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Determinants of Commercial Bank Interest Rate Margins in Swaziland

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Abstract: *The study analysed the determinants of commercial bank interest rate margins in Swaziland using bank-specific, industry-specific and macroeconomic data for the period 1997-2008. Panel data techniques were used for analytical work. The study used two different measures of interest rate margin, namely, the net and narrow interest rate margins (NIM and NAIM) as dependent variables. The empirical results indicate that increases in overhead costs, liquidity, equity, bank market power (or concentration), South Africa's interest rate (T-bill rate) and changes in exchange rates have significant effects on the rise in NAIM while intermediation has a negative effect. On the other hand, a rise in overhead costs has a significant positive effect on the NIM whereas liquidity has a negative effect. The study findings underscore the importance of enhancing the efficiency of the financial sector through reduction of intermediation margins to boost investment and economic growth in Swaziland.*

Keywords: Commercial bank, interest rate margin, liquidity, bank market power, economic growth

Introduction

The level of interest rate margin is one of the most important parameters for gauging the efficiency or otherwise of financial institutions (Randall, 1998; Brock and Rojas-Suarez, 2000; Chirwa and Mlachila, 2004; Gelos, 2006; Crowley, 2007).

While a number of authors have investigated the determinants and implications of interest rate margins in different economies of the world, yet the results documented in the literature are far from being conclusive. Although many authors seem to agree on the negative implications of wide interest rate margins for financial intermediation and financial development in general, there is little consensus on the causes or determinants of interest rate margins. While some authors argue that the main determinants of interest rate margins are bank specific factors, others argue that industry specific factors are more important. In fact, another group of researchers believe that macroeconomic factors are more important in explaining the level of interest rate margins in developing countries. This study attempts to test the various hypotheses concerning the determinants of interest rate margins using Swaziland data. The focus on Swaziland is important for a number of reasons: First, there has been the need for an improved understanding of the efficiency of the financial sector following the liberalization of interest rates in Swaziland. As a member of the Common Monetary Area (CMA), Swaziland's monetary policy is closely linked to South Africa policy and interest rate movements depend mostly on South Africa's interest rates. Secondly, there has also been concern in many developing economies about the level and structure of interest rates which remained high with marked interest rate margins during post-liberalization, which have implications for the efficiency of the financial sector (Turtelboom,

1991). High intermediation margins imply inefficiency of the financial sector, which acts as a disincentive to investment and could slow down economic growth. This study therefore investigated the determinants of interest margins in Swaziland using bank specific, industry specific and macroeconomic data.

Overview of Swaziland's Financial System

Swaziland's financial sector is made up of the Central Bank of Swaziland (CBS), four commercial banks with 31 bank branches, one building society, two unit trusts, two development finance institutions, 56 Savings and Credit Cooperatives (SCCOs), a stock exchange, over 200 pension funds (private and public), six insurance companies, and over 100 micro finance institutions (MFIs) (Central Bank of Swaziland Report, 2007). For a long time, the banking industry has been under the dominance of South- African owned banks. Initially there were three major commercial banks in Swaziland, (Barclays and Standard Chartered Bank with headquarters in London) and Swazi Bank, a quasi-governmental bank. First National Bank entered the market after the Bank of Credit and Commerce International (BCCI) failure via acquisition from the curator. Barclays Bank Swaziland Ltd was subsequently sold to Standard Bank of South Africa while Standard Chartered Bank of Swaziland (PLC) was sold to the South African bank, Ned bank. The state owned development bank otherwise known as the Swazi Bank continued to be a loss making institution until March 2001 due to a high non-performing loan book in June 1995. In restructuring the bank, the Swaziland government appointed a full complement of directors and employed an entirely new executive management team. Government has also re-capitalized the bank in order to help it adopt modern technology so as to compete effectively with its competitors. This has also enabled the bank to operate within internationally recognized banking standards. Following its formal re-launch in November 2001, Swazi Bank has since increased its product range and strengthened its operations. In 2002 the bank released its' first annual report since 1993, recording profits of above E13 million. However, the bank faces a daunting and challenging task of meeting a dual objective of being a commercial and a development bank while competing with other banks that are largely private (World Bank, 2005).

The Monetary Authority of Swaziland (MAS) was established in 1974 through an Order of Parliament and became the Central Bank of Swaziland, under the Monetary Authority (Amendment) Act of 1978. It was anticipated that the 1974 order would experience legislative amendments to widen the capacity of the central bank's supervisory powers and to improve the prudential ruling in order to improve banking soundness in the country. This was meant to further facilitate a legal framework conducive to global trends (Central Bank of Swaziland Report, 2000).

Before the establishment of the MAS, Swaziland was a member of a monetary arrangement along with Botswana, Lesotho and South Africa. All circulating currency was issued by South Africa and bank deposits were denominated in the South African currency. Interest rate trends for countries in this monetary arrangement were a replica of the South Africa's economy. Pension and provident funds invested their funds in the Johannesburg market. This loose monetary arrangement was only formalized in 1974 when the Rand Monetary Area (RMA), which allowed a free flow of capital within member states, came into existence. Botswana participated in the RMA negotiations but opted out in 1976 in favour of a managed float of its currency, the pula. Since then, Botswana has pegged the pula to a trade-weighted basket of rand and SDR with the South African rand having a large weight in the basket (Central Bank of Swaziland Report, 2000).

The establishment of the MAS came with the issuance of Swaziland's currency- Lilangeni (Emalangeni in plural), whose exchange rate is at unity with the rand. Domestic holdings of rand notes were converted into bank balances in the South African Reserve Bank (SARB) earning interest, and at the same time held as 100 percent backing for emalangeni issued as required by the RMA agreement (Central Bank of Swaziland report, 2000). The legal tender status of the rand did not change; with the rand circulating alongside the lilangeni. South Africa paid compensation to Swaziland for loss of seigniorage, based on a predetermined formula on the estimated amount of rands in circulation. However, in 1986, after a series of economic events in South Africa, including the huge depreciation of the rand in 1985 which led interest rates to shoot up in all member countries, Swaziland renegotiated the RMA agreement, which changed to the present Common Monetary Area (CMA) agreement of which Lesotho, Namibia, South Africa and Swaziland are members. This agreement resulted in the termination of the legal tender status of the rand; consequently, Swaziland gave up its right to receive compensation from South Africa on account of the rands circulating in the country (Central Bank of Swaziland Report, 2000).

The important part of the CMA agreement is that Swaziland now has the liberty to delink the lilangeni from the rand, should circumstances so dictate. Swaziland has, however, opted to maintain the peg on the grounds that it is in the country's best interest. By implication, pegging the lilangeni at par to the rand means that any change in the international exchange rate of the rand culminates in an equivalent movement in the lilangeni. In essence, the policies pursued by Swaziland are to a large extent influenced by South African policy pronouncements (Central Bank of Swaziland Report, 2002).

In South Africa, for both loans and deposits the national T-bill rates play an increasingly important role in determining interest rates (Sander and Kleimeier, 2004). According to Sander and Kleimeier (2004), the monetary policy of South Africa has an unswerving influence on the bank rates in all CMA countries. This impact is increasingly mediated through T-bill markets. The arrangement under the auspices of the common monetary area has rendered Swaziland's control of its money supply ineffective, as the rand has continued to freely circulate side by side with the Lilangeni, and has also meant that interest rates are determined in a unified market (Central Bank of Swaziland Report, 2002).

Given Swaziland's membership of the CMA characterized by a fixed unitary exchange rate with the South African rand (which eliminates the threat of exchange rate risk), there is very little scope for Swaziland's interest rate to deviate substantially from those ruling in the CMA. Despite tracking the South African interest rate structure, Swaziland's interest rate regulation is largely through moral suasion, where the Central Bank of Swaziland (CBS) uses this instrument to encourage the local banking sector to lend to the private sector. However, the CBS has to maintain slightly lower interest rates than South Africa to stimulate investment, and manage the differential to prevent arbitrage. In practice, there have been occurrences of wide differentials in interest rates between South Africa and Swaziland (Central Bank Report, 2000).

Interest rates are the principal instrument of monetary policy and closely track those obtained in South Africa (Central Bank Report, 2008). Historically, the Central Bank of Swaziland has maintained marginally lower interest rates than the South African Reserve Bank (SARB) to stimulate investment and lower the cost of borrowing and doing business. However, policy rates (the discount rate in Swaziland and the repo rate in South Africa) converged from September 2001, and prime rates from September 2003, until May 2008. According to the 2008 Central bank report, from June 2008 interest rates were 50 basis points lower in Swaziland than in South Africa as the CBS did not raise its discount rate in that month but left rates unchanged. Swazi-

land's discount rate averaged 11.3 percent in 2008 up from 9.7 percent in 2007 and 7.7 percent in 2006, whereas the prime rate averaged 14.8 percent in 2008 up from 13.2 percent in 2007 and 11.2 percent in 2006 (Central Bank Report, 2008). Ho and Saunders (1981) revealed that interest rate volatility leads to larger margins.

Whilst the objective is to minimize the interest rates differentials, there has been direct control on the movement of interest rates against the trend in South Africa in some years. In 1998 for instance when the rand was depreciating and when interest rates were going up within the CMA, the differential between Swaziland and South Africa interest rates reached six percentage points. At that time the CBS felt that raising local rates to the SA levels would put too much pressure on the economy and be contrary to the objective of stimulating investment in the real sector (Central Bank Report, 2008). The general policy is to maintain a differential of 0.25-0.50 percentage points. It should be noted that this policy has serious implications, particularly with regard to the huge capital flows that result as a response to the discrepancy. A related objective is that of ensuring that depositors are compensated positive net returns. However, due to inflationary pressures in the past, it was not possible to reward depositors' positive net returns except since 1999/2000 when single-digit inflation levels were achieved (Central Bank Report, 2008).

From a bank's point of view, interest rate margin is a return for the risk the bank bears. It compensates for the risk of loan default and also for the risks related to funding costs. Banks usually borrow short-term funds from depositors and provide long-term loans. Interest rate margins should consequently cover both spot and future cost of funds. The margin may move up or down depending on the predictions of future short-term interest rate (Ramful, 2001).

To stimulate the economy to recover due to the effects of the global financial crisis of 2007, the Central bank of Swaziland has been pursuing an accommodative monetary policy position by reducing interest rates since 2008. Given the effectiveness of the monetary policy, prime-lending rates also adjusted accordingly in the same direction and magnitude as the discount rate, (Central Bank Report, 2008). The Central Bank reduced the discount rate by a cumulative 200 basis points over the quarter, from a level of 11 percent in December 2008 to 9 percent in March 2009. Consequently, other depository corporations reduced their prime-lending rate from 14.5 percent to a level of 12.5 percent by the end of March 2009. Changes in the deposit rates were also put into place during the three months, with the 31 days deposits rate being revised from a level of 7.30 percent to 6.08 percent, while the 12 months deposits rates were reduced from 9.81 percent to 6.35 percent. Interest rates were reduced by 100 basis points at the beginning of May 2009. The discount rate was revised downwards to 8 percent, while other depository corporations reduced their prime lending rates by the same margin to 11.5 percent (Central Bank of Swaziland Report, 2009).

According to Crowley (2007) and Ndung'u and Ngugi, (2000), when the interest margin is enormous, it contributes to financial dis-intermediation as it discourages potential savers with too low returns on deposits and limits financing for potential borrowers thus reducing viable investment opportunities and therefore the growth potential of the economy. An increase in the inefficiency of banks will certainly increase these intermediation costs, and thereby enlarge the part of savings that is 'lost' in the process of intermediation. This eventually reduces lending, investment and economic growth.

Empirical literature suggests that financial systems in developing countries like Swaziland display momentous, unstable and persistently larger intermediation margins on average than in developed countries. As a result, the interest rates charged by local banks have been a sensitive and recurring policy issue in Swaziland and one which requires an objective examination of all

the factors behind the structure of commercial bank interest rates. In the past, these unstable and high margins have generally been attributed to high operating costs, financial taxation, and lack of competition and high inflation rates (Central Bank Report, 2007). This study, therefore, attempts to investigate the determinants of interest rate margins in Swaziland.

Review of Empirical Literature on Interest Rate Margins

Empirical literature suggests that interest margins are broadly linked to the efficiency of the banking sector. The determinants of commercial bank interest margins have been classified into three categories namely; bank-specific, industry-specific and those determined by macroeconomic variables (Dermirguc-Kunt and Huizinga, 1999; Craigwell and Moore, 2000; and Sologoub, 2006).

Bank-specific factors are also known as firm or micro determinants. These come from bank accounts mainly from the balance sheet, income statements and/or profit and loss accounts meaning that they are internally determined. The main source of bank-specific or internal risk in many developing countries is credit risk. Poor enforcement of credit rights, fragile legal setting, and inadequate information on borrowers expose banks to credit risk. At the macroeconomic level, weak economic growth adds to risk as it encourages the deterioration of credit quality and increase the probability of loan defaults. Credit risk could be measured using the loan loss provisions (Crowley 2007).

Using accounting decompositions as well as panel regressions, Al-Haschimi (2007) examined the determinants of bank net interest rate margins in 10 Sub Sahara African countries. The findings suggested that credit risk and operation inefficiencies, which indicate market power, explain most of the disparities in net interest margins across the region.

