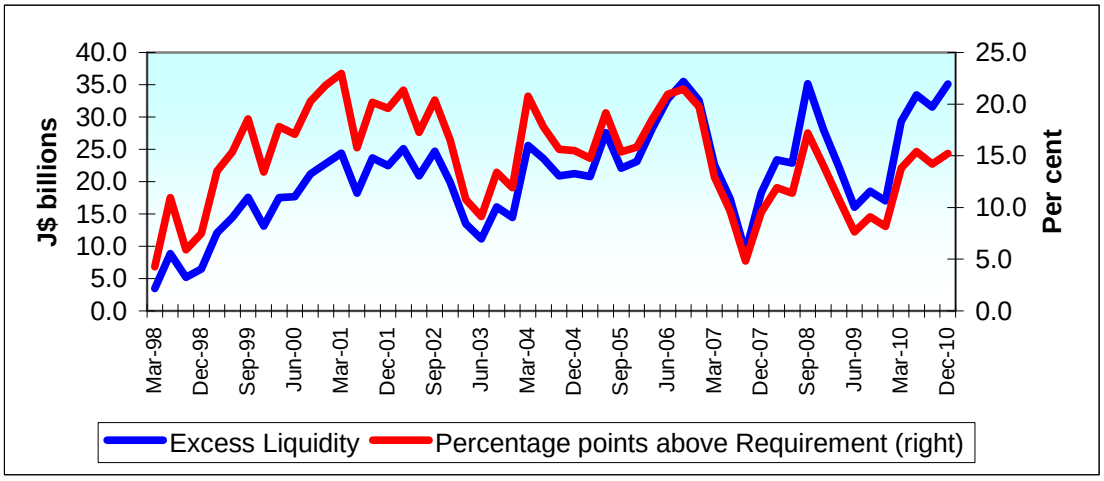
Saxegaard noted that the distinction between the concepts of involuntary excess liquidity and precautionary excess liquidity had important monetary policy implications. He explained that if a bank held significant excess liquidity for precautionary purposes, then sterilization was unnecessary, since this liquidity was less likely to be inflationary. Saxegaard argued that it was important to recognize that precautionary excess reserves represented a structural problem which entailed an inefficient allocation of resources, although it might not pose an immediate danger to inflation. If banks held significant amounts of involuntary excess liquidity, however, the danger existed that once demand conditions improved; lending would rapidly expand, increasing the risk of inflation. Hence, to the extent that involuntary excess liquidity existed, this liquidity should be removed from the system.

[10] Only the results for the precautionary motive of holding excess reserves will be discussed as this is in line with the purpose of this paper given that excess liquid assets in Jamaica earn a return and are not involuntarily held.

Ganley (2004) focused on the implications of surplus liquidity for monetary policy. He noted that the importance of surplus liquidity for central banks lay in its ability to influence the transmission mechanism of monetary policy; the conduct of central bank intervention in the money market, and the central bank's balance sheet and income. Ganley highlighted the impact of the surplus liquidity on the transmission mechanism, particularly the interest rate channel. He noted that with surplus liquidity, the transmission mechanism may break down or become weakened at an early stage as rates may not adjust accordingly and as such the central bank's ability to transmit its preferred interest rate into the market is weakened. Surplus liquidity may also have implications for the exchange rate as excess balances may also find their way into the foreign exchange market if the public prefers to hold some of its liquidity in foreign currency. This would exert downward pressure on the domestic currency and could have inflationary effects.

3.0 Excess Reserves in the Commercial Banks and Challenges which these present for Monetary Policy: The Jamaican Experience

Figure 1: The Trend in Excess Reserves



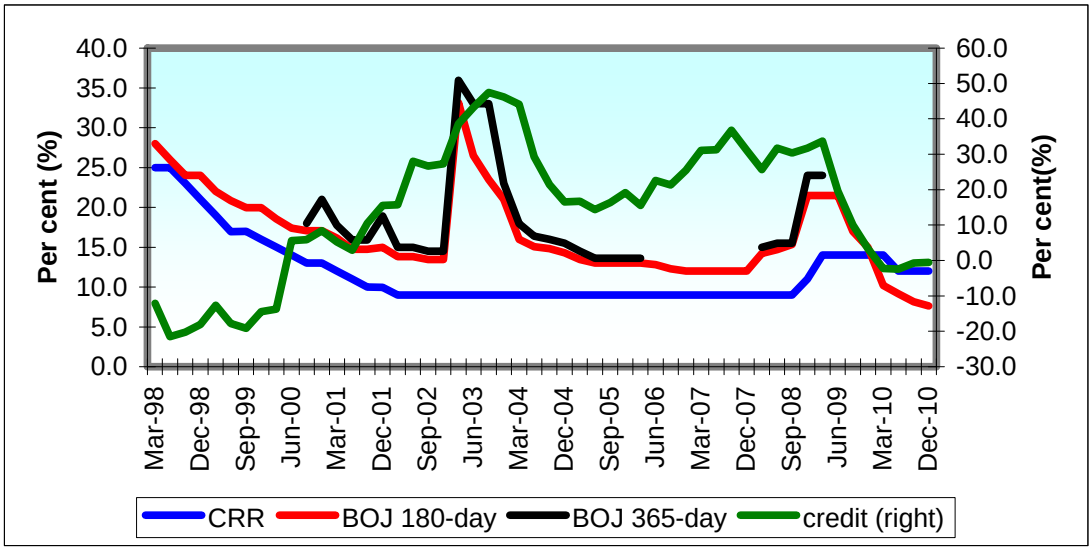
During the period March 1998 to December 2010, excess reserves in the commercial banks operating in Jamaica increased to $35.1 billion from $3.5 billion. On average, these reserves were 14.7 percentage points above the statutory requirement and were approximately 15.0 per cent at end-December 2010 (see Figure 1). The banks' decision to increase or lower these reserves during different periods appeared to have been

conditioned upon the prevailing macroeconomic condition, investor sentiment as well as the outlook for the main macroeconomic indicators. In this context, changes in the banks' liquidity preference would oftentimes create challenges for the Central Bank in its pursuit of price and financial system stability. For example, in response to periods characterized by an increased demand for credit, banks have been able to easily find the resources to meet this demand, despite a tightening of monetary policy by the Central Bank. Conversely, credit growth has been weak in periods when the central bank loosens policy. The non-responsiveness of credit during these period increases the discussion on the fact that although there has been a the trend reduction in both the reserve requirement and policy rates, interest rate spreads in commercial banks have remained high. The high spreads reflect lending rates which have been sticky. With regard to the foreign exchange market, excess reserves have provided the banks with the wherewithal to create demand pressure and consequently instability in the market during periods of uncertainty and reduced confidence.

