The Predictive Power of the Yield Curve on the South African Economy

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ABSTRACT

The purpose of this study is to determine if the information contained in the South African Yield Curve – being a profile of debt bearing instruments with different maturities – is a predictor of the South African Gross Domestic Product. The report is limited to the period following the 1994 democratic elections as this event signified a major shift in economic policy.

The Term Spread – being the difference in yield between a short term instrument and a long term instrument – had been shown in a number of studies to be a significant predictor of inflation, economic activity and recessions. Most of these studies were carried out on first world economies. Literature showed that the addition of a stock market index and the level of the yield curve (the short term interest rate) to the model increased its performance.

The numeric data – the GDP, Yields on T-Bills and RSA Government Bonds and the All-Share Index – used to complete this study is readily available from reputable institutions.

This work shows that the Term Spread has weak predictive ability over the change in the South African GDP in the near term – up to two quarters ahead. The all-share index contains negligible additional information. When the 91 day T-Bill Rate (the short term rate) is added to the model, the predictive ability increases tremendously, both in terms of the explanatory power and the forecasting horizon – to the point where the contribution of the term spread can be considered non-significant.

It is not clear why the T-Bill rate shows strong predictive power relative to the Term Spread in the South African context and represents an area for further research.

DECLARATION

I, Steven Rymer, declare that this research report is my own work except as indicated in the references and acknowledgements. It is submitted in partial fulfilment of the requirements for the degree of Master of Business Administration in the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in this or any other university.

(Steven Glen Rymer)

Signed at ……

On the …….. day of …… 2010

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Without the invaluable assistance of my supervisor, Prof. M. Ncube, this research would not have been possible.

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CHAPTER 1: INTRODUCTION

1.1 Purpose of the study

The purpose of the study is to determine if changes in the real economic output of South Africa (as measured by the Gross Domestic Product) can be predicted by movements in the yield curve. The yield curve is a profile of the yield of debt instruments with different maturities.

1.2 Context of the study

Burnett (2001) carried out a study of the Yield Curve's relationship with the South African economy for the period 1970 to 1995. The period Burnett considered was, as he stated, characterised by fluctuating fiscal policy. After this period the South African economy has been characterised by stable fiscal policy. Due to this shift in context, the study has been updated and expanded.

1.3 The research problem

1.3.1 *Main problem*

The purpose of the study is to propose a model for predicting future GDP growth for the South African economy.

The model has been developed using regression analysis. The dependent variable is the change in quarterly GDP growth. The independent variables are the term spread, the short-term rate and a stock market index.

1.3.2 *Sub problem 1*

Does a yield curve have predictive power over the South African economy, under the criteria Burnett (2001) originally proposed?

These criteria are that no additional independent variables other than the term spread – derived from the 3 month T-Bill yield and the 10 year bond yield – be included in the regression analysis to predict the quarterly GDP growth 4 quarter's ahead.

1.3.3 *Sub problem 2*

How far into the future does this predictive power extend?

1.3.4 *Sub problem 3*

Which term spread is the most accurate predictor of South Africa's future GDP growth?

1.3.5 *Sub problem 4*

Can the yield curve model be improved through the addition of additional explanatory variables?

1.4 Significance of the study

"Managers are always trying to make estimates of what will happen in the future in the face of uncertainty. … good forecasts are an essential part of efficient and effective management" (Waddel and Sohal 1994:41). Many researchers (including Harvey (1988) – USA; Estrella and Hardouvelis (1991) – USA; Alles (1995) – Australia; Burnett (2001) – RSA; McMillan (2002) – UK) have shown that the yield curve does exhibit useful powers of prediction over the real

economies of various countries. Moreover, theory suggests that acceptable forecasts can be made using simple regression analysis and widely available data. This goal is in line with Hossain and Bhatti's (2003) view, that a good model be measured against two important properties, being goodness-of-fit and parsimony.

Lastly, other than Burnett's (2001) work, there appear to be no studies on the predictive effect of the South African Yield Curve on the South African economy, and particularly for the "New South African" (i.e., post 1994) economy. This study fills this gap by considering the post 1994 period.