Wong (1997) found bank interest margins to be positively related to bank's market power, bank's operating costs, credit risk and the degree of interest rate risk. Increase in equity was found to have a negative effect on margins when the bank is faced with little interest rate risk. Angbazo (1997) tested the theory that banks with extra risky loans and higher interest rate risk exposure selected loan and deposit rates, which achieved higher net interest margins. Using Call Report data for different size classes of banks for 1989-1993, Angbazo (1997) showed that the net interest margins of commercial banks reflected both default and interest-rate risk premiums.

Ho and Saunders (1981) also observed that pure spread is a microstructure phenomenon, influenced by the amount of bank risk management, the size of bank transactions, interest rate elasticity and interest rate variability.

Secondly, industry-specific or market determinants refer to market concentration, competition, size of the industry and ownership. These factors affect the market as a whole meaning that the banking sector instead of just an individual bank is affected by these factors. It must be noted though that many researchers single out bank specific factors as the main determinants of bank interest margins (Crowley 2007).

Demirguc-Kunt and Huizinga (1999) used bank level data for 80 countries to investigate how bank characteristics and the overall banking setting influence both interest rate margins and bank returns. When taking into account both measures, the study provided a breakdown of the income effects of a number of determinants that affect depositor and borrower behaviour, as opposed to that of shareholders. The findings suggested that macroeconomic and regulatory conditions have a prominent impact on margins and profitability. Lower market concentration ratios lead to lower margins and profits, while the effect of foreign ownership varies between developed and devel-

oping countries. In particular, foreign banks have higher margins and profits compared to domestic banks in developing countries, while the opposite holds in developed countries.

Margins have been found to be linked to the level of market concentration in European banking sectors (Saunders and Schumacher, 2000; Maudos and Fernandez de Guevara, 2004). Ho and Saunders (1981) also noted that the magnitude of the margin is much higher in a non-competitive market, which calls for strengthening of the regulatory and legal structure to boost the solidity of the market. Barajas et al. (1996) demonstrated that loan market power has momentous effects on interest margins.

Other empirical results reveal that market imperfections broaden the interest rate spread. Ho and Saunders (1981), approximating market control with bank size, found a huge disparity in spread between large and small banks. Small banks had higher spreads compared to the large ones. Elkayam (1996) found that in a competitive banking arrangement, the interest rate margin derives exclusively from central bank variables (including the discount window loans, reserve requirement and interest on liquid assets on deposit with the central bank), while under a monopolistic (or, oligopolistic) structure the interest rate spread is in addition affected by elasticity of demand for credit and deposits. Moreover, taking into account monetary policy, Elkayam (1996) found that a rise in money supply under elastic demand lessens the margin further in a monopolistic setting than in a competitive market.

Finally, macroeconomic determinants of interest rate margins are external determinants which are not related to bank management but reflect the economic and legal environment that affect the operation and performance of commercial banks. The macroeconomic environment has variables such as inflation, interest rates and cyclical output (Crowley 2007). Most studies have used inflation rate, the long-term interest rate and/or the growth rate of money supply. Allen and Saunders (2004) studied the literature on pro-cyclical operations, credit market exposures and revealed that these cyclical effects originated from systematic risk that emerge from ordinary macroeconomic influences or from financial institution interdependences as a result of international consolidation.

Allen and Bali (2004) noted that macroeconomic variables to a great extent affect bank profitability in developing countries. Inflation in particular, is positively linked to bank profits meaning that banks forecast future changes in inflation correctly and are quick enough to adjust interest rates and margins.

Hanson and Rocha (1986) analysed the determinants of interest rate margins looking at the role of explicit and implicit taxes and other factors like bank costs and profits, inflation, scale economies and market structure. Using aggregated interest rate data for 29 countries for the period 1975-1983, they found a positive correlation between interest rate margins and inflation.

Zarruk (1989), taking note of risk management by banks, found that risk-averse banks operate with a smaller margin than risk-neutral banks, while Paroush (1994) explains that risk aversion raises the bank's optimal interest rate and reduces the amount of credit supplied. Actual margin, which incorporates the pure margin, is in addition influenced by macroeconomic variables including monetary and fiscal policy activities. Hanson and Rocha (1986) emphasized the role of direct taxes, reserve requirements, cost of transactions and forced investment in defining interest rate margin.

Gelos (2006) explored the determinants of bank interest margins in Latin America using both bank bank-specific and economy wide macroeconomic data. He found that interest rate margins on deposits and lending rates are huge because of relatively high interest rates (which in the

study is a proxy for high macroeconomic risk, including from inflation), less efficient banks, and higher reserve requirements.

Data Sources and Model Specification

Data Sources

The study utilised secondary data on four banks in Swaziland for the period 1997-2008 for which consistent data was available on bank-specific, industry-specific and macroeconomic variables. Bank specific data was obtained from the annual balance sheet, income statements and Central Bank of Swaziland Reports. Data on the macroeconomic variables (inflation, T-bill rates and exchange rates) were got from the Central Bank of Swaziland reports.

Model Specification

Following Ho and Saunders (1981), Saunders and Schumacher (2000), Brock and Suarez (2000) and Drakos (2003), a general class of regressions for interest rate margins takes the form;

$NIM_{it} = \alpha + \beta B_{it} + \eta I_{bt} + \pi M_t + \mu_{it}$ ..... (1)

Where: *it* indicate bank *i* at time *t,* and *b* represents the bank industry (all other variable except for α vary with time).

NIM_{it} = represent the net interest margin *i* at year or time *t*

α = represent the constant term

B_{it} = represent a vector of bank-specific variables for bank *i* at time *t*

I_{bt} = represent industry- specific variables (the banking industry)

M_t = vector for macroeconomic variables over time

μ_{it} = residual

For this study, the bank-specific variables consist of liquidity, intermediation, equity ratio, overhead costs, loan loss provision, taxes and intermediation. For industry or market variables, we used bank concentration or competition measured by Herfindahl-Hirschman Index (HHI) and ownership (market share in loans and deposits markets). The HHI is computed for both the loans and deposits markets. The macroeconomic variables include inflation, exchange rate volatility and the South African interest rate (T-bill rate), which measures the effect of South Africa's monetary policy on Swaziland as a member of CMA where the rand is the anchor currency.

Definition and Measurement of Variables

The variables for the study can be classified under three broad categories namely: bank-specific, banking industry-specific and macroeconomic variables. The definitions of the specific variables are highlighted below.

Dependent Variables

This study used two measures of interest rate margins: the net and the narrow interest rate margins (NIM and NAIM).

i) The *Net Interest Margin (NIM)* is defined as the difference between interest income generated by banks by their lending and interest paid on borrowing (for example, deposits). NIM is expressed as net interest income (interest earned minus interest paid on borrowed funds) as a percentage of earning assets (any asset, such as a loan, that generates income).

$$Net\ Interest\ Margin = \frac{Net\ Interest\ Income}{Average\ Total\ Earning\ Assets}$$

ii) The *Narrow Interest Margin (NAIM)* is defined as the difference between income received on loans (divided by total loans) and interest paid on deposits (divided by total deposits).

$$Narrow\ Interest\ Margin = \frac{Interest\ Income}{Total\ Earning\ Assets} - \frac{Interest\ Paid}{Total\ Deposits}$$

Explanatory Variables

Bank-specific Variables

Overhead costs: These are the operating costs of the bank. The higher the overhead costs in the banking sector, the higher the interest rate spreads since higher spreads would be required to cover the additional costs as banks pass on these added costs to borrowers. Overhead costs were measured as a ratio of bank's operating expenses to total assets.

$$Ovehead\ cost = \frac{Bank's\ Operating\ Expenses}{Total\ Assets}$$

Liquidity ratio (computed as liquid assets as a ratio of total deposits) measures the liquidity of the banking system. Banks with high holding of liquid assets bear higher opportunity costs which they pass to borrowers through wider intermediation margins. Liquidity ratio was measured as:

$$Liquidity = \frac{Liquid\ Assets}{Deposits}$$

Intermediation involves the "matching" of lenders with savings to borrowers who need money by an agent or third party, such as a bank. If this matching is successful, the lender obtains a positive rate of return, the borrower receives a return for risk taking and entrepreneurship and the banker receives a marginal return for making the successful match. Banks that are more involved in intermediation of loans should be better prepared for competition and charge lower spreads hence a negative relationship between intermediation and interest margins is expected. It is measured as total loans over total liabilities.

$$Intermediation = \frac{Total\ Loans}{Total\ Liabilities}$$

Equity refers to total assets minus total liabilities. If valuations placed on assets do not exceed liabilities, negative equity exists. High equity capital holdings due to banks voluntary decisions or regulation can be costly for banks; hence a positive association with interest rate margins is expected (Martinez Peria and Mody, 2004).

$$Equity = Total\ Assets - Total\ Liabilities$$

Equity ratio is equity over assets (equity/assets). It is expected to have a positive relationship with interest rate margins. According to Martinez Peria and Mody (2004), high equity or capital holdings due to either banks voluntary decisions or regulation could be costly for banks so a positive relationship is expected.

$$Equity\ ratio = \frac{Total\ assetts - Total\ Liabilities}{Total\ Assets}$$

Loan loss provision could be a signal of inefficiency in the banking sector. Since both interest rate income and expenses are ex-post items on the banks' revenue statements, the expectation is that higher loan loss provisions should lead to high interest rate margins.

$$Loan\ loss\ provision = \frac{Bad\ Debts}{Total\ Loans}$$

The *taxes* considered in this study are taxes on financial operations (taxes on gross revenues). Taxes are expected to have a positive influence on interest margins.

Industry Variables

Bank *concentration or competition* is measured using the Herfindahl index (HHI), which is defined as the sum of the squares of the market shares of each individual firm. It is a measure of

industry concentration equal to the sum of the squared market shares of the firms in the industry. The HHI ranges from 0 to 100 moving from a very large quantity of very small firms to a single monopolistic producer. The Herfindahl index for both the loan and deposit market would be expected to bear a positive relationship with the interest margins (Demirguc-Kunt and Huizinga, 1999).

Macroeconomic Variables

Annual inflation is the general increase in prices over a given period of time. Inflation can affect interest margins if monetary shocks are not passed through the same extent to deposit and lending rates, or adjustment occurs at different speed. Inflation is used as an indicator of macroeconomic instability and the cost of doing business in an economy. Higher inflation is expected to lead to higher interest rate margins because it causes banks to charge a risk premium.

Exchange rate volatility (measured by changes in exchange rates) is an indicator of macroeconomic instability and is positively correlated with interest rate margins (Ho and Saunders, 1981).

The S*outh African interest rate (Treasury bill rate):* Considering Swaziland's membership of the CMA characterized by a rigid unitary exchange rate with the South African rand, it is apparent that there is very little scope for Swaziland's interest rate to swerve significantly from those ruling in the CMA. The South African interest rates (for both loans, deposits and the national T-bill rate) play an important role in determining the rates of interest in Swaziland. The general policy stance in Swaziland is to maintain a differential of 0. 25 - 0.50 percentage points between local rates and South African rates (Central Bank of Swaziland Report, 2007). The T-bill rate is generally regarded as an indicator of the interest rate policy being pursued by the government, and a benchmark for the rates charged by commercial banks. This variable is therefore also expected to be positively correlated to the NIM, because lower Treasury bill rates would lead to lower interest rate spreads and vice versa.

Techniques for Data Analysis

This study estimates the NIM equation using pooled OLS and panel regressions in which bank-specific effects are controlled for. It must be noted that the assessment made concerning the NIM equation depend on the assumptions about the intercept and slope coefficients. It is assumed here that the intercept and slope coefficients are constant over time and that the error term captures differences over time in individual banks.

With respect to panel data, various tests were conducted. These include unit root using panel Augmented Dickey Fuller (ADF) to test if the variables are stationery or not and testing the order of cointegration. The ADF may not detect stationarity if structural breaks exist in the data. Hence, ADF test was complemented with Philips Peron, which is a useful tool for detecting unit roots even if structural breaks exist in the data. If variables are not stationary, then the next empirical procedure is to test for cointegration. Panel cointegration was therefore tested in this study using Pedroni test to see if long run relationship exists between and among the variables so that the model can be estimated in Error Correction Form. According to Granger representation (Engle and Granger, 1987), if two variables are cointegrated, then the relationship between the two can be represented in an Error Correction Model. Tests for the significance of variables were conducted using t-test, among others. For estimation purposes, Eviews 6 econometric software was used.

Empirical Results of the Study

Unit Root Tests

The panel unit root tests were used to test for stationarity of the series used in the analysis (Im, Pesaran and Shin, 2003; Levin and Lin, 1992; Maddala and Wu, 1999). The panel unit root test

results with individual effects show that some variables are stationery in levels while in some tests stationarity is achieved after first or second differencing. The ADF test suggested that all variables are not stationary at levels with the exception of market share in deposits market (MSD).

Cointegration Tests

Tests for cointegration were carried out using panel cointegration tests proposed by Pedroni (1999 and 2004) to assess the existence of long-run relationship between the variables. The cointegration tests results suggested that there is cointegration implying the existence of a long run relationship, which justifies the use an error correction model (ECM).

Pooled OLS-Fixed Effects Results

The Pooled Ordinary Least Squares (OLS) model with fixed effects was used to estimate the determinants of net interest margin (NIM) and the narrow interest rate margin (NAIM) for the period 1997 to 2008 and the results are presented in Tables 1 and 2 below.