Excess Reserves, Private Sector Credit & Loan Rates

The data suggests that private sector credit often times does not respond to changes in the signal rate or the reserve requirements given banks capacity to extend credit from holdings of excess reserves. For example, during 2002, the Bank pursued an expansionary policy stance. Concurrently, annual growth in loans and advances accelerated to 34.6 per cent in February 2003 from 17.1 per cent in February 2002 (see Figure 2). Subsequently, although monetary policy was significantly tightened, growth in credit accelerated to 49.9 per cent in October 2003 and grew further to 45.9 per cent in January 2004. Another clear example, is the 2006 period when the bank tightened policy but growth in credit accelerated. Given the onset of the global financial crisis and the resultant tightening of monetary policy, credit growth decelerated sharply. However, this was due to a fall in demand for loans as banks still had the wherewithal to extend credit.

Figure 2: The CRR, BOJ 180-day & 365-day rates and Annual Growth in Private Sector Credit [11]



Following work done by Khemraj (2007), a liquidity preference curve for Jamaica for the period 1997:1 to 2010:4 was constructed using the Loess procedure.[12] Khemaj showed that the liquidity preference curve was horizontal at approximately 17.0 per cent which suggested that a commercial bank would not, on average, lend to the marginal borrower at a rate below 17.0 per cent. The results obtained using data up to 2010 were close to those of Khemraj. The liquidity preference curve was horizontal at approximately 16.5 per cent which indicates that loans and excess reserves were perfect substitutes and as such a commercial bank would not, on average, lend to the marginal borrower, if that borrower could not pay at least 16.5 per cent. [13] In addition, at rates below 16.5 per cent commercial banks would rather hold excess reserves than extend loans. This minimum

[11] As at May 2009, the Bank removed the 365-day tenor from its menu of securities.

[12] In the Loess method, weighted least squares is used to fit linear or quadratic functions of the predictors at the centers of neighborhoods. The radius of each neighborhood is chosen so that it contains a specified percentage of the data points. The fraction of the data, called the smoothing parameter, in each local neighborhood controls the smoothness of the estimated surface.

[13] In Khemaj (2007), the curve became horizontal at a loan rate of approximately 17.0 per cent for the period 1990:1 to 2006:4. Khemraj argued that this was possible because as oligopolies, banks were able to mark-up the loan rate over an exogenous interest rate, transaction costs, and also account for the risk of default associated with a specific class of borrowers.

rate is expected to continue to decline with an improvement in macroeconomic conditions and operating efficiency in the banks.

Figure 3: Liquidity preference curve for Jamaica (Loess fit)

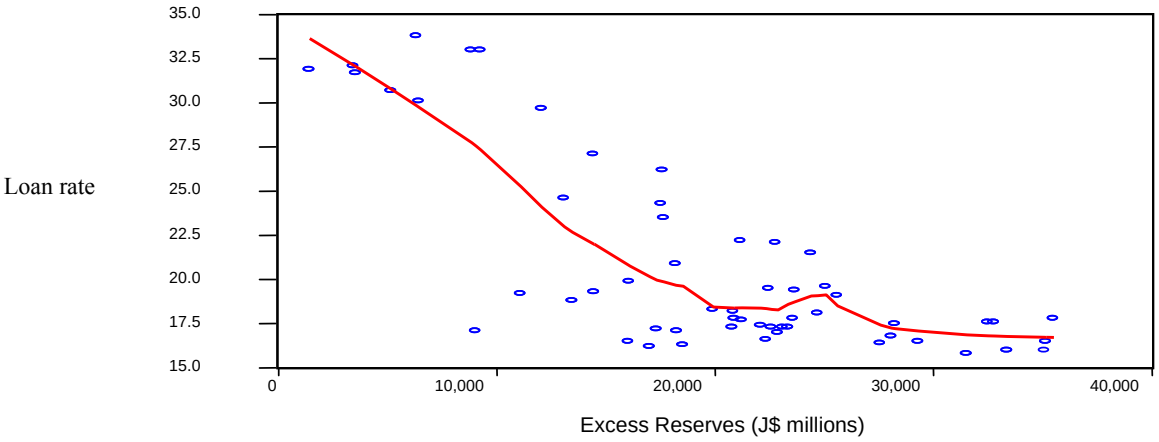
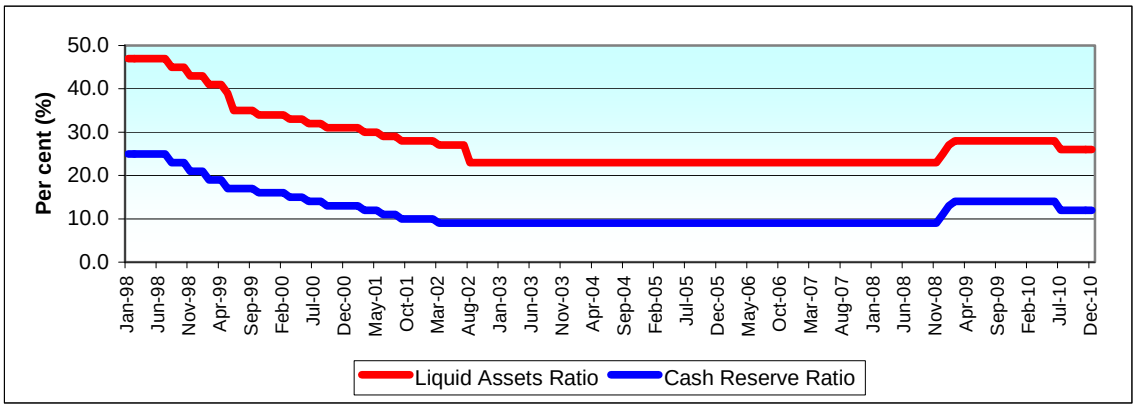
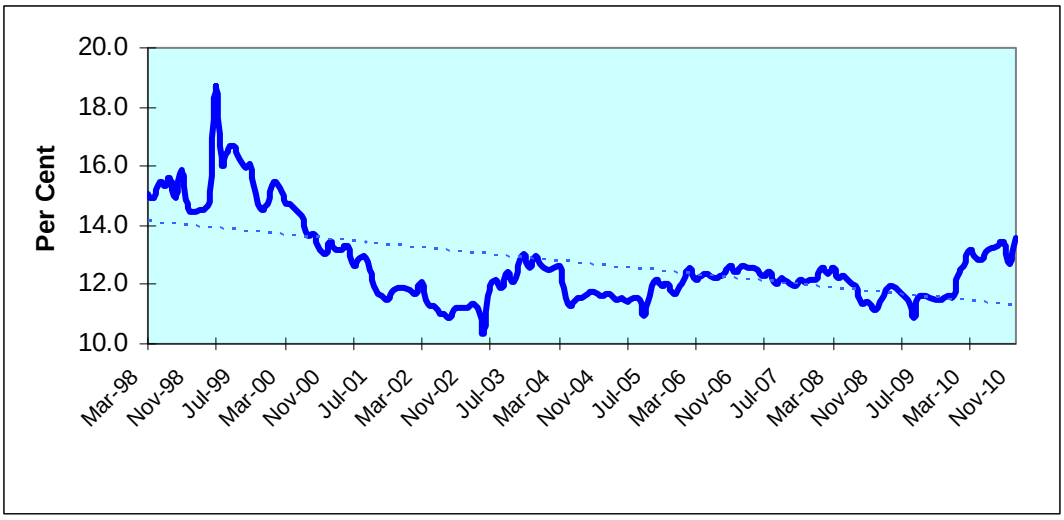