1.5 Definitions

Yield Curve:	If the return on debt instruments is plotted against the term of the debt, the resultant curve is termed the "Yield curve" or the "Term structure of interest rates".
Term Spread:	The difference in yield between two debt instruments of different terms. In this study, the short-term instrument is the T-Bill rate and the long-term instrument is a government bond.
Gross National Product (GNP):	The total value of final goods and services produced in a year by a country's nationals (including profits from capital held abroad)
Gross Domestic Product (GDP):	The total value of final goods and services produced within a country's borders in a year

CHAPTER 2: LITERATURE REVIEW

The GNP, GDP and other associated macroeconomic measures are used by all manner of person's in the economy. "Managers are always trying to make estimates of what will happen in the future in the face of uncertainty. … good forecasts are an essential part of efficient and effective management" (Waddel and Sohal 1994:41).

2.1 Forecasting using Financial Spread Variables

The difference between two financial variables is often used as the input to a model to predict a change in the economic variable of interest (Gripaios 1994). A commonly used indicator is the "yield curve"; which is a plot of the yield of long term and short term debt instruments (typically government bonds, as these are debt instruments with high liquidity). Models that utilise the yield curve as an input have been developed to predict future interest rates (Fama 1984); future inflation (Miskin 1990); the change in a macro-economy variable such as GDP, consumption, industrial production or investment (Estrella and Trubin 2006) and the likelihood of recession (Estrella and Mishkin 1996).

Estrella and Mishkin (1996) spelt out the advantages of computing a forecast based on the yield curve. They contend that the computation thereof is relatively quick and simple in comparison to the complex econometric models that the institutions typically apply and that the result thereof is interesting in its own right. Econometric forecasts are usually composed of a series of simultaneous equations "based on the forecaster's beliefs about how the economy works in theory, with parameters estimated on the basis of multiple regressions of time-series data" (Gripaios 1994:61). Estrella and Mishkin (1996) also state that yield curve forecast can be used to double-check the predictions from more complex models, and indeed, from a judgemental

analysis of the future. Should those predictions agree with a yield curve based forecast, then ones confidence in the forecast will be strengthened.

In addition to this, the number of input variables is small. Hossain and Bhatti (2003) indicate that a parsimonious model is desirable. The econometric technique often leads to large, cumbersome models (Gripaios 1994).

The work in this area also has a theoretical underpinning. Harvey (1988) used the Capital Asset Pricing model to justify the relationship between the yield spread and consumption in the USA. This in contrast to autoregressive techniques, which do not have a theoretical underpinning (In fact Gupta (2007) refers to his autoregressive model of the South African economy as being "atheoretical"). In this case past values of the economic variable of interest are used to predict future movement in the same variable.

2.2 The Yield Curve as a Predictor

2.2.1 *Information contained in the Yield curve*

The literature on the information content of the yield curve is divided into three broad strands. Authors in the tradition of Fama (1985) and Mishkin (1990) have used the yield curve to predict interest rates and inflation. Authors in the tradition of Harvey (1988) and Estrella and Hardouvelis (1991) link the information content of the yield curve to future real economic activity. They use the yield curve to predict either GDP – or consumption – growth. There is also a broad literature (such as Estrella and Mishkin (1996) and Chauvet and Potter (2005)) that focuses on predicting recessions.

The yield curve has also been used to predict property prices (Tsolacos 2001). Since property prices are strongly correlated with the overall health of the economy and with the level of interest rates, this finding is not unsurprising.

It would seem that the largest body of recent literature is devoted to predictions of the GDP and recessions.

2.2.2 *Theoretical Basis*

The earliest work is in the field of predicting future inflation and spot rates. This work is based on the expectations hypothesis proposed by Fisher in his book "The Theory of Interest" published in 1930, which is widely cited in the literature. Fama (1975:269) summarised the Fisher hypothesis as "In a world of uncertainty where foresight is imperfect, the nominal rate of interest can be thought of as the equilibrium expected real return plus the market's assessment of the expected rate of inflation".