The diagnostic test statistics suggest that the models are good with adjusted R-squared ranging between 0.582 and 0.625 (for NIM) in Table 1, while Table 2 shows that adjusted R-squared ranges between 0.728 and 0.822 (for NAIM). This shows that between 58.2 percent and 62.5 percent (for NIM), and between 72.8 percent and 82.2 percent (for NAIM) of the variations in interest rate margins are explained by the identified explanatory variables. Looking at the Durbin-Watson statistic in both tables, there is no indication of serious autocorrelation. The F-statistic reveals that the estimated parameters are jointly significantly different from zero [Prob (F-statistic) = 0.000].

With reference to the pooled OLS fixed effects estimation results shown in Tables 1 and 2, there is a positive relationship between overhead costs and net and narrow interest margins (though not statistically significant). The effect of liquidity on the net interest margin is mixed and unclear whereas higher banks' liquid holdings appear to increase the narrow interest margin and this effect is significant. Equity does not significantly influence both the interest margins even though the signs are predominantly negative.

As shown in column 2 of Tables 1 & 2, taxes, whether implicit or explicit, widen the interest margin as they increase the intermediation costs. These include: reserve requirements, withholding taxes, stamp duties, transaction taxes, value added taxes, profit taxes and license fees. With reference to the pooled OLS results presented in tables 1 & 2, taxes (levy on gross earnings) appear to decrease both interest margins (NIM and NAIM) as seen by the predominantly negative signs but do not significantly influence the margins. There is ambiguity with respect to the findings on intermediation. This variable increases net interest margin and the effect is significant. However, intermediation tends to decrease narrow interest rate margin and the effect is also significant. Banks with a higher intermediating role or that have a higher lending portfolio relative to their total liabilities, charge lower margins.

Looking at bank concentration as shown by column 4 and 5 in Tables 1 & 2, the results are conflicting. With respect to the net interest margin the coefficients for concentration in both the deposit and loan markets as measured by the HHI, the coefficients are positive and statistically significant. Focusing on the narrow interest margin, there is significant evidence that a higher bank concentration in deposit and lending market segments lead to significantly lower narrow margins contrary to a priori expectations.

In conclusion, columns 5 to 8 include some macroeconomic variables. There is evidence that domestic inflation tend to increase interest margins (NIM and (NAIM) although this effect is not important in statistical terms. This could be due to the fact that monetary shocks are not passed

Table 1: OLS Fixed Effects - Net Interest Margin (NIM)

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Overhead Cost	0.117	0.153	0.063	0.101	0.103	0.101	0.115	0.092
	(0.703)	(0.933)	(0.362)	(0.559)	(0.569)	(0.594)	(0.660)	(0.519)
Liquidity	-0.003	0.026	0.003	-0.002	-0.002	-0.003	-0.003	-0.001
	(-0.238)	(1.455)	(0.222)	(-0.139)	(-0.147)	(-0.249)	(-0.181)	(-0.052)
Loan Loss Provision	0.425*	0.408*	0.432*	0.426*	0.426*	0.420*	0.425*	0.428*
	(5.377)	(5.352)	(5.382)	(5.308)	(5.306)	(5.246)	(5.240)	(5.337)
Market Share Deposits	0.029	0.035***	0.032	0.029	0.029	0.030	0.029	0.030
	(1.577)	(1.875)	(1.438)	(1.569)	(1.567)	(1.604)	(1.555)	(1.595)
Equity	-0.011	-0.314	-0.511	-0.018	-0.017	-0.037	-0.012	-0.035
	(-0.097)	(-1.209)	(-1.066)	(-0.145)	(-0.140)	(-0.290)	(-0.101)	(-0.267)
Tax		-0.874						
		(-0.852)						
Intermediation		0.047**						
		(2.137)						
Market Share Loans			-0.004					
			(-0.347)					
Equity Ratio			0.084					
			(1.081)					
Herfindahl Deposits				0.004				
				(0.233)				
Herfindahl Loans					0.003			
					(0.212)			
Domestic Inflation						0.004		
						(0.610)		
South Africa's Interest Rates (T- Bill Rate)							-0.287	
							(-0.038)	
Changes in Exchange rates								0.001
								(0.469)
Constant	0.027**	-0.017	0.024**	0.024	0.024	0.025**	0.027**	0.021
	(2.601)	(-0.753)	(2.148)	(1.406)	(1.423)	(2.222)	(2.100)	(1.290)
Observations	12.000	12.000	12.000	12.000	12.000	12.000	12.000	12.000
Total pool (unbalanced) observations	44.000	44.000	44.000	44.000	44.000	44.000	44.000	44.000
Adjusted R-squared	0.593	0.625	0.584	0.582	0.582	0.586	0.581	0.584
Durbin – Watson	2.232	2.475	2.335	2.244	2.243	2.251	2.236	2.272
F- Statistic	8.841	8.154	7.028	7.653	7.649	7.759	7.635	7.708
Prob (F- Statistic)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Cross Section Included	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000
Method	OLS	FE	FE	FE	FE	FE	FE	FE

*FE- Fixed Effects, *Values in parentheses are associated t- values, * Indicates significant at the 1percent level, ** significant at 5 percent level and *** significant at the 10 percent level, Time period; 1997-2008*

Table 2: Pooled OLS Fixed Effects -Narrow Interest Margin (NAIM)

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Overhead Cost	0.022	0.080	0.252	0.129	0.125	-0.050	0.315	0.103
	(0.059)	(0.251)	(0.661)	(0.313)	(0.303)	(-0.130)	(0.907)	(0.256)
Liquidity	0.179	0.059	0.158	0.172	0.172	0.178	0.131	0.172
	(6.694)*	(1.670)	(5.639)*	(5.982)*	(5.989)*	(6.715)*	(4.769)*	(5.964)*
Loan Loss Provision	0.640*	0.692*	0.615*	0.631*	0.632*	0.619*	0.555*	0.628*
	(3.531)	(4.670)	(3.526)	(3.451)	(3.454)	(3.423)	(3.432)	(3.425)
Market Share Deposits	0.066	0.075	0.028	0.063	0.063	0.069	0.061	0.063
	(1.571)	(2.045)**	(0.585)	(1.498)	(1.500)	(1.668)	(1.648)	(1.492)
Equity	-0.177	0.172*	0.160	-0.134	-0.136	-0.291	-0.036	-0.103
	(-0.653)	(3.407)	(1.538)	(-0.477)	(-0.484)	(-1.022)	(-0.149)	(-0.350)
Tax		-0.181						
		(-0.908)						
Intermediation		-0.181*						
		(-4.203)						
Market Share Loans			0.046					
			(1.637)					
Equity Ratio			-0.305***					
			(-1.802)					
Herfindahl Deposits				-0.026				
				(-0.703)				
Herfindahl Loans					-0.025			
					(-0.685)			
Domestic Inflation						0.002		
						(1.227)		
South Africa's Interest Rates (T- Bill Rate)							0.005*	
							(3.320)	
Changes in Exchange rates								-0.003
								-(0.660)
Constant	0.022	0.180*	0.033	0.044	0.043	0.012	-0.028	0.041
	(0.935)	(4.106)	(1.372)	(1.127)	(1.112)	(0.474)	(-1.085)	(1.101)
Observations	12.000	12.000	12.000	12.000	12.000	12.000	12.000	12.000
Total pool (unbalanced) observations	44.000	44.000	44.000	44.000	44.000	44.000	44.000	44.000
Adjusted R-squared	0.732	0.822	0.753	0.728	0.728	0.736	0.792	0.728
Durbin – Watson	1.709	1.704	1.791	1.771	1.769	1.798	2.105	1.713
F- Statistic	15.697	20.903	14.118	13.806	13.794	14.321	19.174	13.776
Prob (F- Statistic)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Cross Section Included	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000
Method	OLS	FE	FE	FE	FE	FE	FE	FE

*FE- Fixed Effects, * Values in parentheses are associated t- values, * Indicates significant at the 1percent level, ** significant at 5 percent level and *** significant at the 10 percent level, Time period; 1997-2008*

through the same extent to deposit and lending rates. Looking at South Africa's interest rate (Treasury bill rate), the findings on both dependent variables are contradictory. Lower T-bill rates as seen on net interest margin lead to a decrease to bank's marginal costs of funds while on the other hand, higher T-bill rates lead to an increase in banks marginal costs of funds with respect to the narrow interest rate margin where the coefficient for South Africa's interest rate is positive and statistically significant. Banks will include these higher funding costs in their lending rates so this might cause the higher margins. The last macroeconomic variable is exchange rate changes. Just like the T-bill rate, the results are conflicting with respect to the two dependent variables. Changes in exchange rates appear to increase the net interest margin and decrease the narrow interest margin. Both effects are insignificant.

Error Correction Model (ECM)

The Error Correction Models (ECM) was estimated with the two aims of separating long-run and short-run dynamic responses. An error-correction model is a dynamic model in which the movement of the variables in any periods is related to the previous period's gap from long-run equilibrium (Kim, Ogaki, and Young, 2003). ECM is useful because they provide a consistent integration of short-run dynamic adjustment with long-run equilibrium specifications, thereby providing empirical models that rest easily with the constraints of economic theory and that focus on short-run disequilibrium behaviour.

ECM requires the variables to be non-stationery and to have the same order of integration within a cointegration system. A simple Error Correction Model has been developed to correct for short-term equilibrium by reconciling the short run behaviour of the variables with their long run behaviour. As shown in Pedroni (1999), the Granger Representation Theorem - according to which a system of cointegrated variables, can be represented in the form of a dynamic ECM model, which also holds for panel data. Thus, the error correction model was carried out repeatedly varying the variables with regard to the two dependent variables (narrow and net interest rate margins). Due to the large number of time varying variables multiple tests were conducted for each dependent variable (varying the variables) to see the effects of the independent variables on the two dependent variables (NIM and NAIM). The results of panel least squares in error correction form are presented in Tables 3 and 4 below:

Since Pedroni (1995) tests support the existence of cointegration, the results of panel least squares in error correction form are presented in Tables 3 and 4. Normally, results from error correction panel least squares appear to support results from pooled OLS. The error correction term is rightly signed (negative) and significant at 1percent level on average for both net interest and narrow margins. The ECM as shown by its sign is also statistically significant and therefore corrects between 63.5 to 73.2 percent (for NIM) and 41.4 to 72.9 percent (for NAIM) of the errors in the two models in case of any shock to the models in the long run.

Based on the ECM estimations for NIM and NAIM, the variables that are significant (at least at the 10 percent significance level) included overhead costs, liquidity, equity, intermediation, bank concentration, South Africa's interest rates (T-bill rate) and changes in exchange rates. The other variables which include: loan loss provision, Herfindahl index for the deposit and loan markets, taxes, equity ratio, domestic inflation market share and loans are all statistically insignificant. The detailed discussion is devoted to only the variables that were significant at least at the 10 percent significance level.

Overhead costs have a positive and significant effect on both NAIM and NIM in Swaziland. This means that an increase in bank operating expenses lead to an increase in the net and narrow interest margins to cover the extra costs. These results are consistent with other scholars who also

Table 3: ECM Regression Results- Net Interest Margin (NIM)

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Overhead Cost	0.443**	0.463*	0.390**	0.446**	0.447**	0.383**	0.383**	0.504*
	(2.695)	(2.772)	(2.345)	(2.641)	(2.640)	(2.223)	(2.240)	(3.067)
Liquidity	-0.025	-0.016	-0.025	-0.027	-0.027	-0.028	-0.033***	-0.030
	(-1.357)	(-0.758)	(-1.3040	(-1.420)	(-1.420)	(-1.470)	(-1.707)	(-1.6130
Loan Loss Provision	-0.181	-0.174	-0.158	-0.174	-0.175	-0.181	-0.193	-0.156
	(-0.891)	(-0.852)	(-0.770)	(-0.843)	(-0.844)	(-0.887)	(-0.941)	(-0.779)
Market Share Deposits	0.007	0.013	0.027	0.007	0.007	0.008	0.008	0.003
	(0.364)	(0.6300	(1.184)	(0.350)	(0.350)	(0.389)	(0.397)	(0.158)
Equity	0.106	0.107	-0.676	0.117	0.116	0.709	0.116	0.111
	(0.682)	(0.368)	(-1.044)	(0.736)	(0.732)	(0.445)	(0.748)	(0.727)
Tax		-0.121						
		(-1.218)						
Intermediation		0.024						
		(1.118)						
Market Share Loans			-0.013					
			(-1.083)					
Equity Ratio			0.140					
			(1.250)					
Herfindahl Deposits				-0.003				
				(-0.202)				
Herfindahl Loans					-0.003			
					(-0.216)			
Domestic Inflation						0.001		
						(1.035)		
South Africa's interest rates (T-bill rate)							0.001	
							(1.243)	
Changes in Exchange rates								0.004
								(1.346)
ECM(-1)	-0.635*	-0.642*	-0.652*	-0.646*	-0.645*	-0.660*	-0.653*	-0.732*
	(-4.131)	(-3.969)	(-4.1220	(-4.129)	(-4.124)	(-4.226)	(-4.236)	(-4.512)
Constant	0.002	0.001	0.001	0.002	0.002	0.001	0.002	0.001
	(0.726)	(0.536)	(0.448)	(0.699)	(0.705)	(0.584)	(0.827)	(0.118)
Observations	40.000	40.000	40.000	40.000	40.000	40.000	40.000	40.000
Adjusted R-squared	0.342	0.346	0.334	0.329	0.328	0.339	0.346	0.371
Durbin – Watson	1.853	1.944	1.751	1.834	1.835	1.924	1.837	1.956
F- Statistic	4.373	3.575	3.446	3.729	3.723	3.857	3.948	4.279
Prob (F- Statistic)	0.002	0.005	0.006	0.005	0.005	0.004	0.003	0.002
Cross Section Included	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000
Method	PLS	PLS	PLS	PLS	PLS	PLS	PLS	PLS