Figure 4: The Liquid Assets Ratio



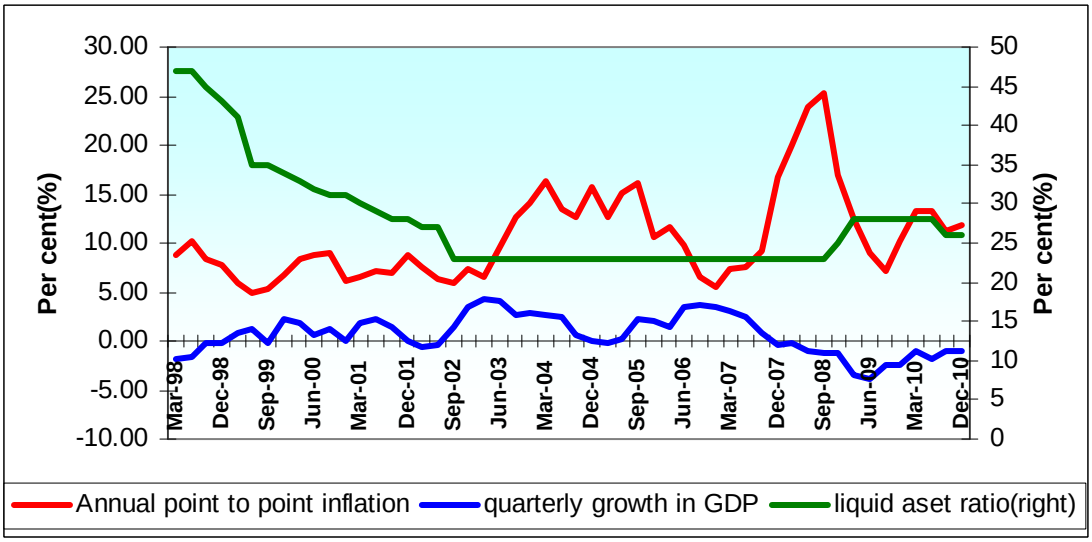
Commercial banks' interest rate spread has declined marginally despite a trend reduction in the reserve requirement; particularly the non-interest bearing cash reserve requirement as well as sharp downward adjustments to policy rates (see Figure 4). Figure 5 shows that the interest spread in Jamaica declined to 13.59 pps in November 2010 from 15.05 pps in March 1998 and averaged approximately 12.70 pps during the period. The maintenance of these high spreads has been largely been facilitated by the ability of the banks to charge high loan rates in an oligopolistic market structure.

Figure 5: The Interest Rate Spread (March 1998 to November 2010)



Economic Growth

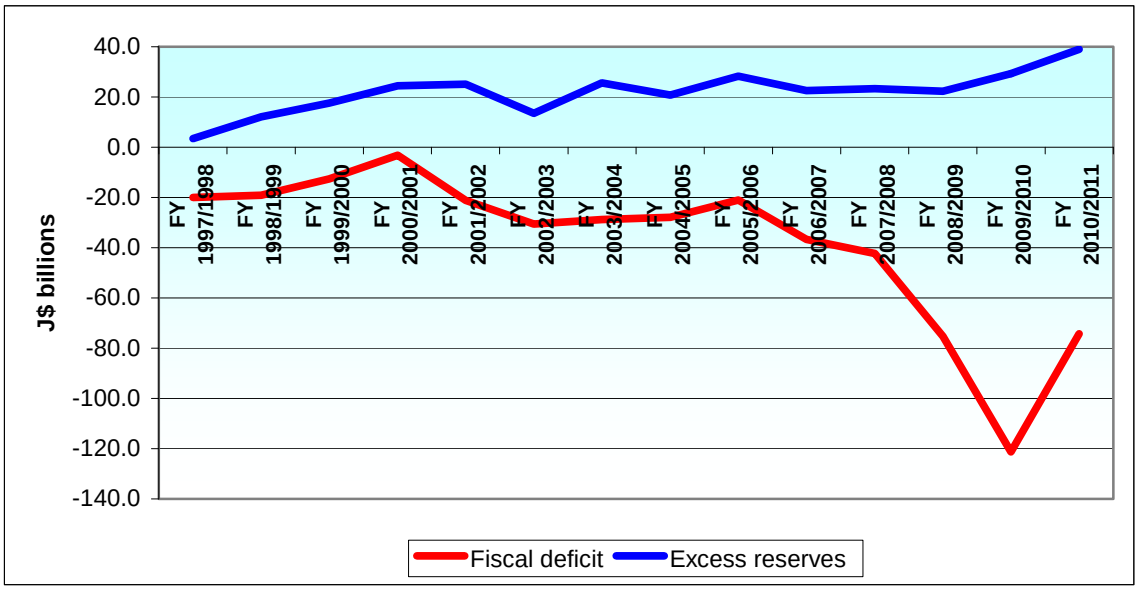
Figure 6: Quarterly Growth in GDP, 12-month Point-to-point Inflation and the Liquid asset Requirement



In a context where adjustments to the Bank's monetary policy stance did not always create the desired changes in private sector credit, an interesting line of investigation which was undertaken was the pattern of economic growth which evolved during the review period. The data show that the country experienced economic growth for most of the review period, albeit marginal (see Figure 6). The increased economic activity was

underpinned by a stable macroeconomic environment, for some of the sample years. For example, the country experienced its fifth consecutive year of single digit inflation in 2001. These positive developments facilitated an easing of monetary policy stance conveyed through successive reductions in the liquid asset and cash reserve requirements of deposit-taking institutions. Consequent on these reductions, the liquid asset and cash reserve ratios declined to 23.0 per cent and 9.0 per cent, respectively, by September 2002.[14] Private sector credit expanded during the period; however, there was a notable increase in the banks' excess reserves given the need to sterilize the liquidity which emanated from the buildup in the NIR consequent on the financing of the fiscal deficit through foreign resources.