Drawing on the work on interest rates, a body of research arose in the late nineteen eighties, linking movements in the yield curve to movements in the real economic output of an economy. It was noticed that "A positive slope of the yield curve is associated with a future increase in real economic activity …" (Estrella and Hardouvelis 1991:555). Harvey had drawn a similar conclusion in 1988.

Estrella and Trubin (2006) state that much of the literature has focussed on documenting empirical correlations. They point out that the risk exists that, due to the focus on empirical research, the impression may have been created that there is no underlying theory to explain why a relationship exists, and that the "relationship is a fluke" (Estrella and Trubin 2006:1).

However, there are actually reasonable explanations for why the yield curve should predict the economy. Harvey (1988) uses the consumption-based capital asset pricing model to justify the link between consumption and the yield curve. Should a consumer expect a recession in the future, he will sacrifice

today in order to purchase a bond to provide a hedge against the coming bad times. If enough people do this, it bids up the price of the future maturing bond and simultaneously lowers the yield. Estrella and Trubin (2006) cite two further explanations that, they contend, are mutually reinforcing. If monetary policy is tightened – often in response to inflationary pressures – this tends to increase short-term interest rates. However, long-term rates will reflect longer term expectations and rise by less relative to short-term rates. Investor expectations should also lead to changes in the shape of the yield curve. If investors expect a slowdown in economic activity in the future and consequently lower inflation (and lower interest rates), they will be prepared to accept lower yielding long term instruments now. In each of these scenarios one would see a flattening of the yield curve.

2.2.3 *The Yield curve as a predictor of Future Interest Rates and Inflation*

Stock and Watson (2003) summarised the current state of the literature regarding the yield curve as a predictor of future interest rates and inflation. They found that the empirical evidence does not support the premise that the yield curve has predictive ability over inflation. However many authors have found that the short rate itself is a significant predictor of future rates.

Fama (1984) found that the forward rate contains information on future spot rates in the USA. He points out that it is important to note that the future rates also contain expected risk return premiums, in addition to expectations of future rates. Since the premium demanded varies through time, the effect of this must be considered; else the forecasting power may be obscured. Miskin's (1990) findings support this view. He found that one could forecast future rates effectively using a term spread constructed from short term yields (below 9 months). However, this term spread had almost no information relating to future inflation. Mishkin (1990) also showed that a term spread constructed from

yields at the long end of the yield curve (i.e., yields with maturities greater than 9 months), does contain information pertinent to future inflation.

Karfakis and Moschos (1995:94) examined the predictability of interest rates in Australia. During the period they reviewed there was a significant change in the monetary policy in Australia. Their opinion is that if the authorities use the short rate as a tool in monetary policy, then "the term structure of interest rates is central to the monetary transmission mechanism".

2.2.4 *The Yield curve as a predictor of real activity*

Harvey (1998) and Estrella and Hardouvelis (1991) focused on the predictive power of the yield curve over the real economy of the USA. These early works have since been built upon and expanded by later studies.

Harvey (1988) and Estrella and Hardouvelis (1991) independently proposed similar linear models utilising a spread variable derived from the yield curve as the only variable to predict changes in the GDP/GNP. The spread variable is the difference between the yield of short term and long term debt instruments. These authors claim that the yield curve exhibits similar, if not greater, powers of prediction over the American economy, than the institutional forecasts.

Estrella and Hardouvelis (1991) used an ordinary least squares approach to regress the slope of the yield curve against the growth in GDP. They proposed the following model, and tested it using quarterly data from the US economy for the period 1955 to the end of 1998.

Their dependant variable is the annualised cumulative percentage change in the seasonally adjusted finally revised real GNP (based on 1982 numbers). The Spread variable is the difference between the annualise bond equivalent yield of the 10-year government bond and the annualise bond equivalent yield

of the 3-month T-bill. These two debt instruments were used due to the availability of data. They point out though that a richer array of interest maturities could provide finer information on the predictive accuracy.

In both cases the average quarterly rate was used as opposed to point-in-time rates. The authors felt that the real GNP would be more closely linked to average rates over the quarter.

Estrella and Hardouvelis (1991) found that a steeper yield curve implied faster future growth in real output. They found that the predictive power extended to four years into the future, but was most accurate between five and seven quarters ahead. They also contend that the yield spread was able to explain one third of the variation in future output changes.