*PLS- Panel Least Squares, values in parentheses are associated t- values, * Indicates significant at the 1percent level, ** significant at 5 percent level and *** significant at the 10 percent level, Time period; 1997-2008*

Table 4: ECM Regression Results- Narrow Interest Rate Spreads (NAIM)

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Overhead Cost	0.952*	0.950*	0.889**	0.873**	0.873**	0.803**	0.814**	1.256*
	(2.770)	(3.350)	(2.492)	(2.704)	(2.700)	(2.220)	(2.395)	(4.174)
Liquidity	0.104**	0.501	0.103**	0.095**	0.095**	0.100**	0.080**	0.109*
	(2.624)	(0.138)	(2.537)	(2.610)	(2.609)	(2.520)	(2.119)	(3.253)
Loan Loss Provision	-0.492	0.562	-0.651	0.216	0.202	-0.425	-0.521	-0.544
	(-0.114)	(0.150)	(0.000)	(0.054)	(0.051)	(-0.098)	(-0.128)	(-0.149)
Market Share Deposits	0.053	0.050	0.028	0.050	0.050	0.055	0.045	0.030
	(1.290)	(1.400)	(0.549)	(1.316)	(1.320)	(1.316)	(1.136)	(0.850)
Equity	0.427	0.213*	0.668	0.486	0.488	0.326	0.417	0.302
	(1.320)	(4.450)	(0.482)	(1.636)	(1.640)	(0.958)	(1.364)	(1.102)
Tax		-0.157						
		(-0.915)						
Intermediation		-0.177*						
		(-4.992)						
Market Share Loans			0.023					
			(0.892)					
Equity Ratio			-0.050					
			(-0.210)					
Herfindahl Deposits				0.049				
				(1.585)				
Herfindahl Loans					0.049			
					(1.600)			
Domestic Inflation						0.002		
						(1.120)		
South Africa's' interest rate (T-bill rate)							0.004**	
							(2.187)	
Changes in Exchange rates								0.014*
								(2.846)
ECM(-1)	-0.440*	-0.414**	-0.459**	-0.531*	-0.529*	-0.465	-0.611*	-0.729*
	(-2.778)	-2.211	(-2.712)	(-3.609)	(-3.596)	(0.008)	(-3.455)	(-4.815)
Constant	-0.003	-0.001	-0.002	-0.005	-0.005	-0.003	-0.002	-0.007
	(-0.525)	(-0.289)	(-0.439)	(-1.098)	(-1.097)	(-0.627)	(-0.364)	(-1.646)
Observations	40.000	40.000	40.000	40.000	40.000	40.000	40.000	40.000
Adjusted R-squared	0.402	0.602	0.371	0.495	0.494	0.391	0.465	0.575
Durbin – Watson	1.690	1.282	1.667	1.584	1.584	1.693	1.537	1.796
F- Statistic	5.370	8.372	3.875	6.455	6.434	4.580	5.839	8.541
Prob (F- Statistic)	0.001	0.000	0.003	0.000	0.000	0.001	0.000	0.000
Cross Section Included	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000
Method	PLS	PLS	PLS	PLS	PLS	PLS	PLS	PLS

*PLS- Panel Least Squares, values in parentheses are associated t- values, * Indicates significant at the 1percent level, ** significant at 5 percent level and *** significant at the 10 percent level, Time period; 1997-2008*

found a positive relationship between the interest margin and bank operating costs (Liebeg and Schwaiger, 2006; Estrada et.al , 2006; Naceur, 2003; Affanasief et al., 2002; Maudos and Fernández de Guevara, 2004). From a policy perspective, the government should put in place an efficient credit reference bureau to reduce the credit assessment and contract enforcement costs as a strategy to reduce bank-operating costs in order to reduce interest rate margins in Swaziland.

Bank liquidity may have either a negative or positive effect on interest rate margins. The negative effect of bank liquidity on interest margins implies that excess liquidity by banks does not lead to higher spreads, which may be due to existence of low deposit rates and government debt instruments as safe havens for banks. The positive effect of bank liquidity on interest margins is a scenario where banks with excess holdings of liquid assets incur more opportunity costs which they pass over to borrowers. From the empirical results of this study, bank liquidity had varying effects on NAIM and NIM. While bank liquidity had a negative and significant effect on NIM, the effect on NAIM was positive and significant. By implication, bank liquidity reduces net interest margins and increases narrow interest margin. Martinez Peria and Mody (2004) also found a positive relationship between liquidity and margins due to banks foregone interest income that is recovered from borrowers in the form of higher margins. However holding liquid assets reduces the risk that banks may not have adequate cash to meet deposit withdrawals or new loan demand (i.e. liquidity risk), in that way forcing them to borrow at excessive costs. Consequently, as the proportion of liquid assets increases, a bank's liquidity risk decreases, leading to a lower liquidity premium component of the net interest margin (Angbazo, 1997 and Drakos, 2003).

With regard to *Intermediation*- banks that are more involved in intermediation of loans should be better prepared for competition and charge lower margins and so, a negative association between intermediation and the various margin measures was expected. In relation to the results from this study, mixed findings were observed. Intermediation bears a negative coefficient and is statistically significant in relation to the NAIM but statistically insignificant with a positive coefficient in relation to the NIM. The expected sign for intermediation agrees with the results from the ECM estimation (particularly with the narrow interest rate margin).

The equity variable which is a measure of the level of bank capitalization has a positive and significant effect only on NAIM but predominantly statistically insignificant with NIM. While adequate bank capitalization is important to enhance the stability of the banking sector through restriction of excessive risky asset growth and provision of protection to depositors, undue restrictions of scale of banking operations may negatively impact on bank profitability. So bank regulators need to act with restraint to strike the balance between the safety and soundness of the banking system vis-à-vis bank profitability to as to provide an incentive to reduction of interest rate margins. Martinez Peria and Mody (2004) also found a positive relationship between equity and interest rate spreads, as large amount capital assets can be expensive for banks.

Concentration of the banking sector (measured by Herfindahl index for both loan and deposit markets) did not have any significant effect on interest spreads in Swaziland. This was in sharp contrast to other empirical studies where the bank concentration index had a positive and significant effect on interest rate spreads. For example, margins have been found to be positively related to the level of market concentration in European banking sectors (Saunders and Schumacher, 2000; Maudos and Fernandez de Guevara, 2004), the US (Angbanzo, 1997) and Australia (McShane and Sharpe, 1985).

The variability of the exchange rate (rand to dollar) -banks' balance sheets is also affected by changes in the exchange rates. As expected, this variable has a positive and significant association with the narrow interest rate margin as indicated by the ECM estimations. However, the im-

pact of changes in exchange rates with regards to the net interest margin is not significant though the sign is positive. Exchange rate volatility increases risk in cross-border bank activity and losses can occur in foreign exchange transactions. The variability of the exchange rate is a measure of macroeconomic instability, which tends to push up interest rate margins. From the policy perspective, government must work towards stabilization of macroeconomic policies so as to induce banks to charge low risk premiums and to reduce interest spreads.

South Africa's interest rates- (South Africa's Treasury bill rates) have a positive and significant effect on NAIM. As a member of the CMA, Swaziland's interest rates track South Africa's rates and this study have proved that the higher the interest rates, the higher the margins.

Conclusion

Interest rate margins in Swaziland are significantly influenced by overhead costs, liquidity, equity, intermediation, bank concentration, South Africa's interest rates (T-bill rate) and exchange rates volatility.

The intermediation function of banks is important to stimulate private sector investment in the economy and so there is a need for a more specific policy on interest rate margins. The measure of concentration shows ambiguity in the results (statistically positive for NAIM and negative for NIM) hence there should be an improved provision and enabling environment to encourage more banks to set up branches in Swaziland.

An effective role should be continued by the Central bank of Swaziland to maintain a stable and competitive exchange rate since this variable has a positive effect on interest rate margins (for both net and narrow interest rate margins). This is important in order to narrow interest rate margins in the long run. An effective management of exchange rates improves macroeconomic stability which in the process reduces the risks faced by banks and hence banks can reduce the interest rate margins. This also keeps the credibility and trust that banks put on the exchange rate policies. Findings on overhead costs, liquidity (for NAIM) and intermediation with respect to the narrow interest margin show that these variables are statistically significant and therefore important in the determination of interest rate margins in the context of Swaziland economy. It is considered that the higher the operating costs, the higher the margins that banks set out to cover these costs. On the other hand, banks with high holdings of liquid assets bear high opportunity costs. These variables should also be monitored for efficiency's sake in the banking system since such costs are usually passed on to borrowers by charging high interest rates or bank charges.

Overall, margins are driven by bank specific, banking industry-level factors as well as macroeconomic variables. We find strong evidence that the South African real Treasury bill rate and exchange rate volatility are positively related to interest margins. The T- bill rate proxies for the marginal cost of funds, and this are a benchmark for interest rate decisions by banks. The real T-bill rate could also proxy for alternative investment opportunities of banks. Therefore, a stable macroeconomic environment is potentially conducive to reduce interest rate margins.

It is therefore of paramount importance to sustain stable inflation exchange rates in order to induce banks to reduce interest rate margins. This will reduce the cost of funds and stimulate borrowing by private agents for investments, thereby contribute to economic growth. Demirguc-Kunt and Huizinga (1999) found a positive correlation between higher inflation; higher real interest rates and higher spreads. These variables contribute to a stable macroeconomic environment, which is ideal for business.

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New Banking Technology and Service Quality in Indian Public Sector Banks: A Micro Level Study

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Abstract: *The banking sector in India is facing challenging times. With the advent of globalisation, privatisation liberalization in India, the banks are now focusing on cost reduction, innovative products and technology. Customer's service in banks is a systematic concept. With the competition in banks becoming fierce, it is natural for banks to view with one another to win over customers. In a competitive environment, not only winning new customer, but also retaining he existing customer base assumes greater importance. Though in the eighties Transaction Banking was the order of the day[1]. Relationship Banking has regained its prominence once again, with many banks the world over strengthening this concept. Studies indicate that it is much more profitable and cost effective retaining customers rather than getting new customers. Therefore, this paper attempts to analyse the impact of new banking technology on quality service in public sector banks in Chennai city.*

Keywords: Public sector bank, globalisation, customer's service

Introduction

The banking sector in India is facing challenging times. With the advent of globalisation, privatisation liberalization in India, the banks are now focusing on cost reduction, innovative products and technology. The banking industry is expected to be a leading player in e-business. While the banks in developed countries are working primarily via Internet as non-branch banks, banks in the developing countries use Internet as an information delivery tool to improve relationship with customers. Customer service in banks is being talked about everywhere. In various forums, in the press and in conversations, customer service is in the news. Customer's service in banks is a systematic concept. With the competition in banks becoming fierce, it is natural for banks to view with one another to win over customers. In a competitive environment, not only winning new customer, but also retaining he existing customer base assumes greater importance. Though in the eighties Transaction Banking was the order of the day[1]. Relationship Banking has regained its prominence once again, with many banks the world over strengthening this concept. Studies indicate that it is much more profitable and cost effective retaining customers rather than getting new customers. A successful bank of the future will be the one that excels in customer service and providers them a range of service and product and does continues exercise in improving its potential to serve well.

Service Scenario up to the 1980s and 1990s

For over two decades, the Government, the Reserve Bank of India and the banks were seriously concerned about the standard of customer service in banks. Several studies were instituted and strategies evolved to improve customer service, as early as in 1972, the Banking Commission appointed by the Government of India under the Chairmanship of Shri R.G. Saraiya, had made several recommendations on customer service. In the year 1975, the Government appointed a Working Group on customer service in banks under the Chairmanship of Shri R.K.Talwar. This Working Group made 176 recommendations covering all the important areas relating to

customer service besides some general recommendations. During the eighties, greater importance was given to the redressal of grievances of customers[2]. The Government and the RBI, to redress the grievances took several steps such as setting up of Customer Service Committees, Customer Service Centers in Various cities, Directorate of Public Grievances under the Cabinet Secretariat, etc., as also in the observance of Customer Day. The year 1986 was elaborated by public sector Banks as Customer service year. In 1988 witnessed further improvement in customer service with the implementation of the recommendations of the Estimate Committee.

During 1990-91 two Committees, viz Narasimham Committee and the Goiporia Committee looked into various issues relating to working of public sector banks and customer service. The recommendations of the Narasimham Committee had a much greater impact on the financial strength, profitability, and commercial character and functioning of Indian banks, whereas, the recommendations of the Goiporia Committee focussed on improving the customer service in banks. In many ways the recommendations of the Goiporia Committee complement the efforts of the Narasimham Committee. Both these Committees have together addressed various issues having a bearing on customer perception and customer satisfaction[3]. The first major development during this period is the entry of new players in the market. The new breed of private sector and foreign banks has entered the market, with branches established mostly in metropolitan cities and major towns. The ambience and a level of service that is far different from those of an average public sector bank branch. Their emphasis on the state of art technology, banking convenience and staff responsiveness has made them stand out as models worthy of emulation. As a result of this the customer today has a much wider choice of banking institutions to choose from.