Figure 7: Excess Reserves and the Fiscal Deficit



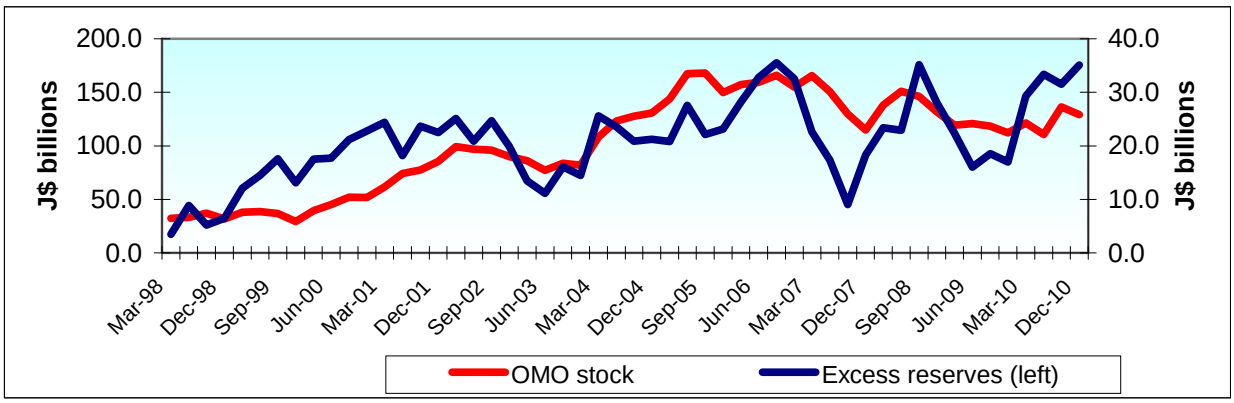
Excess Reserves and Open Market Operations

The fiscal deficit which was partly financed from external sources, contributed to a build-up in the NIR and consequently Jamaica Dollar liquidity in the financial system. The BOJ

[14]The liquid asset and cash reserve ratios remained at this level until December 2008 when against the background of elevated inflation; an increase of 2.0 percentage points in each ratio was effected. There were further increases in subsequent months of 2.0 percentage points and 1.0 percentage point, respectively, in each ratio.

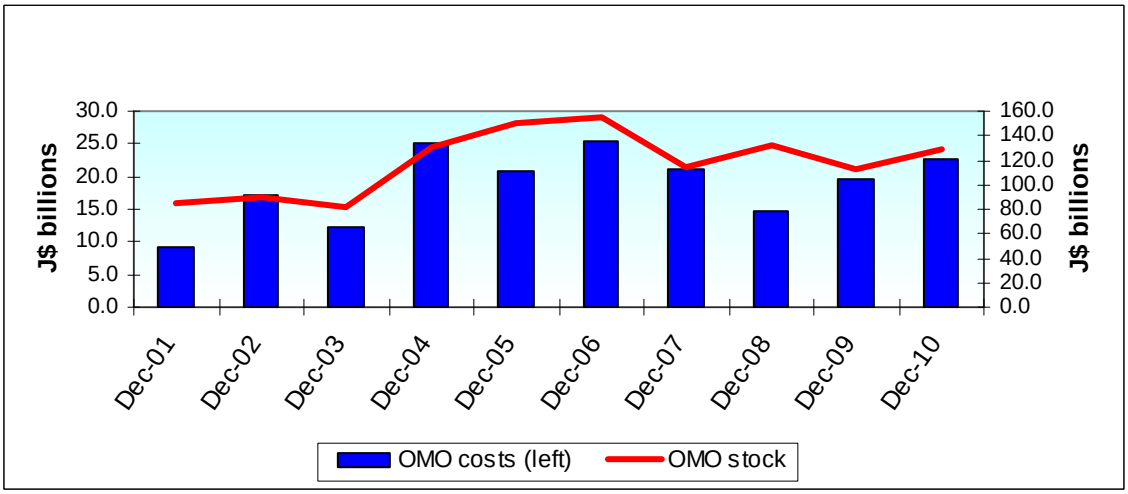
has used open market operations to influence the level of liquidity and the entire structure of interest rates in the Jamaican financial system. This has resulted in an increase in the stock of open market securities on the balance sheet of the Central Bank. These liabilities increased to $129.2 billion at end-December 2010 from $32.3 billion in March 1998 (see Figure 8).

Figure 8: Stock of Open Market Securities and Excess Reserves



The use of open market operations to remove excess liquidity from the financial system is not without cost. Annual OMO costs increased to $22.6 billion in December 2010 from $9.3 billion in December 2001 (see Figure 9).

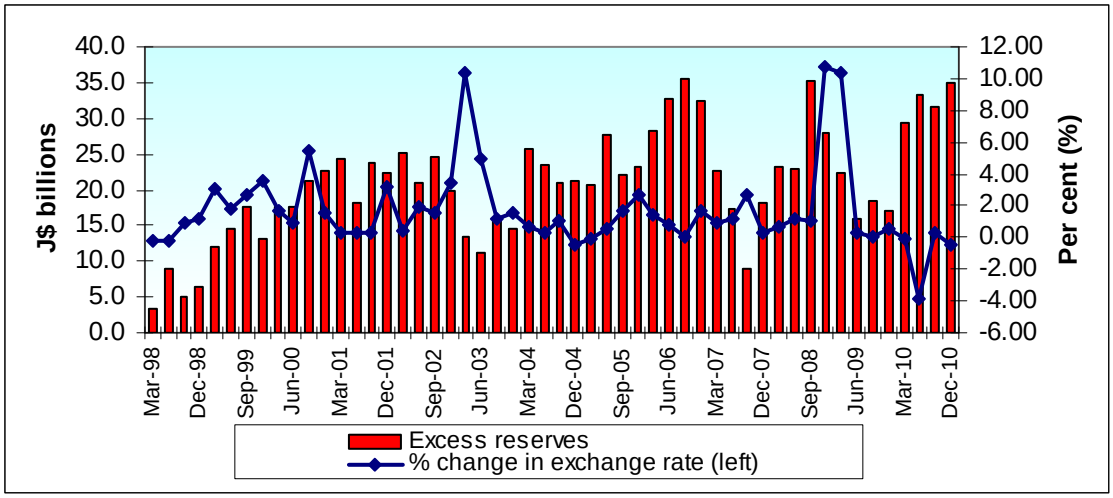
Figure 9: Annual Stock of Open market Securities and its Interest Costs



Excess Reserves and the Foreign Exchange Market

Another challenge for the Central Bank is the maintenance of an "orderly" foreign exchange market in periods of uncertainty given the high levels of excess reserves in the banks which may be liquidated to buy foreign exchange on their account.