Estrella and Hardouvelis (1991) also went on to show that the yield curve has predictive power over the private sector components of GNP (consumption, consumer durables and investment), but it did not predict (unsurprisingly) government spending. They also tested the predictive power of the yield curve in the presence of other economic indicators that, they claim, are widely supposed to have predictive power over the real economy:

1. The real federal funds rate (nominal minus expected inflation)
2. The annualised growth index of leading indicators (a composite index of 12 macroeconomic variables).
3. The lagged growth in real output and
4. The lagged rate of inflation.

They found that the yield spread again showed predictive power over the forecasting horizon, and its coefficients are significant 3 years into the future. All the other indicators only exhibit weak predictive powers.

Harvey (1988) and Estrella and Hardouvelis (1991) claim that the yield curve exhibits similar, if not greater, powers of prediction, over the American economy, to the forecasts produced by the institutions. They also tested the yield spread against survey evidence (the American Statistical Association) of the GNP. In this case the survey data only showed statistically significant forecasting ability 2 quarters into the future.

In the same study Estrella and Hardouvelis (1991) outline a model for predicting recessions. In this case the probability of a recession is modelled using a probit equation; that is, the output is coded as a 1 or a 0 to represent the presence or lack-of-presence-of a recession.

2.2.5 *Application of the model to developed economies*

The predictive power of the yield curve has since been tested on numerous developed economies around the world.

Alles (1995), testing the Australian Yield Curve found that he could predict nominal GDP growth, but not real growth. In addition, the yield curve had greater powers of prediction that the index of leading indicators. Since the deregulation of the Australian bond market in 1982, the predictive power of the term spread increased. Alles (1995) also found that the best predictions occurred when the maturity of the long term bond used in the computations closely matched the forecasting horizon. Alles (1995) used the 3 – and 6 – month rates versus the 2 –, 5 – and 10 – year rates in his predictions.

McMillan (2002) tested the predictive power of the UK yield curve. He showed that the yield curve had marginally greater predictive power when regressed in combination with a stock market index, whilst the inclusion of lagged growth as an explanatory variable had no impact on the predictive power of the model. McMillan (2002) found that the predictive power of the UK yield curve was less

powerful than that suggested by the studies on the US economy and could account for 17% of the variation in growth, 6 quarters ahead.

Estrella, Rodrigues, and Schich (2003) looked at the stability of yield curve models in Germany and the USA. They found that the forecasts conducted on German data were stable, whilst there was evidence of instability in the US forecasts. They found that the yield curve models were "generally informative". They also confirmed that binary models predicting recessions were generally more stable than continuous models that looked at output growth.

2.2.6 *Application of the model to developing economies*

In contrast to the developed economies, very little work in the area has taken place in developing economies.

Burnett (2001) conducted research on the predictive power of the South African yield curve on the South African economy, for the period 1970 to 2000. He found that the yield curve did have predictive power over the South African economy. He also found that the yield curve was comparably powerful compared to institutional forecasts in South Africa. He also tested whether or not the United States yield curve exhibited any predictive power over the South African economy. He found that it did not.

Burnett (2001) did not investigate the effect of different prediction horizons, nor did he take into account alternative spreads (he used the annualise bond equivalent yield of the 10-year government bond and the annualise bond equivalent yield of the 3-month T-bill). In addition the period over which Burnett conducted his research (1970 to 1995) was characterised by fluctuating fiscal policy.

Gonzales, Spencer and Walz (2000:293) carried out a study on the Mexican economy. They found that the yield curve had "significant forecasting ability for inflation and real growth".

Mehl (2006) published an extensive study on the yield curve as a predictor of both inflation and industrial output that took 14 developing economies – Brazil, Czech Republic, Hong Kong, Hungary, India, Korea, Malaysia, Mexico, Philippines, Poland, Saudi Arabia, Singapore, South Africa and Taiwan – into consideration. Mehl found that there was evidence that the yield curve is a significant predictor of both inflation and industrial output in all the countries surveyed. However the model he used was based on the Consumer Price Index and the Producer Price Index and only one point on the long end of the yield curve was used to construct the spread. Moreover his models included an autoregressive component, which made the computations data intensive and it is not clear whether the inclusion of the SPREAD variable added significantly to the predictive power of the autoregressive component for output.