Another important development during this period relates to the liberalization of branch licensing policy. Banks were encouraged to fall a market segmentation approach and establish specialized branches such as NRI branch, SSI branch, if branches, AF branch, etc., this period also witnessed the beginning of a new era of price competition. There is a greater degree of freedom available to the banks in pricing their products and service and it is generally believed that any much price competition would help pass on the benefits of efficiency to the customer. In a bid to provide greater value for money, many banks are adding new features to their schemes and services, brining greater flexibility and operational convenience[4]. Another important development is in the area of computerization and technology upgradation. The historic agreement signed between the IBA and bank trade unions has thrown open tremendous opportunities in terms of making Indian banking technologically advanced[3]. The benefits of such technology upgradation are available to bank customer in different ways such as: Computerized banking environment, Speedier transactions, and accurate statements, ATMs offering 24 hours banking, Telephoning, Anywhere anytime banking, Customers terminals, and so on.

Challenges of the Future

The Talwar Committee put is very aptly when it said that the main purpose of banking is to create and deliver customer needed services in a customer-satisfying manner. Hence, there are two elements of the banking service viz., creation and delivery of service. All the measures mentioned earlier can vouch for a bank's success in creating customer needed service, but we have to go a long way in delivering them in a customer-satisfying manner. Focussing our attention on the following aspects, viz., Technology Product Diversification and innovation can achieve this.

Technological Factors

The foreign banks and the private sector banks having a clear technological advantage and economies of scale right from day one are posing a formidable challenge to the public sector

banks. These new banks are targeting the cream of business through sophisticates services and improved facilities. As competition gains further momentum in a deregulated interest rate regime, banks will have to operate within the ambit of a declining spread. Under such circumstances, reengineering of business through sophisticated technology based services, will not only lead to business creation, but will also help to cut down the operational expenditure and enhance efficiency of operations, payments system, transfer of funds and various housekeeping functions. At the same time, technology can no longer is considered as a backroom expense item, but it should be seen as a competitive asset. In the coming days, technology will have to become the all-pervasive catalyst in matters of product diversification expeditious transfer of funds mechanism, customer friendly payment system and efficient housekeeping functions. The advent of a cashless society has made it imperative for banks. It abroad to introduce a host of info tech based product. Namely smart and super smart cards, debit cards, the electronic purse, hi tech cash dispensers, shared network of ATMs etc., These have given rise to the concept of anywhere anytime banking that have a clear cut customer focus associated with them. The shorter product life cycle information technology and computer based services[5]. The industry has to take cognisance of the development information technology and apply them not as a compulsion, but as an effective marketing weapon.

Product Diversification and Innovation

In keeping with the market realities, it is almost certain that he range of products and services will enlarge considerably in the coming years. As the life cycle theory suggests, many new products, which have become popular abroad, will soon make their appearance in the Indian financial market. To name a few, concepts like financial derivatives, asset securitisation, futures, and options, custodial services, bought out deal are sure to gain popularity. These could be the areas wherein banks will have to concentrate more to make up for the lost ground in traditional business. Competition inherently calls for specialization of operations and banks, in order to stay afloat in the competitive environment, will have to take recourse to increasing specialization and skill upgradation. Specialization will have to be considered for undertaking agricultural consultancy services, allied activities, venture capital financing, industrial financing etc., Market segmentation will again be the crucial cornerstone on which business prospects will have to be redefined. However, at the same time, it should be ensured that the social considerations and responsibilities are not diluted to promote business. Rather, strong and effective machinery should be evolved to productively channel resources towards socio economic priorities, conceived at the time of nationalization.

Office Atmosphere and People

One of the most important aspects, which should receive our attention, is the layout of the branch. The alignment of counters and the various departments should facilitate smooth flow of activities in an office. The seating arrangements sometimes do not attribute to optimum efficiency. It is advisable to organize the layout of the branch according to the customer profile of the branch. These are simple factors, if ignored that can result in customer inconvenience, which ultimately may affect business. People are often the most discussed but least addressed aspect of retail banking. People are important because they are the ones who with their knowledge and behaviour influence customer perception about the quality of service and the image of the bank. Changes taking place in the market calls for an attitudinal reorientation. Customer care and customer concern becomes far more important[6]. The staff in general, and those at the counters in

particular, should be made to realize that the installation of computers and other machines notwithstanding, it is they who make a major difference in terms of achieving customer satisfaction[7]. Branch managers should make it a point to spend more time with customers to understand their needs and aspirations and take genuine interest in meeting them. Our focus should be on: Re-deploy people released as a result of computerization for customer contact and relationship maintenance; Greater training and upgradation of skills; Trade unions should move away from their traditional roles and bring about a new customer friendly work culture in banks; and Comprehensive and more frequent studies both at the bank level and the industry level to assess customer expectations and service related perceptions. Therefore, this paper attempts to analyse the impact of new banking technology on quality service in public sector banks in Chennai city.

Methodology

This study involved the collection of primary data collected from sample customers of public sector banks viz, IOB, SBI, Indian Bank, and PNB in Chennai City through structured questionnaires. Samples of 60 customers from various selected public sector bank branches in Chennai city for the purpose of this study. This study selected following new banking technology parameters viz., Net Banking, Tele Banking, Web banking, Mobile banking, ATMs smart, credit and debit cards, Phone Banking, ATM and Electronic Funds Transfers, FOREX Remittances, Electronic Clearing Service, E-Finance, ATM and Bill Payments. Most of questions were designed having a 5-point scale excellent (5), very good (4), good (3), satisfactory (2) and poor (1). Interviewee's response to various elements under each question was totalled and multiplies by the grades and divided by number of respondents and scores were calculated. The Multiple Log Linear Model is used to analyse the data.

Analysis of Data and Results

A successful bank of the future will be the one that excels in customer service and providers them a range of service and product and does continues exercise in improving its potential to serve well[8]. The Talwar Committee put is very aptly when it said that the main purpose of banking is to create and deliver customer needed services in a customer-satisfying manner[9]. Hence, there are two elements of the banking service viz., creation and delivery of service. Al the measures mentioned earlier can vouch for a bank's success in creating customer needed service, but we have to go a long way in delivering them in a customer-satisfying manner. Focusing our attention on the following aspects, viz., Technology Product Diversification and innovation can achieve this[10]. Indian economy is expected to post a growth of around 7 to 8percent in 2006-2007, sustaining the momentum of 2007-2008. Prospects of good performance under agriculture appear bright, with the prediction of normal monsoon. While industry is likely to grow by about 7 per cent service sector may expand by 8 per cent. Economic activity may be accelerated by greater investment by the Government and the private sector[11]. The Government has already proposed creation of a fund for promoting investment in infrastructure in rural and urban areas for facilitating growth in agriculture and industry including small industry. Banks are to play a positive role in sustaining economic growth through the provision of requisite finance[12]. Therefore, this study selected the new banking technology parameters viz., Net Banking, Tele Banking, Web banking, Mobile banking, ATMs smart, credit and debit cards, Phone Banking, ATM and Electronic Funds Transfers, FOREX Remittances, Electronic Clearing Service, E-Finance, ATM and Bill Payments and how for and to what extent these attributes are responsible for ser-

vice quality in Public sector banks in Chennai City may now be examined with the help of Multiple Log Linear Model, it is given in the form of

$$LogY = a + logb_1^{x1} + logb_2^{x2} + \ldots + logb_n^{xn} + u$$

Where,

Y = Dependent Variable (i.e. Service quality)
X1…Xn = Independent Variables (i.e. New banking technology)
U = Random Disturbance

From the results of table 1**,** it is discernable that impact of new banking technology parameters on service quality in public sector banks, the statistical test of the significance of the functional relationship as expressed by the equation as well as several characteristics. The 't' values are the result of a test of the significance of relationship. The value of elasticity indicates that the degree of relationship between the dependent and the explanatory variables. Of the ten explanatory variables of new banking technology, five variables viz., Net Banking, ATMs smart, credit and debit cards, FOREX Remittances, E-Finance, ATM and Bill Payments that influence the differences in service quality in public sector banks, it is evident that the calculated value of't' is greater than the tabulated value of 't' at 1 per cent level of significance. Therefore these five new banking technology parameters have positively determined the service quality in public sector banks.

The sign of elasticity co efficient (b) of these variables is positive and more than one, it means that, if all the five significant parameters influence increase, the service quality also increases. The value of co efficient of determination (R2) indicates that the parameters included in the new banking technology attributes bring about differences in service quality by 0.6875 (i.e. 68.75 per cent) in public sector banks. The new banking technology attributes influence much more, the value of co efficient (b) of all the explanatory variables is more than one, indicting that the percentage change in the service quality (due to the new banking technology variables) is more than the percentage change in the new banking technology variables. In other words, the rate of increase in the service quality is more than the rate of increase in the new banking technology attributes.

Further, the value of co efficient (b) of Net Banking, ATMs smart, credit and debit cards, FOREX Remittances, E-Finance, ATM and Bill Payments determined service quality in public sector banks is significant. The impacts of new banking technology attributes on service quality are higher. The signs of the co efficient (b) of all the five new banking technology attributes are positive sign, it indicates that the higher the level of the new banking technology, higher will be the service quality in public sector banks. I.e. the value of elasticity (b) of Net Banking (1.65), ATMs smart, credit and debit cards (1.065), FOREX Remittances (1.99), E-Finance (1.069), ATM and Bill Payments (1.04) increases by 10 per cent, in turn they influence service quality increases by 16.5 per cent, 10.6 per cent 19.9 per cent 10.6 per cent and 10.4 per cent. It could be inferred that from above findings that the new banking technology attributes determined positively as shown in positive sign of value of co efficient (b).

Table 1: the Regression Co Efficient of Selected Attributes

(Effect of new banking technology on service quality in public sector banks)

Dependent variable: Service of Quality

Sl.No.	Name of the variables	The Value of Co efficient (b)
		Public Sector Banks in Chennai
1.	Net Banking	1.6547* (3.827)
2.	ATM's smart, Credit and Debit	1.065*

	Cards	(3.821)
3.	Web Banking	0.3242 ^{NS} (1.812)
4.	Phone Banking	0.4223 ^{NS} (1.534)
5.	Mobile Banking	0.8425 ^{NS} (1.978)
6.	ATM's and Electronic Funds Transfer	0.1834 ^{NS} (1.001)
7.	FOREX Remittance	1.9921* (3.114)
8.	Electronic Clearance service	0.6345 ^{NS} (1.221)
9.	E-Finance	1.069* (3.458)
10.	ATM's and Bill Payments	1.0423* (3.112)
	Constant (a)	
	R2	

Sources: Computed
Note: * Significant at 1 per cent level, NS: Not Significant

Conclusion

Therefore it could be concluded that the of effects of new banking technology on service quality in public sector banks in Chennai city, using Multiple Log Linear Regression analysis, which explain that the value of co efficient (b) of new banking technology variables viz., Net Banking (1.65), ATMs smart, credit and debit cards (1.065), FOREX Remittances (1.99), E-Finance (1.069), ATM and Bill Payments (1.04) determined service quality in public sector banks is significant. The signs of the co efficient (b) of the entire five new banking technology attributes are positive, it indicating that the higher the level of the new banking technology, higher will be the service quality in public sector banks in Chennai city. The value of co efficient of determination (R2) indicates that the parameters included in the new banking technology attributes bring about differences in service quality by 0.6875 (i.e., 68.75 per cent) in public sector banks. Therefore, the new banking technology attributes viz., Net Banking, ATMs smart, credit and debit cards, FOREX Remittances, E-Finance, ATM and Bill Payments, are most important variables which determined service quality of public sector banks in Chennai City.

The study has highlighted the in new banking technology and quality service in public sector banks in Chennai city, which need to improve to survive the competition posed by the new entrants in the foreign sector. The exiting organizational structure and policies of public sector banks are ill equipped through new banking technology to meet the new objective. Despite various committees being set up to examine the changes required in the exiting insurance framework, not much work has been done to improve quality to service delivery. Asset management not only entails the management of funds but also efficient handling of clients who are the invisible assets on the balance sheet. If public sector banks hope to survive, they will have to equip themselves with a commitment to quality services.

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Supply Response of Perennial Crops: A Case of Balochistan Apricots

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Abstract: Extensive studies have been carried out in the field of agricultural supply response without complementing substantially with the studies on the acreage response for horticultural perennial crops. Perennial crop production differs from that of annuals by the long gestation period between initial capital investment and the first output, a long-continuous period of output and finally a gradual decline in productivity. The present study primarily undertakes to estimate acreage response behavior of apricot growers in Balochistan. The study, therefore, hypothesizes various factors as the possible expectations which enter into the decision making process of the apricot growers such as prices, profitability, parity prices, developmental indicator, etc. The study is based on secondary data and covers a period of 27 years, spanning from 1980-81 to 2006-07. The most significant finding of the study is conclusive evidence in regard to acreage response of perennial crops, which establishes that the apricot growers in Balochistan are responsive to raw prices. Apart from prices, the profitability of the crop, development of infrastructural facilities, trend, etc. also exhibited positive impact while taking long-term apricot plantation decisions.

Keywords: Horticultural perennial crops, gestation period, productivity, compound growth rate, auto-correlation.