Figure 10: Excess Reserves and the Quarterly Change in the Exchange Rate



The impact of excess reserves on the foreign exchange market would be evidenced in the volatility of the exchange rate coinciding with sharp changes in the excess reserves. Figure 10 shows the quarterly change in the exchange rate and the excess liquid assets of commercial banks during the review period. There are a number of periods in which a sharp depreciation in the exchange rate coincided with a sharp fall in the excess reserves. Most noticeable, in the March 2003 and June 2003 quarters, the exchange rate depreciated by 10.1 per cent and 4.9 per cent, respectively. There was also a reduction in the excess liquid assets which coincided with the depreciation of the exchange rate in these two quarters. The depreciation in the exchange rate during these two quarters was largely due to a fall in market confidence triggered by deterioration in the balance of payments and fiscal accounts and the related downgrade of the outlook on Jamaica's sovereign debt by Standard and Poor's(see Figure 8). In response to these developments, the Bank tightened monetary policy by increasing interest rates and augmenting the

supply of foreign exchange to the market.[15] A similar relationship was observed in 2006, 2007 and 2008.

The Central Bank was severely challenged to maintain stability in the foreign exchange market during the period 2007 – 2009, in light of the impact of adverse external developments on the domestic economy. More specifically, the December 2008 and March 2009 quarters were characterized by sharp depreciations of 10.7 per cent and 10.4 per cent, respectively, in the exchange rate. Concurrently, there were reductions in the excess liquid assets in commercial banks in these quarters. These declines occurred in tandem with increases in the demand for foreign currency in response to a fall out in foreign exchange inflows, increased margin calls on GOJ global bonds, the need to meet repo payments to overseas institutions as well as a reduction in trade credit lines. Market confidence was also negatively affected by unfavourable reports by various rating agencies. In response, to a heightened pace of depreciation in the value of the Jamaica Dollar, particularly in the first quarter of 2009, some banks reduced their excess reserves, in particular their holdings of BOJ securities to finance an increase in the holdings of GOJ foreign securities as a hedge. The Bank responded by instituting a raft of measures which included tightening monetary policy at various points over the three-year period, moral suasion and augmenting the supply of foreign currency to the market. These measures led to a restoration of stability in a context where increases in the rates offered on the BOJ's instruments as well as the offer of attractively priced variable rate instruments by the Bank restored the demand for Jamaica Dollar financial assets. The demand for the assets would have caused a build-up in excess reserves.

Excess reserves remained high during 2010 despite an easing of the Bank's policy stance, without being a threat to stability in the foreign exchange market. Of significance, was an appreciation of approximately 4.0 per cent in the June quarter, the largest quarterly appreciation since the June 1996 quarter. This coexistence of high levels of reserves with sharp appreciations in the exchange rate could be considered a paradigm shift in the Jamaican economy. The shift occurred in the context of improved prospects for inflation,

[15] See Bank of Jamaica Quarterly Monetary Policy Reports January – March 2003 and April – June 2003.

weak domestic demand conditions, expectations for a lowering of the fiscal deficit and the Government's debt to GDP ratio as well as for a build-up in the NIR. The outlook and expectations emanated from the implementation of the Jamaica Debt Exchange (JDX) programme and the signing of a 27-month Stand-by Arrangement with the IMF.

Given the challenges posed by excess reserves in the implementation of monetary policy, it is important to understand the factors which influence the level of these reserves held by commercial banks. As such, the demand for excess reserves will be estimated.

4.0 Data and Econometric Methodology

4.1 Data

The data used in the estimation of the ARDL model was of quarterly frequency and covered the period 1998:Q1 to 2010:Q4. The dependent variable is the logarithm of the excess reserves in commercial banks as a fraction of prescribed liabilities. The regressors used were lagged values of the dependent variable; current and lagged values of (the log of) required liquid assets as a proportion of prescribed liabilities, current and lagged values of the coefficient of variation of the currency-to-deposit ratio, current and lagged values of the quarterly deficit of the Central Government, current and lagged values of the Bank's 180-day rate, current and lagged values of the deviation of output from trend and the coefficient of variation of the deviation of income from trend. Output was seasonally adjusted using the Census x12 method and the trend component of income was generated using the Hodrick-Prescott filter. The coefficient of variation for the ratio of income to trend and the log of currency to deposit ratio were calculated based on the average of the standard deviation of the specified for 3 prior periods and the current variable divided by the average of 3 leads and the current period.

4.2 Model Techniques

Following Agénor, Aizerman and Hoffmaister (2004), an autoregressive distributive lag model (ARDL) was used to estimate the demand for excess reserves by commercial banks. However, to empirically analyze the long-run relationships and dynamic interactions among the variables of interest, this paper employed the bounds testing (or

autoregressive distributed lag (ARDL) cointegration procedure, developed by Pesaran et al (1995, 1999). This procedure was adopted for several reasons. The bounds testing procedure does not require the pre-testing of the variables included in the model since it is applicable irrespective of whether the regressors in the model are purely I(0), purely I(1) or mutually cointegrated. However, the procedure is not applicable in the presence of I(2) variables and therefore unit root testing is still relevant in its implementation. A further advantage is that while other cointegration techniques requires all of the regressors to be integrated of the same order, the autoregressive distributed lag approach overcomes some of these problems by providing an application on mixed regressors which captures both short run and long-run dynamics when testing for the existence of cointegration. The ARDL also avoids concerns on a large number of choices, such as the number of endogenous and exogenous variables (if any) to be included, the treatment of deterministic elements, as well as the order of the VAR. It is also possible that each regressor may have a different number of optimal lags. When compared to other multivariate cointegration techniques, the bounds testing procedure is easily employed since ordinary least squares (OLS) may be used to estimate the cointegration relationship. In addition, this procedure is a statistically significant approach for determining cointegrating relationships in small samples and as such is deemed to be robust in small samples such as that employed in this study.