2.2.7 *Extensions and challenges to the models.*

Stock and Watson (2003) point out that the term spread has lost some of its predictive power since the early work in the area. Indeed the first major failure of the term spread as a predictor occurred just after the publishing of Campbell (1998) and Estrella and Hardouvelis's (1991) work. Dotsey (1998) points out, that the term spread did not predict the 1991 recession in the USA. However, he finds that the term spread is still a useful variable.

Estrella (2005:722) developed a rational expectations model to explain why the yield curve has been found to predict future growth and inflation. One of the findings of this analysis was that "the relationships are not structural but are instead influenced by the monetary policy regime". Estrella showed that the

focus of the monetary authority has an effect on the applicability of the yield curve as a predictive tool. He cites two extreme cases:

1. In the case where the authority focuses on output fluctuation and the change in the interest rate (rather than the level of the rate), the yield curve is the optimal predictor of future output.
2. In the case where the authority makes vigorous changes to the level of the interest rate in response to inflation and output gaps, the predictive power of the yield curve disappears.

Duarte, Venetis and Paya (2005:262) concluded from Estrella's work that they would "expect to find in empirical works that the spread has a stronger relationship with future output when the monetary authorities are relatively more concerned with output than with inflation."

Ang, Piazzesi and Wei (2005), contend that the level (i.e., the short term rate) as well as the slope of the yield curve matter. They find that the best slope variable is when the difference between long and short rates is maximal. They also contend that the nominal short rate dominates the prediction and they add in the lagged GDP as an additional explanatory variable. Bordo and Haubrich (2007) concur with these findings.

Diebold, Rudebusch and Aruoba (2003) present the contrarian view that, in fact, the stronger relationship is actually the GDP predicting the yield curve, rather than the yield curve predicting as per Estrella et. al. They do acknowledge that the relationship is actually likely to be both forwards and backwards but do not put forward a compelling theoretical argument for their case.

2.3 Conclusion

Stock and Watson (2003:822) present a succinct summary of the status of output and inflation forecasting using the asset prices. They have three main findings that are illuminating:

1. Asset prices have been useful predictors of output and/or inflation for some economies in some periods. No one single asset price has been shown to be a consistent predictor of output growth over multiple decades. They acknowledge that "The term spread perhaps comes closest to achieving this goal", certainly in terms of output growth.
2. These forecasts do tend to have an unacceptably high level of instability. Stated otherwise, evidence suggests that if an asset price forecasts well in one country at one time, there is no guarantee that the forecast power will continue. Stock and Watson allude to the fact that a change in monetary policy could lead to previously strong forecasting relationships breaking down.
3. Models comprising of combinations of asset prices tend to improve on forecast models based on single predictors.

2.4 Hypothesis testing considerations

All the previously mentioned researchers have tested the hypothesis that the coefficients of the models derived in their papers are not zero at the 5% significance level.

Since the models are based on time-series data, there are likely to be issues regarding autocorrelation (Albright, Winston and Zappe 2003). Hintze (2001) states that unless steps are taken to deal with the autocorrelation, one could be faced with a situation where:

1. There are minimum variance estimates
2. The mean square errors can be underestimated,

3. T-tests could show significance where there is none
4. Confidence intervals are shorter than they should be

All the researchers that have conducted studies into the yield curve have run into problems of autocorrelation. The forecasting horizons overlap, leading to overlapping data, which, in turn, generates a moving average error term of k-1. This produces inconsistent standard errors.

Most authors propose that a technique proposed by Newey and West (1987) be employed to restate the standard errors, thereby dealing with the fact that data is autocorrelated and likely to suffer from heteroskedasticity. Newey and West describe their method in detail in their 1987 study.

CHAPTER 3: RESEARCH METHODOLOGY

The purpose of the study is to propose a model for predicting future GDP growth for the South African economy.