Introduction

In a developing economy like ours, the overall economic development depends to a greater extent on the rate of growth in agriculture. In Pakistan, progress in this sector is crucial in achieving the plan targets. Any development programme envisaged in the primary sector is aimed at increasing the overall production of the economy and the success or failure of this programme is mainly dependent on the reactions of the farmers to such programme. The decision of the farmers regarding the allocation of land and other resources to increase production is directly or indirectly influenced by the policies formulated by the governments and the economic and climatic factors, which are operative in production. Farmers may increase production either by bringing additional area under the crop or by increasing the productivity or by both.

Literature on crop supply response is concentrated mainly on the supply of annuals crops. Perennial crops received little attention till the sixties. Perhaps, the first attempt to analyze the supply of perennial crops was made by Ady (1949). Latter Bateman (1968), Behrman (1968), Frederick (1965), Arak (1967), Bacha (1968), Saylor (1974), Williams (1972), Maitha (1970), Rajagopalan, Sennimalai, Radhakrishnan and Kandaswamy (1971), Rajagopalan and Meenakshisundaram (1969), Wah (1962), Stern (1965), Oni (1969), Gwyer (1971), and Matthews (1971), developed a supply response model for perennial crops in different countries. Some new studies on perennial crops response has been studied by Chowdhury and Ram (1978), Devi (1977), French, King and Minami (1985), Olayemi and Olayide (1975), Viju and Prabhakaran (1988), Gajanara, Mallikarjunaiah, Chengappa and Ramanna (1988), Thomas, Prasher and Nadda (2001) and Onyango and Bhuyan (2000).

Fruit crops in the past few years have assumed greater importance in the process of agricultural development. It is because of the high increase in income derived from the cultivation of fruit crops as compared to annual crops. In addition, fruit crops being the source of protective foods, brought awareness among the consumers. The developing countries also depend heavily on perennial crops to earn foreign exchange. It is in this context that the acreage supply response studies have become important so as to help formulate proper policies for horticultural development.

In the process of transformation of agricultural development from primitive stages to maturing, the prices of agricultural commodities have a pivotal role to play. The price system, no doubt, has its own limitations, still it is a powerful tool to elicit and transmit the economic information for stimulating proper decisions by producers and consumers[1].

The investigation to estimate the extent of price-supply relationship would help in developing appropriate price and non-price policy package for the development of horticulture especially in the hilly areas of Balochistan. These perennial horticulture crops differ from annual crops in many respect[2], which makes the estimation of price-supply relationship more complex. In this article an attempt has been made to quantify the role of price and non-price factors responsible for the supply of apricot[3]. Balochistan has been selected for this study because of its spectacular achievements in horticulture development. Amongst various fruits grown in the province, apricot occupies prime position both in terms of area and production. Amongst the total area and production of apricot in the country, Balochistan accounts for 92 percent of area and 91 percent of production (2006-07). It has been argued that the government intervention both in factor and product market have been instrumental in transforming traditional farming systems and today Balochistan is said to be an apricot province of Pakistan. The impact of these policy initiatives, however, is still a matter of concern and needs empirical investigations, which will help in designing policies for sustainable development of horticulture.

In the light of above consideration this study has the following objectives:

i) To analyze trends in area, production and productivity of apricot in Balochistan.
ii) To analyze annual compound growth rates of area, production and productivity of apricot in Balochistan.
iii) To estimate supply response of apricot with respect to: (a) price expectation, (b) expected profitability, (c) parity prices and (d) road length expectation.
iv) To suggest appropriate policy measures for developing apricot industry in Balochistan, in particular and horticulture in general.

The study has hypothesized that the supply elasticities of apricot in Balochistan are positive.

Data Sources

The study is based on secondary data at Balochistan level. Time series data on various aspects of apricot cultivation like area, production, productivity and prices were collected from, Agricultural Statistics of Balochistan, published by the Government of Balochistan, Agricultural Statistics of Pakistan, published by the Government of Pakistan and Statistical Year Book, published by the Government of Pakistan. The study covers a period of 27 years spanning from 1980-81 to 2006-07.

[1] Robert Dorfman: Prices and Markets, Foundation of Modern Economic Series; Prentice Hall, Inc., New Jersey, 1967.
[2] These crops have long gestation period between initial cash outflow and first cash inflow, an extended period of output flowing from the initial investment and eventually a gradual deterioration in the productive capacity of the plant. The apricot plant attains commercial bearing in the seventh year from its plantation.
[3] In Pakistan not a single study is available on perennial crops.

Specification of Variables

Price Expectation

The prices which the farmers take into consideration for making production decision are called the expected prices. Traditionally, last year's prices used to be regarded as the basis; however, Nerlove[4] has argued that estimates of supply response obtained by using last year's price is an under-estimation; he, therefore, proposed that the farmers take many years into account and the weightage declines as we move into the past. Nerlove's price expectation model has been the basis for many supply response studies, which previously have gone into various dimensions of price expectation formulations. However, in the case of perennial crops, the literature on price expectations is negligibly limited [Grilicks (1960), Trail, Colmen and Young (1978) and Rao (1989)]. These few studies are also not intensively devoted to varied formulations of price expectation.

A study by Ady (1949) implicitly assumes that cocoa available for harvesting in 't' years is the function of prices in 't-9', because the cocoa crop requires full nine years to mature. Another study by Bateman (1968) formulates acreage planted in any one year as the function of mean values of discounted future price of cocoa and coffee. The price of coffee has been incorporated into the model because of its being considered as an alternative crop to cocoa in some of the Ghanaian regions. Baritelle and Price (1974) have hypothesized average price received by growers for their apple and assumed that the growers' behavior is based on several past years' prices. In view of the longevity of investment, the length of lag was, however, left to, statistical estimation. French and Matthews (1971) have tried several combinations of prices and argued that two years' average price is statistically superior for estimating the supply response of asparagus in the United States. Onyango and Bhuyan (2000) in their study of fruits and vegetables argued that the practice of representing expected prices by price lagged one year is a special case of the general hypothesis of assigning higher weights to more recent prices and the weights decline towards zero as time regresses. The studies discussed above have considered prices as one of the important variables in the estimation of supply response. However, in each study a different type of formulation has been tried and as such nothing specific can be derived from them concerning price expectation behavior pattern followed by the growers.

Though in the studies relating to agricultural supply response, farm harvest or farmer's prices have been the basis, the situation, which regard to perennial crops is altogether different due to non-existence of time-series data on farm harvest prices. However, time-series data on wholesale prices of apricot are recorded and maintained in big cities like Quetta and an attempt has been made to utilize these data which are collected by the Federal Bureau of Statistics, Islamabad. Based on these wholesale prices, another series of prices were generated by deducting the marketing costs. The idea of generating two price series was to help in identifying the most suitable series influencing the expectation behavior of growers. The former series does not take into account the marketing cost and the farmers cannot ignore the cost aspect indefinitely. Therefore, it has been considered essential to generate another series which takes into account the marketing costs as well.

To begin with, it has been considered appropriate to examine which of the price series carries more weight in the decision-making process, i.e., wholesale price of Quetta apricot market

[4] Marc Nerlove: Dynamics of Supply: Estimation of Farmers' Response to Price, John Hopkins University Press, Baltimore, U.S.A., 1958.

termed as raw price (Pr) or net price, i.e., wholesale price minus marketing cost, termed as prices (P).

The degree of association of each price series with apricot acreage was examined with the help of correlation coefficient. The result so obtained clearly signified that the raw price series provided better relationship with the acreage as compared to the prices, hence price series was dropped.

Besides, the relationship of the dependent variable was examined with varied lag length of raw prices with a view to selecting the appropriate lag. Various formulations of raw prices, such as Pr_{t-1} - - - - - - Pr_{t-4} and their simple averages were tried. The result so obtained provided conclusive evidence in support of the fact that as we moved backward the explanatory power of the independent variable, i.e., the raw prices declined. The fact revealed that current prices (last year's raw price) carried more weight in the decision making process than its higher lags; may be so due to their short memory. The length of lag, therefore, was restricted to the preceding two years only which helps in conserving the degree of freedom. On the basis of 'r' and 'r^2' values, last year's prices (Pr_{t-1}) and simple average of the last two years (Pr_{t-1} + $Pr_{t-2}/2$) were found to be more strongly associated with the dependent variable, and as such were selected for the final analysis.

Expected Profitability

While estimating the aggregate and regional supply function for Ghanian Cocoa, Bateman (1965) ignored the cost expectations and argued that it is not a major factor in determining the acreage planted and the fluctuation in the cost have been directly related to changes in cocoa prices. The above contention of the author is not based on any empirical investigation because the farmers cannot ignore the cost component indefinitely which has a direct bearing on profitability. Subsequently, improvements were noticed and researchers tried to accommodate profitability as one of the explanatory variables in the supply response models. In a study of United States apples, future profitability was hypothesized as a function of recent past prices and costs were duly accounted for by deflating the price series with the index of prices paid by the farmers. However, in the absence of time-series data pertaining to cost of production of asparagus, alternative means were used to approximate the profitability variable[5].

In the case of apricot it is assumed that profitability is also an important factor governing the expectation behavior of the growers. Since it is not an observable variable, it is therefore approximated as the function of past prices. A look at the time-series data on apricot prices depicts an erratic behavior. In a year of good crop, prices are observed to be lower and vice versa. Therefore, per hectare profitability is considered to be a better indicator, rather than price per

[5] French and Matthews, opt.cit., wherein the authors have approximated the profitability variable in the absence o time-series data on cost of production for asparagus in U.S.A., as follows:

$$\pi_t^e = C_0 + C_1\left(\frac{P_t}{W_t}\right)^e + V_{gt}$$

Where 'P' is the grower's price, 'W' is the index of farm wage rates expressed as a proportion and the subscript 'e' denotes expected value. The value of (P/W) was approximated as a two-years average of actual value of (P_t/W_t), alternatively they were expressed as geometrically weighted average of past prices. This formulation has been derived from the adaptive expectation model.

box. Though the productive capacity of the plants goes on increasing with the age reaching at its maximum and declining thereafter, it could not be possible to incorporate this factor in the model due to the limitation of time-series data on the age-wise distribution of plants and their production. Hence, the average yield was calculated by dividing the total production by the total area.

In order to approximate the profitability variable, it is a pre-requisite to have time-series data on cost of production, but till date no systematic/scientific study has been conducted in respect of the estimation of cost structure as well as the cost of production of apricot in Pakistan. In the absence of such a study, it is rather difficult to select suitable cost deflators. However, the Balochistan Department of Horticulture has estimated the recurring cost for one-hectare orchard. According to these estimates, labor and fertilizers together account for 80 percent of the total recurring cost (45 percent on labor and 35 percent on fertilizers). These estimates indicate that the profitability of the crop was, by and large governed by the movement in wage rates and fertilizer prices. Thus, a composite price index was prepared and weights were assigned to each component in proportion to their share in total cost. Finally, prices per box received by the farmers were deflated by the composite price index to arrive at the profitability per box.

Since apricot production is a biological phenomenon and very much sensitive to the vagaries of weather the profitability per box may not be an efficient indicator in measuring the profitability of the crop. Therefore, as discussed earlier, the profitability per hectare was taken into account and the same was arrived at by multiplying the profitability per box with the yield per hectare.

The long-run expected profitability per unit area associated with the incremental change in acreage might be the actual profits realized in year t-1. However, the apricot crop is typically subject to fairly large year-to-year variation in prices, production and productivity. It is, therefore, likely that the producers might consider experience over several previous years to form a better indicator of expected profitability. This indicator might be summarized in the form of a simple average or it could follow some more complex form such as the Nerlovian type of adaptive expectation model. However, simple averages of past years were considered as better indicators than a more complex weighting structure. Various formulations of profitability which can possibly influence the decision-making process of the growers may be π_{t-1}, π_{t-2}, $\pi_{t-1} + \pi_{t-2/2}$, etc. Each formulation has been tried with the dependent variable and the two formulations adjudged on the basis of 'r' and 'r^2' value were considered for further analysis.

Parity Prices

Another important independent variable which determines the farmer's expectation behavior could be the parity between the prices received fro apricot and the price paid for the consumables. Apricot a cash/commercial crop is also a major source of income of the orchardists and therefore, if the terms of trade remain in favor of the apricot industry, the growers can invest more for extending the area under apricot. Therefore, prices received by the growers were deflated by the consumer price index to arrive at parity prices. The decision to effect change in area under apricot could be the function of previous year's parity prices or simple average of previous year parity prices etc. The various formulations of lagged parity prices, which can influence the decision-making process could be Pqt-1, Pqt-2, Pqt-1+Pqt-2/2, etc., and the two associated more closely with the dependent variable were selected for further analysis.

Infrastructure Development

Infrastructure development plays a vital role in the overall development in general and for horticulture in particular. Apricot being a commercial crop, is entirely marketed at distant places, which are located over the country, hence improvement of roads is imperative. It is, therefore, hypothesized that if the transportation facilities like construction of roads are extended to difficult hilly areas, more and more people will be encouraged to take up apricot cultivation. The incremental change in apricot acreage in this case assumes a function of lagged road length. Various formulations have been tried and the two giving best results have been selected for final analysis.

Apricot is a fine tasty fruit cultivated in mountainous areas. Its real home is the western part of China. The evidence about the existence of apricot is found in one hundred B.C. in Italy and earlier than that of Greece. In our country good apricot trees are cultivated on much high of sea level. From the climatic point of view temperature directly affect upon apricot cultivation. Like apple and pear a long winter season is a must for apricot's successful growth. Those areas are suitable where there are more rains with good water outlet. It is therefore cultivated in mountainous areas. For good nurture of correct plants deep clay land is required. Balochistan is the major province of Pakistan for apricot cultivation.