The ARDL framework as specified in the equation below is used to identify the determinants of excess reserves in Jamaica:

$$lexr_t = \alpha_0 + \Sigma\alpha_{1i}\Delta lexr_{t-i} + \Sigma\alpha_{2i}\Delta lrr_{t-i} + \Sigma\alpha_{3i}\,\Delta\, lcvcd_{t-i} + \Sigma\alpha_{4i}\Delta lcvyt_{t-i} + \Sigma\alpha_{5i}\Delta lgdpgap_{t-i} + \Sigma\alpha_{6i}\Delta ldef_{t-i} + \alpha_{7i}prate_{t-i} + \lambda_1\, lexr_{t-1} + \lambda_4\, lrr_{t-1} + \lambda_3\, lcvcd_{t-1} + \lambda_4\, lcvyt_{t-1} + \lambda_5\, prate_{t-1} + \lambda_6\, lgdpgap_{t-1} + \lambda_7\, ldef_{t-1} + \varepsilon_t \ldots\ldots\ldots\ldots \quad Equation\ (1)$$

The above specification captures the main features of the model employed in this paper. A priori, the demand for excess reserves (*lexr*) is expected to be negatively influenced by the reserve requirement (*lrr)*. The interest rate which is represented by the BOJ 180-day rate, (*prate)* is expected to positively influence the demand for excess liquid assets. Given

that BOJ securities are a component of liquid assets, banks are expected to increase their demand for these assets when the rate of return on these securities increases. In contrast, the volatility of the currency to deposit ratio (*cvcd)* is expected to negatively influence the level of excess liquid assets since banks reduce their excess liquid assets to facilitate higher holdings of currency in periods of increased demand, such as public holidays. The current macroeconomic condition is evidenced in changes in the demand for cash which is proxied by *lgdpgap*. With regard to the current macroeconomic conditions, a cyclical downturn, for instance, would lead banks to anticipate lower transaction demand for currency by the public. Concurrently, credit demand is expected to be weak. Given this, the institutions are likely to reallocate resources to foreign assets or securities if these investments are expected to provide attractive rates of return. In this context, there could either be a reduction or an increase in the holdings of excess Jamaica Dollar reserves. The volatility of income (*cvyt)* is expected to positively influence the demand for excess reserves.

Similar to Maynard and Moore (2004), this paper incorporates changes in fiscal policy which may also significantly influence the liquidity of commercial banks. In this regard, the deficit of the Central Government was included to capture its effect on the excess liquid assets of commercial banks. An increase in the deficit implies ceteris paribus, that Government spending has increased which results in greater deposits in the banking system and by extension an expansion in the bank reserves. Consequently, an increase in the deficit of the Central Government (*ldef)* would lead to an increase in the excess reserves of commercial banks.

The portion of the equation which contains the summation signs and α_{1t} to α_{7t} represents the short-run dynamics of the model that determine the holdings of excess reserves. The long-run parameters computed as (λ_2, λ_3, λ_4, $\lambda 5$, λ_6, λ_7)/ λ_1 represent the adjustment of each variable towards the long-run relationship. The error term, ε_t is the classical disturbance term with the usual assumptions of a zero mean an independent distribution. The ARDL approach to cointegration seeks to determine whether a long run relationship exists among the variables by using the bounds test. The bound test is an F-

test of joint significance of the variables which specifies a null hypothesis of no cointegration against the alternative of the existence of a long run relationship. The null hypothesis of no cointegration defined by:

$H_0 : \lambda_1=\lambda_2=\lambda_3=\lambda_4=\lambda_5=\lambda_6=\lambda_7=0$, is tested against the alternative of

$H_1 : \lambda_1 \neq \lambda_2 \neq \lambda_3 \neq \lambda_4 \neq \lambda_5 \neq \lambda_6 \neq \lambda_7$.

However, the asymptotic distribution of this F-statistic is non-standard irrespective of whether the variables are I(0) or I(1). Pesaran et al. (2001) tabulated two sets of appropriate critical values for a given level of significance. One set assumes all variables are I(1) while the other assumes that they are all I(0). This band covers all possible classifications of the variables into I(1) and I(0) or even fractional integration. If the computed F-statistic exceeds the upper critical bounds value, then the null of no cointegration may be rejected. A test statistic which is below the lower critical bounds value implies that there is no cointegrating relationship however, if the test statistic falls within the bounds, then the test is inconclusive.

To ascertain the goodness of fit of the ARDL model, diagnostic and stability tests are conducted. The diagnostic test examines the serial correlation, functional form, normality, and heteroscedasticity associated with the model. The structural stability test of the model is also tested using the cumulative sum of squares (CUSUMSQ) based on the recursive residuals. Parameter stability is indicated when the plots of the CUSUMSQ move within the 5.0 per cent critical lines.

4.3 Empirical Results

Before testing the cointegration relationship, a test of the order of integration for each variable using the Augmented Dickey-Fuller (ADF) was conducted.[16] Although the ARDL framework does not require the pre-testing of variables, the unit root test could help in determining whether or not the ARDL model should be used as none of the

[16] The ADF tests in Eviews were used to derive the results in the first column of Table 1.

variables used should be integrated of order two. Visual inspection of the time series was therefore conducted to determine whether there were outliers, seasonality and or structural breaks present. These exogenous variables were then incorporated into the ADF test of the time series. Initially, the lag length was set to four and a constant, trend, seasonal dummies or dummies representing structural breaks identified were included. Insignificant lags were deleted until all remaining lags were significant. The histogram normality residuals test was then applied and the equation for each variable was accepted only if the residuals were normal. A p-value greater than the level of significance, 0.05, indicated the null hypothesis of normality of residuals could not be rejected. The t-statistic of the first lag of each variable was compared to the ADF test statistic to determine whether the variable was stationary given the inclusion of constant, trend, seasonality or structural breaks. [17]

Table 1: Augmented Dickey Fuller Tests

AUGMENTED DICKEY FULLER TESTS							
LEVELS						DIFFERENCES	
Intercept [3]			Trend/ intercept /dummy [4]			First difference	
Variables	Test statistic	Lags	Test statistic	Lags	P -value	Test statistic	Lags
LEXR	-4.365*	0	-2.460	0	0.539	-9.558*	0
LRR	-3.076*	0				-6.678*	0
LCVYT	-4.681*	1	-4.681*	1	0.408	-6.733*	0
LCVCD	-3.465*	0				10.121*	0
LDEF	-2.064	3				-7.811*	1
LGDPGAP	-3.527*	1	-3.375	1	0.733	-3.675*	0
PRATE	-2.680	0	-5.193*	0	0.063	-7.567*	0
5% level of significance	**-2.921**		**-3.502**			**-1.948**	

1 * denotes rejection of the null hypothesis of a unit root at the 5% level of significance.