In this study the model developed by Estrella and Hardouvelis (1991) is used. The model states that

(1) $$Y_{t,t+k} = \alpha_0 + \alpha_1 SPREAD_t + \sum_{i=1}^{N} \beta_i X_{it} + \varepsilon_t$$

$Y_{t,t+k}$, is the annualised cumulative percentage change in the seasonally adjusted finally revised real GDP (based on constant prices), given by

(2) $$Y_{t,\,t+k} \equiv \left(\frac{400}{k}\right) \cdot \left(\log\left(\frac{y_{t+k}}{y_t}\right)\right)$$

y_t is the level of real GDP in quarter t and k is the forecasting horizon in quarters.

SPREAD is the slope of the yield curve (the term spread) given by:

(3) $$SPREAD_t \equiv R_t^L - R_t^S$$

R_t^L is the annualised bond equivalent yield of the applicable long term government bond and R_t^S is the annualised bond equivalent yield of the 3-month T-bill. In both cases the average quarterly rate was used as opposed to point-in-time rates. Estrella and Hardouvelis felt that the real GDP would be more closely linked to average rates over the quarter.

X_{it} are other information variables available in quarter t. α_0 is the intercept coefficient, whilst α_i and β_i are the slope coefficients. The coefficients are derived by a least squares regression. ε_t is the error term.

Burnett (2001) proposed that the appropriate term spread in the South African economy was the difference in yield between the 3-month SA T-Bill and the 10 year SA Government Bond.

Other researchers have found this model to be appropriate, namely McMillan (2002) for the UK, Alles (1995) for Australia, and Estrella and Hardouvelis (1991) for the USA. In his study of the South African economy Burnett (2001) had made use of the model proposed by Harvey (1988) which has a similar form.

3.1 Sub Problems and Hypotheses

3.1.1 *Sub problem 1*

Does the South African yield curve have predictive power over the South African economy, under the criteria Burnett (2001) originally proposed?

In this case β was set to zero and k was set to 4 in equation 1. SPREAD was calculated as the difference between the 3 month T-Bill yield and the 10 year bond yield in quarter t. No additional independent variables other than the Term Spread – derived from the 3 month T-Bill yield and the 10 year bond yield – were included in the regression analysis to predict the quarterly GDP growth 4 quarter's ahead.

3.1.2 *Hypothesis 1*

If the chosen term spread has no power to explain the future change in the quarterly South African GDP growth, four quarter's hence; then the model should be rejected.

This statement was tested using the ANOVA test (Albright, Winston and Zappe 2003:631), such that:

1. The null hypothesis is that the slope coefficient of the regression model variable is zero, or:
   H_0: $\alpha_1 = 0$
2. The alternative is that it is not zero.
   H_1: $\alpha_1 \neq 0$

If the ANOVA test finds in favour of the alternate, this yield curve model can be said to have predictive power over the real economy.

3.1.3 *Sub problem 2*

How far into the future does this predictive power extend?

In this case β was set to zero, in other words no additional variables were included, and k was allowed to vary between 1 and 12 quarters.

3.1.4 *Hypothesis 2*

If a particular term spread has no power to explain the change in South African GDP k quarters into the future – where $1>k>12$ – then the it should be rejected as an independent variable.

Each permutation of k ($1>k>12$) was tested using an ANOVA test (Albright, Winston and Zappe 2003:631), such that:

1. The null hypothesis is that the slope coefficient of the regression model variable is zero, or:
   H_0: $\alpha_1 = 0$
2. The alternative is that it is not zero.
   H_1: $\alpha_1 \neq 0$

If the ANOVA test finds in favour of the alternate for a specific value of k, then yield curve model based on the chosen SPREAD and the particular k can be said to have predictive power over the real economy.

3.1.5 *Sub problem 3*

Which term spread is the most accurate predictor of South Africa's future GDP growth?

Burnett (2001) proposed that the appropriate term spread in the South African economy was the difference in yield between the 3-month SA T-Bill and the 10 year SA Government Bond.

He provided no theoretical basis for his claim. Estrella and Hardouvelis (1991) had used a similar term spread, but did say that they believed the use of different term spreads would result in "finer information on the predictive accuracy of the term structure" (Estrella and Hardouvelis 1991:558).