Methodology

Growth Trend Analysis

The compound growth rates are estimated by using log linear functions on the time series data on area, production and productivity of apricot fruit in Balochistan. The equation fitted to analyze the trend growth rate is semi-log exponential form:

$$\text{Log } Y = a + bt$$

where,

Y	=	area/production/productivity of apricot fruit
t	=	time variable in year (1,2, ……n)
a	=	constant
b	=	expresses the rate of change and when multiplied by 100 gives the percentage growth rate in area, production and productivity of apricot fruit.

Specification of Supply Response Models

Two types of multiple regression models, i.e., linear and double-log were specified with different combinations of independent variables. As explained above, the lag length was restricted to past two years only with a view to conserve the degree of freedom to meet the statistical requirements. Also the existing reporting system of apricot acreage does not take into account the removal aspect and the incremental area put under the crop is reported under bearing acreage after six years. Therefore, to measure the acreage response it does not make any difference if we take acreage under bearing category or total acreage under apricots. The latter was preferred in order to conserve the degree of freedom, as incorporation of the former would require minimum lag equivalent to its gestation period, which in the case of apricot is six years. Several alternative specifications, as discussed above, were tried both in linear and double-log formats and the one

giving efficient results on the basis of coefficient of multiple determinations, proper sign and significance of parameters together with the absence of auto-correlation problem, were selected. Though the simple lest square estimates would be biased due to the presence of lagged variables in the model, if the disturbance tern follows a normal distribution, they would tend to have the desirable asymptotic properties of consistency and efficiency. As the number of observations increases, the maximum likelihood estimates would tend stochastically to the least square estimates[6]. Since we have 27 years of time series data, therefore it satisfied the properties of large sample estimates. The two specifications of each variable already selected were further tested for multicollinearity by zero order correlation matrixes. The 'd' statistic was also computed to examine the incidence of auto-correlation. Finally, the specifications of the variables included in the model were $Pr_{t-1} + Pr_{t-2/2}$, $P_{qt-1,}$ π_{t-2} and R_{Lt-1}. These specifications were selected so as to minimize the incidence of multicollinearity. Following models have been specified with different formulations of independent variables (Table 1).

In the linear format the regression coefficients of equation Nos.1.4, 1.5 and 1.7 gave spurious signs to some of the variables included in these equations and hence were dropped. The coefficient of multiple determinations in the case of equation No.1.2 was observed to be comparatively low and hence it was also dropped. The regression coefficients of the remaining equations (1.1, 1.3, 1.6) bore consistent structural sign and had appreciably high value of R^2, and were considered suitable for discussion.

The results obtained from the double-log model revealed that the regression coefficients as well as their level of significance were consistently superior over the linear one. However, equation No.2.2 was dropped in view of the severe incidence of auto-correlation. Equation Nos.2.4 and 2.7 were rejected in view of the spurious structural sign of the regression coefficients. Hence, the remaining equations 2.1, 2.3, 2.5 and 2.6 were found statistically superior for estimating the acreage/supply response.

Results and Discussions

i) Trends in Area, Production and Productivity of Apricot

The area under apricot in Balochistan which was 2400 hectares in 1980-81, increased to 26900 hectares in 2006-07 (an increase of more than 11 percent). The production of the fruit recorded more than 5 percent of increase, being 29100 tonnes in 1980-81 to 158300 tonnes in 2006-07. Productivity was found to be very high and showed an increasing trend during 1980-81 to 1995-96, after that it showed declining trend up to 2002-03, then after it again increased up to 2005-06. In 2006-07 it again declined. In 1980-81, the productivity was 12125 kg/hectares, in 1995-96 it was 17469 kgs/hectares and in 2006-07 it was 5885 kg/hectares.

ii) Growth in Area, Production and Productivity

From Table 2 it can be observed that the area, production and productivity of apricot recorded a positive growth rate of 1.1 and 5 percent respectively. In the increase in production growth rate, area growth contributed more than productivity growth.

[6] J. Johnston: Econometric Methods, McGraw Hill, 1984.

iii) Estimation of Factors Affecting Supply

The results obtained from the selected models, both in the case of linear and double-log functions are presented in Table 3 and 4. It emerged from the results that the value of the coefficient of multiple determination was substantially high and ranged between 86 and 99 percent, which indicated that the models selected were well specified, therefore, holds strong explanatory power.

Among the set of various explanatory variables, raw prices emerged as the most crucial factor influencing the expectation behavior of the apricot growers. The regression coefficient of expected raw prices is found positive in all the specified models and significantly different from zero at 1 percent level of probability in most of the cases both in linear and double-log functions. The above findings supported the hypothesis that the farmers in hilly areas respond to prices while taking long-term investment decisions. These decisions are not merely based on the prices of single year but in view of the longevity of investment and so avoid risk, the farmers consider simple average of last two years as a good indicator to form their opinion about the expectation. The price elasticity of acreage lies between 0.69 to 0.80, which indicates that the acreage response to prices is inelastic. The foregoing discussion confirms the hypothesis that the price elasticity of apricot acreage is positive and significantly different from zero.

The findings of various studies conducted in different parts of the country under diverse agro-climatic conditions revealed that individual crops generally have much higher supply (area) elasticity than the aggregate (area) elasticity. Among the individual crops, food grains occupy a dominant place in the cropping pattern, and have lower elasticities than cash crops[7] depending upon the agro-climatic conditions. The supply (area) elasticity for food grains in a majority of cases generally varied between 0.04 and 0.28 and for cash crops it varied between 0.11 and 0.72[8]. The findings of this study are comparable with those of cash crops and from the foregoing discussion it can be inferred that the apricot growers in Balochistan are as responsive to prices as has been noticed in the case of cash crops grown in other parts of the country.

Another important variable included in the model was parity ratios. The magnitude of the coefficients exhibited negative sign and was significantly different from zero in all the selected models. The type of behavior exhibited by the parity ratios clearly indicated that the apricot prices have not increased at the same pace as the consumer price index, which may be ascribed to the fact that the demand for apricots has not shown a commensurate increase with apricots resulting in a steady rise in raw apricot prices. Notwithstanding the above, there has been a continuous increase in the area under apricots, despite adverse terms of trade, and the orchardists have tried to maintain the same level of parity by producing more through intensive and extensive cultivation practices, which is confirmed from the fact that there has been an increase in both area and production during the period under study.

Through the expected profitability of apricot crop was observed to be associated positively in all the models of linear and double-log formats, it did not emerge as strong as price. The study revealed that the profitability of the crop is also an important factor inducing the growers to take up apricot plantation.

Another factor namely linking of difficult terrains in the interior with roads, was also found associated positively with dependent variable and emerged significant at 1 percent level of probability in all types of models.

[7] Naqvi and Burney (1992), Cummings (1975).
[8] Chaudhry (2000), Cummings (1975).

Apart from these factors trend was also introduced as one of the independent variables and the value of coefficient of multiple determination was found to be maximum with the introduction of this variable. The regression coefficient of trend emerged positive and significant at 1 percent level of significance, which clearly indicated that the acreage response has trend and this may be due to exogenous factors like development of infrastructural facilities, government policies, etc. Owning an apricot orchard is considered a status symbol, which seems to have motivated more people to take to apricot cultivation in this hilly province.

Conclusion

The most significant finding of the study is the conclusive evidence in regard to the acreage response of perennial crops, which establishes that the apricot growers in Balochistan are as responsive to raw prices as has been noticed in the case of cash crops grown in other parts of the country.

It means that there exists more potential for the apricot growers to increase the area of crop as price increases. Apart from prices, the profitability of the crop, development of infrastructural facilities, trend, etc. also exhibited positive impact while taking long-term apricot plantation decisions. The parity ratio, on the other hand, showed inverse relationship. The study provides a clue to policy makers that price policy can be an effective instrument in bringing about the desired change in acreage under perennial horticultural crops.

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Appendices

Table 1
Specification of Models

Linear

1.1 $A_t = a + b2\ P^e_r + b_3\ P^e_q + \mu$

1.2 $A_t = a + b2\ P^e_r + b_4\ \pi^e + \mu$

1.3 $A_t = a + b2\ P^e_r + b_3\ P^e_q + b_4\pi^e + \mu$

1.4 $A_t = a + b2\ P^e_r + b_4\ \pi^e + b_5\ R + \mu$

1.5 $A_t = a + b2\ P^e_r + b_3\ P^e_q + b_4\ \pi^e + b_6\ T + \mu$

1.6 $A_t = a + b2\ P^e_r + b_3\ P^e_q + b_4\ \pi^e + b_5\ R + \mu$

1.7 $A_t = a + b2\ P^e_r + b_3\ P^e_q + b_4\ \pi^e + b_5\ R + b_6\ T + \mu$

Double-Log

2.1 $\log A_t = \log a + b_2 \log P^e_r + b_3 \log P^e_q + \log \mu$

2.2 $\log A_t = \log a + b_2 \log P^e_r + b_4 \log \pi^e + \log \mu$

2.3 $\log A_t = \log a + b_2 \log P^e_r + b_3 \log P^e_q + b_4 \log \pi^e \log \mu$

2.4 $\log A_t = \log a + b_2 \log P^e_r + b_4 \log \pi^e + b_5 \log R + \log \mu$

2.5 $\log A_t = \log a + b_2 \log P^e_r + b_3 \log P^e_q + b_4 \log \pi^e + b_6 \log T + \log \mu$

2.6 $\log A_t = \log a + b_2 \log P^e_r + b_3 \log P^e_q + b_3\ P^e_q + b_4 \log \pi^e + b_5 \log R + \log \mu$

2.7 $\log A_t = \log a + b_2 \log P^e_r + b_3 \log P^e_q + b_4 \log \pi^e + b_5 \log R + b_6 \log T + \log \mu$

where,

At	=	total apricot acreage in year 't'
P^e_r	=	expected raw prices of apricots = $P_{rt-1} + P_{rt-2/2}$
P^e_q	=	expected parity prices of apricot = P_{qt-1}
π^e	=	expected long run profitability = π_{t-2}
R	=	expectation for length/infrastructure development = R_{t-1}
T	=	trend variable
log a	=	intercept
$b_1, b_2 \ldots b_6$	=	are regression coefficients of the respective variables
U	=	random variable

Table 2
Compound Growth Rates of Area, Production and Productivity of Apricot in Balochistan: 1980-81 to 2006-07

Model Specification	A	b_2	b_3	b_4	b_5	TAE	'd'	R^2	R^{-2}
Equation No.1.1 $A_t = f(P_r^e\ P_q^e)$	29552.96	470.52* (80.901) [0.8004]	–135280.17* (16889.787) [–0.7562]	–	–	0.04 (0.432)	2.01	0.93	0.92
Equation No.1.3 $A_t = f(P_r^e\ P_q^e\ \pi^e)$	28078.43	464.38* (83.456) [0.7886]	–140143.39* (17117.583) [–0.6971]	83.36 (78.763) [0.0768]	–	0.09 (0.432)	1.96	0.95	0.93
Equation No.1.6 $A_t = f(P_r^e\ P_q^e\ \pi^e R)$	14831.69	43.76 (67.244) [0.0732]	–44314.75* (15203.142) [–0.2503]	63.61*** (36.076) [0.0561]	2.32* (0.353) [0.6371]	0.44 (0.403)	1.83	0.99	0.98

(Percentage per annum)

Item	Compound Growth Rate
Area (hectares)	0.14 (13.42)*
Production (tones)	0.16 (18.61)*
Productivity (kgs/hectares)	0.06 (2.44)**

Note: *Significant at 1 percent level of significance.
**Significant at 5 percent level of significance.
Figures in parentheses are the 't' values.

Table 3: Regression Coefficients of Apricot Acreage Supply Response: Linear Function

Table 4: Regression Coefficients of Apricot Acreage Supply Response: Double-Log Function

Model Specification	log a	b_2	b_3	b_4	b_5	b_6	TAE	'd'	R^2	R^{-2}
Equation No.2.1 $A_t = f(P_r^e\ P_q^e)$	2.2836	0.736* (0.236)	–0.974* (0.149)	–	–	–	–0.238 (0.282)	2.06	0.88	0.86
Equation No.2.3 $A_t = f(P_r^e\ P_q^e\ \pi^e)$	2.1860	0.692 (0.217)	–1.089* (0.152)	0.172*** (0.084)	–	–	–0.225 (0.241)	1.99	0.90	0.88
Equation No.2.5	3.6652	0.0796 (0.985)	–0.206** (0.088)	0.032 (0.027)	–	0.412* (0.035)	0.206** (0.092)	1.92	0.99	0.99

$A_t = f(P_r^e\ P_q^e\ \pi^e\ T)$										
Equation No.2.6 $A_t = f(P_r^e\ P_q^e\ \pi^e\ R)$	1.5306	0.043 (0.173)	–0.303*** (0.169)	0.173*** (0.081)	0.671* (0.124)	–	0.541** (0.199)	1.88	0.98	0.97

Note: * Significant at 1 percent level of significance.
** Significant at 5 percent level of significance.
*** Significant at 10 percent level of significance.
Figures in parenthesis are the standard errors of the respective coefficients.
Figures in square brackets are the elasticities of the regression coefficients.
TAE Total area elasticity is the sum of all the significant elasticities.