2 Since differencing eliminates trend, unit root tests for the first differences are carried out with and without intercept. The results show that all first differenced variables are stationary without the intercept.

3 These results were obtained using the ADF tests in EViews. These values include an intercept only.

4 Results of ADF tests which include a constant, trend and or dummy variables.

5 The p-value refers to the histogram normality test of residuals.

[17] These results are presented in the second column of Table 1.

The results of the Augmented Dickey-Fuller unit root tests in Table 1 show that variables such as the volatility of income (*cvyt)* and the 180-day BOJ rate (*prate*) were stationary in level form or I(0). The other variables, the coefficient of variation of the cash to deposit ratio (*cvcd)*, the reserve to prescribed liabilities ratio *lrr*, the deviation of income from trend (*lgdpgap)*, the deficit of the Central Government (*ldef*) and the ratio of excess reserves to prescribed liabilities of commercial banks (*lexr*) were found to be I(1). Given the mixture of I(0) and I(1) variables, ARDL modeling is appropriate.

In implementing the ARDL procedure, it is important to determine the order of lags on the first–differenced variables. Pesaran and Pesaran (1997) recommend the use of 4 lags with quarterly data. The model was estimated with four lags and the general-to-specific approach (Hendry, 1995) utilized to reduce the model to a parsimonious representation. Several diagnostic tests including the tests for normality, serial correlation, model misspecification and heteroscedasticity were conducted to ascertain the appropriateness of the model. In addition, following the estimation of the model, the CUSUMSQ test was conducted to assess the parameter constancy. The results indicate the absence of any instability of the coefficients because the plot of the CUSUMSQ was confined within the 5 per cent critical bounds of parameter stability (see Appendix).

Table 2: Calculated F-statistic for the existence of a long-run relationship for excess reserves

Order of lag	**F-statistic**
4	F (6, 32) = 14.830*

The relevant critical bounds are obtained in Table CI(iii) (with an unrestricted intercept and no trend; 7 regressors) in Pesaran et al. (2001). The lower bound is 2.32 while the upper bound is 3.50 at the 5% level of significance. Narayan (2005) argues that exiting critical values were based on large sample sizes and could not be used for small sample sizes. He therefore, recalculated the critical bounds for smaller samples of 30 to 80 observations. These critical values for the bounds test, Case III: unrestricted intercept and no trend indicate that for a sample of 50 observations, the lower bound is 2.593 while the upper bound is 3.941.

The results of the bounds test indicate the calculated F-statistic (F-statistic = 14.830) is greater than the upper bound critical value at 5% level of significance (3.941), using an

unrestricted intercept and no trend as reported by Narayan (2005) (see Table 2). This implies that the null hypothesis of no cointegration is rejected at 5% and that there is a cointegrating relationship among the variables presented in Equation (1).

Table 3: The Estimated ARDL Model of the Demand for Excess Reserves

DLEXR = 0.400*DLEXR(-1) + 0.490*DLEXR(-2) + 2.019*DLNRR(-3) - 0.649*DLCVCD(-1)

(3.323) (4.386) (2.985) (-3.358)

-0.424*DLCVCD(-2) - 0.386* DLCVCD(-3) + 34.658*DLDEF - 25.374*DLDEF + 2.098*DPRATE

(-2.962) (-3.095) (5.243) (-6.123) (2.140)

-2.051*DPRATE - 1.058*LEXR(-1) - 1.180*LRR - 11.846*LGDPGAP(-1) + 0.319*LCVYT

(-2.262) (-8.388) (-4.273) (-3.316) (4.580)

+0.834*LCVCD(-1) - 2.040*LDEF(-1)

(4.483) (-2.771)

Diagnostics

R^2 = 0.791 Norm = 0.080 DW = 1.650 RR = 0.899 HET=0.494 SC =0.080

Notes: T-statistics are shown in the parentheses. R^2 is the fraction of the variance of the dependent variable that is explained by the model. DW is the Durbin Watson statistic; Norm is the test of normality of the residuals based on the Jacque-Bera test statistic; RR is the Ramsey test for functional form mis-specification (square terms only); HET is the Breusch-Pagan-Godfrey heteroscedasticity test based on the regression of the squared residuals; SC is Breusch-Godfrey Serial Correlation LM Test of the 4^{th} order given that quarterly data is used.

The results of the ARDL model, reported in Table 3 show that the model has passed all the relevant diagnostic tests. In this regard, the model may be deemed adequate, explaining 79.1 per cent of the demand for excess reserves in Jamaica during the period. The coefficient on the lagged excess reserves term is negative, highly significant and in line with a priori expectations. It represents the speed at which the variable moves toward

restoring the long run equilibrium. The results showed that excess reserves (*lexr*) have an adjustment of -1.058 which indicates that 105 per cent of the adjustment is achieved in the first quarter.[18] This result suggests that the adjustment process occurs very quickly and that there is some overshooting before excess reserves returns to its long run level. The negative sign implies that the lagged excess reserves holdings induce smaller holdings in the current period.

The long-run cointegrating equation from the ARDL model may be written as:

lexr = 11.194 lgdpgap(-1) - 0.789 lcvcd(-1) + 1.114 lrr(-1) + 1.928 ldef(-1) − 0.301 lcvyt(-1)

With the exception of the required reserve ratio (*lrrd*) and the volatility of income (*lcvyt*) which were incorrectly signed, the long run coefficients generally conformed to the a priori expectations and were found to be statistically significant. The required reserve ratio was found to have a positive impact on excess liquid assets in both in the long-run and the short-run. This result could be explained by the fact that in the last two decades, commercial banks have consistently held liquid assets in excess of the requirement. In this regard, the positive relationship could suggest that commercial banks target some level of excess reserves which increases when the required reserve ratio increases. As such, the required reserve is not a binding constraint.

The volatility of the currency to deposit ratio was found to negatively impact the level of excess liquid assets as expected given that banks reduce their excess liquid assets to facilitate higher holdings of currency in periods of increased demand, such as public holidays. This result is also similar to that obtained by Maynard and Moore (2005).

The deviation of income from trend and the deficit of the Central Government were found to be positively related to the holdings of excess reserves. The positive relationship

[18]B. BhaskaraRao (2005) noted that the error correction coefficient should be negative but its absolute value need not be always be less than unity, implying that, at times, overshooting is a possibility.

between the deficit of the Central Government and the holdings of excess reserves implies that an increase in Government spending, whether through money creation or borrowing from overseas, results in greater deposits in the banking system and by extension an increase bank reserves. In terms of the deviation of income from trend income, a positive relationship suggests that lower holdings of excess reserves are held in a cyclical downturn as consumers reduce their transaction demand for money. The current macroeconomic circumstances was found to have the largest impact on the banks holdings of excess reserves as a 1.0 per cent increase in income from trend is expected to increase the holdings of excess reserves by approximately 11.0 per cent.

The BOJ 180-day rate was found to be a determinant of the banks' holdings of excess reserves but only in the short-run. The cumulative positive impact of the Bank's rate in the short-run is in line with a priori expectations as commercial banks are expected to increase their holdings of liquid BOJ securities as the rate of return on these assets increase. However, the absence of this rate from the long-run equation suggests that over time the commercial banks' stock of liquid assets is not dependent of the BOJ's 180-day rate.

In contrast to the non-inclusion of the volatility of income in the short-run demand for excess reserves, in the long-run the volatility of income was found to have a significant but small negative impact on excess reserves similar to the long-run findings of Maynard and Moore (2005). They posited that the small, negatively signed coefficient implied that the variable had a minor effect on excess reserves probably reflective of the low level of volatility in income in Barbados. The same argument could be posited for volatility of income in Jamaica as quarterly growth in GDP during the period March 1998 to December 2010 was in the range of -1.9 per cent to 4.3 per cent, with average growth of 0.7 per cent and standard deviation of 2.0 per cent.

In terms of the short-run changes of the other variables, lagged values of excess reserves were found to have a positive impact on the demand for excess reserves in Jamaica. This implies that increased holdings of excess reserves in prior periods would positively

impact holdings in the current period. The required reserve ratio was also found to have a significant positive impact on excess reserves in the short-run as a 1.0 per cent increase in the ratio was expected to increase excess reserve holdings by approximately 2.02 per cent by the third quarter. This is reduced over time to approximately 1.1 per cent as suggested by the long-run results. The short-run results suggest that the deficit of the Central Government had a cumulative positive impact in the short-run. In this regard, a 1.0 per cent increase in the deficit was expected to increase the banks' holdings of excess reserves by approximately 9.3 per cent. This result is greater than the long-run result which suggests that excess liquid assets would increase by 1.93 per cent.

5.0 Conclusion

This paper examined the trend in excess reserves held by commercial banks in Jamaica, presented some challenges faced by the Central Bank in the implementation of monetary policy in a context of persistent excess reserves and estimated the demand for excess reserves. The analysis highlighted that the maintenance of relatively high excess reserves would have facilitated instability in the foreign exchange market as well as credit expansion by commercial banks even when the Bank of Jamaica adopted a tight monetary policy stance.

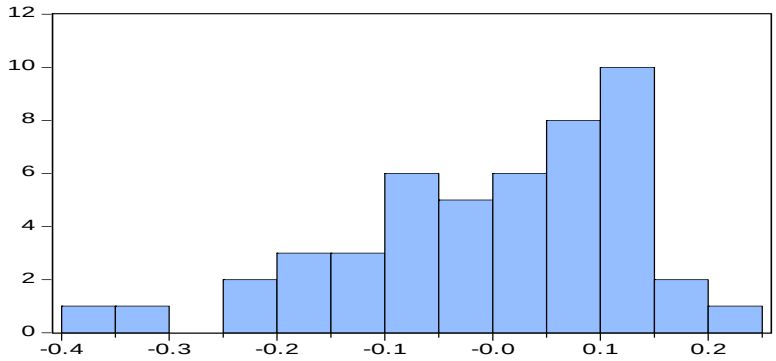
Against this background, the paper estimated the demand for excess reserves by commercial banks in Jamaica using the framework presented by Agenor et. al (2004). Similar to Maynard and Moore (2005), the impact of fiscal strategies on the demand for excess reserves was included in the model. The results of the ARDL cointegration model revealed that the demand for these reserves was influenced by the deficit of the Central Government, the volatility of the currency to deposit ratio as well as the deviation of output from trend in the long run. The volatility of income and the required reserve ratio although included in the long-run model were incorrectly signed. It was argued that commercial banks target some level of excess reserves which is usually above that required by the monetary authorities and as such the required reserve was not considered a binding constraint. It was proposed that the low variability in Jamaica's GDP during the

review period might explain the small negative impact on the holdings of excess reserves in the long run. The paper identified the short-run determinants of excess reserves as lagged values of excess reserves, the BOJ 180-day rate, the required reserve ratio and the deficit of the Central Government, all of which were found to have a positive impact on excess reserves. In contrast, the volatility of currency to deposit ratio was found to have a negative impact on the demand for excess reserves.

Given the findings it could be argued that banks will continue to hold relatively high excess reserves for a sustained period. However, a reduction in the fiscal deficit could substantially lower the commercial banks' holdings of excess reserves and consequently the cost of open market operations. In addition, the promotion of policies that could help to channel excess liquidity into real sector activities would facilitate the reduction of these assets. In this regard, a useful line of investigation for future research would be to determine the role of credit in the monetary transmission mechanism in Jamaica.

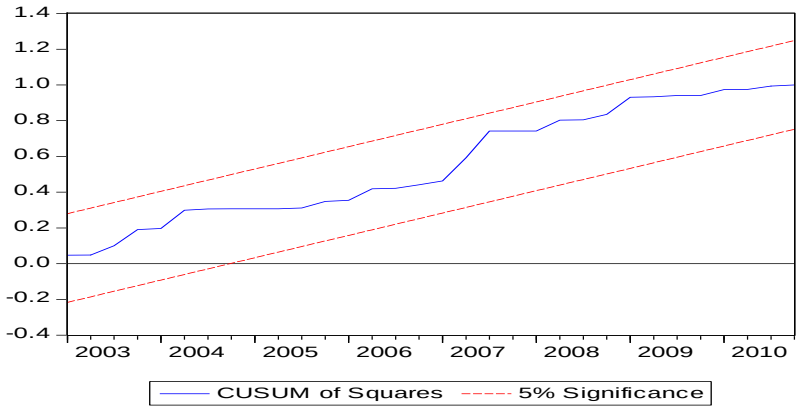
6.0 Appendix

Figure 11: Histogram Normality of Residuals



Series: Residuals	
Sample 1999Q1 2010Q4	
Observations 48	
Mean	-6.79e-07
Median	0.030080
Maximum	0.222642
Minimum	-0.390187
Std. Dev.	0.133461
Skewness	-0.778634
Kurtosis	3.322705
Jarque-Bera	5.058450
Probability	0.079721

Figure 12: CUMSUM of Squares



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