Government Debt and Long-Term Interest Rate: Application of an Extended Open-Economy Loanable Funds Model to South Africa

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Abstract: *This study finds that more government debt or deficit as a percent of GDP leads to a higher long-term interest rate in South Africa and that a higher real Treasury bill rate, a higher expected inflation rate, a higher world long-term interest rate, or depreciation of the rand increases the long-term interest rate, and that the percent change in real GDP may or may not affect the long-term interest rate, depending upon whether the government debt or deficit is used. In the conventional open-economy loanable funds model, the negative coefficient of the net capital inflow is significant at the 1% level.*

Keywords Loanable funds model; government debt or deficit; long-term interest rate; expected inflation rate; nominal effective exchange rate

Introduction

Since the global financial crisis and the worldwide economic recession, many countries have experienced declining government revenues, rising government expenses, and/or huge government deficits. Debt or deficit financing has become an avenue to make up budget shortfalls. South Africa is no exception. Its central government deficit rose from 2,137 million rands in 2008.Q2 to 53,988 million rands in 2009.Q2. Its central government gross debt increased from 508,747 million rands to 561,661 million rands during the same period (*International Financial Statistics*, International Monetary Fund, 2009). The Economist (2010) predicts that South Africa's government balance as a percent of GDP will be -6.1% in 2010 compared to -1.1% in 2008. Africa Monitor (2010) indicates that South Africa's fiscal position remains manageable.

Whether the government debt or deficit may affect the interest rate remains unsettled. Feldstein (1982), Hoelscher (1986), Wachtel and Young (1987), Boskin (1988), Zahid (1988), Thomas and Abderrozak (1988), Tran and Sawhney (1988), Cebula (1988, 1991, 1993, 1997a, 1997b, 1999, 2003, 2005), Miller and Russek (1991), Raynold (1994), Correia-Nunes and Stemitsiotis (1995), Vamvoukas (1997), Ewing and Yanochik (1999), Gale and Orszag (2004), Ardagna, Caselli and Lane (2004), Saleh and Harvie (2005), Quayes and Jamal (2007), Barnes (2008), and Laubach (2009) hold that the interest rate is positively associated with the government deficit. On the other hand, Plosser (1982, 1987), Kormendi (1983), Hoelscher (1983), Makin (1983), Aschauer (1985), McMillin (1986), Barro (1974, 1987), Evans (1985, 1987, 1988), Gupta (1989), Darrat (1989, 1990), Findlay (1990), Ostrosky (1990), García and Ramajo (2004), and Akinboade (2004) maintain that more government deficit would not raise the interest rate.

This paper attempts to examine the impact of more government debt or deficit on the long-term interest rate in South Africa and has several focuses. First, the paper employs the relative interest rate and the exchange rate to explain the behaviour of the international capital flow. Second, this study applies comparative static analysis to determine the partial derivative of the equilibrium long-term interest rate with respect to the exogenous variable. Third, empirical re-

sults are compared with the findings based on the conventional closed-economy and open-economy models.

The Model

Several previous studies have applied the loanable funds model to examine the impact of the government deficit or debt on the interest rate (Hoelscher, 1986; Tran and Sawhney, 1988; Thomas and Abderrezak, 1988; Cebula, 1988, 1994, 1997a, 1997b, 1998, 1999, 2000, 2003, 2005; Correia-Nunes and Stemitsiotis, 1995; García and Ramajo, 2004; Quayes and Jamal, 2007; Barnes, 2008). A closed-economy loanable funds model is proposed by Hoelscher (1986), and an open-economy loanable funds model is developed by Cebula (1988, 1994, 1997a, 1997b, 1998, 1999, 2000, 2003), who considers the international capital flow in the supply of loanable funds.

In this paper, the relative interest rate and the exchange rate are selected to explain the behaviour of the net capital inflow (Devereux and Saito, 2006; De Santis and Luhrmann, 2009). As the world long-term interest rate decreases relative to the South African long-term interest rate or as the South African rand appreciates relative to other currencies, the net capital inflow to South Africa would increase, the supply of loanable funds would shift to the right, and South Africa's long-term interest rate would decline. On the other hand, as the world long-term interest rate rises relative to the South African long-term interest rate or as the South African rand depreciates relative to other currencies, the net capital inflow to South Africa would decrease, the supply of loanable funds would shift to the left, and South Africa's long-term interest rate would rise. Suppose the demand for loanable funds is negatively affected by the long-term interest rate and positively influenced by the short-term real interest rate, the expected inflation rate, the percent change in real GDP, and the government debt and that the supply of loanable funds is positively associated with the long-term interest rate, the percent change in real GDP, and the nominal effective exchange rate and negatively determined by the short-term real interest rate, the expected inflation rate, and the world interest rate. Thus, in the extended open-economy loanable funds model, the demand for and the supply of loanable funds can be expressed as

$$DLF = A(RL, RS, \pi^e, YC, DE) \tag{1}$$

$$SLF = B(RL, RS, \pi^e, YC, RW, EX) \tag{2}$$

Where,

DLF = the demand for loanable funds in South Africa,
SLF = the supply of loanable funds in South Africa,
RL = the long-term interest rate in South Africa,
RS = the short-term real interest rate in South Africa,
π^e = the expected inflation rate in South Africa,
YC = percent change in real GDP in South Africa,
DE = government debt in South Africa,
RW = the world long-term interest rate, and
EX = the nominal effective exchange rate (An increase means appreciation.).

Setting DLF and SLF equal to the equilibrium loanable funds, we can write the equilibrium long-term interest rate as

$$\overline{RL} = \overline{RL}(DE, RS, YC, \pi^e, RW, EX) \tag{3}$$

The partial derivatives of $\overline{RL}$ with respect to each of the exogenous variables are given by

$$\partial \overline{RL} / \partial DE = A_{DE} / |J| > 0 \ ` \quad (4)$$

$$\partial \overline{RL} / \partial RS = (A_{RS} - B_{RS}) / |J| > 0 \quad (5)$$

$$\partial \overline{RL} / \partial YC = (A_{YC} - B_{YC}) / |J| > or < 0 \quad (6)$$

$$\partial \overline{RL} / \partial \pi^e = (A_{\pi^e} - B_{\pi^e}) / |J| > 0 \quad (7)$$

$$\partial \overline{RL} / \partial RW = -B_{RW} / |J| > 0 \quad (8)$$

$$\partial \overline{RL} / \partial EX = -B_{EX} / |J| < 0 \quad (9)$$

where $|J|$ is the Jacobian for the endogenous variables and has a positive value. Hence, the equilibrium long-term interest rate is positively associated with the government debt, the short-term real interest rate, the expected inflation rate, and the world long-term interest rate, is negatively affected by the nominal effective exchange rate, and may be influenced by the percent change in real GDP.

Empirical Results

The source of the data came from IMF's *International Financial Statistics*. The dependent variable is the 10-year South African government bond yield. The ratio of the government debt to GDP as a percent is used to represent government demand for loanable funds. The South African real Treasury bill rate is selected to test for a potential substitution effect. The percent change in real GDP is derived from real GDP index with 2005 as the base year. The expected inflation rate is represented by the average inflation rate of the past four quarters. The 10-year U.S. Treasury bond yield is chosen to represent the world long-term interest rate. The nominal effective exchange rate is a trade-weighted exchange rate index with 2005 as the base year. An increase in the nominal effective exchange rate means appreciation of the rand. The sample ranges from 1975.Q1-2009.Q2 with a total of 138 observations.

The ADF tests show that except for RS and YC, other variables have unit roots in level and that all the variables are stationary in first difference. Based on the ADF unit root test on the regression residuals, the test statistic of -5.377 is greater than the critical value of -2.582 in absolute values at the 1% level. Hence, these variables are cointegrated and have a long-term equilibrium relationship.

Table 1 presents the estimated regression and related statistics. According to the Breusch-Godfrey serial correlation LM test with 2 lags and the White heteroskedasticity test without the cross terms, serial correlation or heteroskedasticity cannot be rejected at the 5% level. Thus, the Newey-West generalized least squares method is employed in empirical work in order to yield consistent estimates for the covariance and conventional errors when the forms of serial correlation and heteroskedasticity are unknown. As shown in Version I, 84.4% of the variation in the government bond yield can be explained by the right-hand side variables with significant coefficients. The government bond yield is positively affected by the ratio of the government debt to GDP, the real Treasury bill rate, the expected inflation rate, and the 10-year U.S. Treasury bond yield, is negatively associated with the nominal effective exchange rate, and is not influenced by the percent change in real GDP. Specifically, if the government debt/GDP ratio increases by one percentage point, the government bond yield will rise by 0.157 percentage points. One percentage point increases in the U.S. government bond yield rises will cause the government bond yield to rise by 0.968 percentage points. On the other hand, if the nominal effective exchange rate index rises by one unit, the government bond yield will decline by 0.014 percentage points.

Table 1 Estimated Regressions of The Government Bond Yield for South Africa Based on the Extended Open-Economy Loanable Funds Model

Variable	I	II	III	IV
C	-2.209	3.485	-1.562	-1.049
	(-2.201)	(3.645)	(-1.330)	(-0.995)
DE	0.157		0.146	0.148
	(7.319)		(5.212)	(5.848)
DEF		0.390		
		(2.543)		
RS	0.230	0.310	0.497	0.501
	(3.696)	(3.700)	(12.724)	(12.637)
YC	0.128	0.315	0.330	0.359
	(1.106)	(1.988)	(2.272)	(2.574)
π^e	2.151	2.208	3.264	3.018
	(5.802)	(5.151)	(13.148)	(13.052)
RW	0.968	0.885		
	(4.731)	(3.323)		
EX	-0.014	-0.014		
	(-5.564)	(-4.475)		
CF				-2.847
				(-3.083)
Adjusted R^2	0.844	0.752	0.785	0.804
AIC	3.253	3.717	3.645	3.562
Schwarz criterion	3.402	3.866	3.744	3.681
Sample period	1975.Q1-2009.Q2			
Sample size	138			

Notes: The dependent variable is the government bond yield (RL). C is the constant. DE is the ratio of the government debt to GDP. DEF is the ratio of the government deficit to GDP. RS is the real Treasury bill rate. YC is the percent change in real GDP. π^e is the expected inflation rate. RW is the 10-year U.S. Treasury bond yield. EX is the nominal effective exchange rate (NEER). CF is the ratio of the net capital flow to GDP.

If the ratio of the government deficit to GDP is selected to represent government demand for loanable funds (Version II), its positive coefficient is significant at the 1% level, the positive coefficient of the percent change in real GDP is significant at the 5% level, adjusted R-squared of 0.752 is lower than the value in Version I. Other results are similar.

Several different measurements of the variables are tested to compare the results. When the ZAR/USD exchange rate is selected to represent the exchange rate, its positive coefficient is insignificant at the 10% level, the positive coefficient of the 10-year U.S. Treasury bond yield is also insignificant at the 10% level, and other results are similar. When the government bond yield of the European Central Bank (ECB) is added to the regression, its positive coefficient is insignificant at the 10% level mainly due to a high degree of multicollinearity. To save space, these results are not printed here and will be available upon request.

If the estimated regression is based on $\overline{RL} = \overline{RL}(DE, RS, YC, \pi^e)$, which is a conventional closed-economy loanable funds model (Hoelscher, 1986), the value of adjusted R-squared is 0.785, and all the coefficients are positive and significant at the 1% or 5% level (Version III). If the estimated regression is based on a conventional open-economy loanable funds model, (Cebula, 1988, 1994, 1997a, 1997b, 1998, 1999, 2000, 2003), $\overline{RL} = \overline{RL}(DE, RS, YC, \pi^e, CF)$, where CF stands for the net capital inflow as a percent of GDP, the value of adjusted R-squared is 0.804, the negative coefficient of the net capital inflow as a percent of GDP is significant at the 1% level, and other coefficients are positive and significant at the 1% level (Version IV). In comparison, the inclusion of the world interest rate and the nominal effective exchange rate improves the explanatory power of the behaviour of the long-term interest rate in South Africa.

Conclusion

This paper has applied an extended open-economy loanable funds model to examine whether South Africa's long-term interest rate would be affected by the government debt or deficit and other selected macroeconomic variables. The results show that more government debt or deficit as a percent of GDP, a higher real Treasury bill rate, a higher expected inflation rate, a higher world long-term interest rate, and a lower nominal effective exchange rate (depreciation of the rand) would raise South Africa's government bond yield. The percent change in real GDP may or may not affect the government bond yield, depending upon whether the government debt or deficit is used in empirical work. In the conventional closed-economy loanable funds model, the coefficients of all the four variables are positive and significant at the 1% or 5% level. In the conventional open-economy loanable funds model, the negative coefficient of the net capital inflow is significant at the 1% level, and the coefficients of other four variables are positive and significant at the 1% level.

There are several policy implications. The positive significant sign of the ratio of the government debt or deficit to GDP implies that continual debt-financed or deficit-financed expansionary fiscal policy would increase the long-term bond yield and crowd out part of private spending. The central bank needs to contain rising inflation expectations, which would raise the long-term interest rate. The world long-term interest rate and the exchange rate need to be considered as international investors search for better returns or gains due to exchange rate appreciation in supplying loanable funds to South Africa.

As the South African economy recovers from the worldwide recession, the regressions may need to be re-estimated to determine whether the results are robust. We may apply other techniques to estimate the expected inflation rate. Interest rate determination may be analysed by other models (Romer, 2000).

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