It was felt that there is likely to be a term spread that more accurately models the South African economy than the difference in yield between the 3-month SA T-Bill and the 10 year SA Government Bond. The term spreads were calculated based on the available data from the South African Reserve Bank which list the yield on government bonds with maturities between 0 and 3 years, 3 and 5 years, 5 and 10 years and over 10 years.

In these cases β was again set to zero in equation 1 – in other words no additional variables were included. The most appropriate forecasting horizon (based on sub-problem 2's outcome) was to be used.

3.1.6 *Hypothesis 3*

If one of the following term spreads has no power to explain the future change in South African GDP, then it should be rejected as an independent variable:

R_t^L could be one of the following bond yields:

- 0-3 years
- 3-5 years
- 5-10 years
- 10+ years

R_t^S is the yield of the 3 month T-Bill.

The outcome of regressions performed using every possible permutation of SPREAD to predict $Y_{t, t+k}$ were tested using ANOVA tests (Albright, Winston and Zappe 2003:631), such that:

1. The null hypothesis is that the slope coefficient of the regression model variable is zero, or:

   H_0: $\alpha_1 = 0$
2. The alternative is that it is not zero.

   H_1: $\alpha_1 \neq 0$

Had the ANOVA test found in favour of the alternate for a specific value of SPREAD, then the yield curve model based on the chosen k and that particular SPREAD could be said to have predictive power over the real economy.

To choose the most powerful SPREAD, the R^2 and error terms of each permutation that passed the hypothesis test were compared.

3.1.7 *Sub problem 4*

Can the yield curve model be improved through the addition of additional explanatory variables?

Estrella and Hardouvelis's model (1991) allows for the addition of extra variables X_i – refer to equation 1.

Literature suggested that possible additional variables were a stock market index (McMillan 2002) or the level of the Yield Curve (Ang, Piazzesi and Wei 2005). The "level" of the yield curve means, simply, that the short rate R_t^S is included as a variable X_i. The JSE Securities Exchange All-Share Index is widely quoted and this seemed the most appropriate index variable in the South African Context.

In this case the most appropriate values of k (sub-problem 2) and SPREAD (sub-problem 3) were to be used in the regression.

3.1.8 *Hypothesis 4*

If the Level of the Yield Curve or the JSE Securities Exchange All-Share Index had no power to explain the future change in South African GDP then it was rejected as an independent variable.

The outcome of regressions performed using the Level of the Yield Curve and the JSE All Share Index as additional explanatory variables to predict $Y_{t,\,t+k}$ were tested using ANOVA tests (Albright, Winston and Zappe 2003: 631), such that:

1. The null hypothesis is that the coefficients of the regression model variables are zero, or:
   H_0: $\alpha_1 = 0$; $\beta_i = 0$
2. The alternative is that it is not zero.

H_1: $\alpha_1 \neq 0$; $\beta_i \neq 0$

If the ANOVA test had found in favour of the alternate, the yield curve model based on a particular spread, k, the short rate R_t^S and the All-Share Index could be said to have predictive power over the real economy.

In order to determine if the additional variable had added to the power of the model, the R^2 and error terms generated were compared to those generated in the earlier sub-problems.

3.2 Assumptions

1. For Sub-problem 1:
   1.1. The term spread was assumed to be the difference between the bond equivalent yield of the 3 month T-Bill and the yield on the 10 year government bond.
   1.2. The forecasting horizon was held constant at 4 quarters.
2. For Sub-problem 2:
   2.1. The term spread was assumed to be the difference between the bond equivalent yield of the 3 month T-Bill and the yield on the 10 year government bond.
   2.2. The forecasting horizon was allowed to vary between one and twelve quarters (1>k>120).
3. For Sub-problem 3:
   3.1. The term spread was assumed to be the difference between the bond equivalent yield of the 3 month T-Bill and the yields of the 3 year, 5 year, 10 year and 25 year government bonds.
   3.2. The forecasting horizon was fixed at the most appropriate k from sub-problem 2.
4. For Sub-problem 4:
   4.1. The term spread was fixed at the most appropriate value from sub-problem 3.

4.2. The forecasting horizon was fixed at the most appropriate k from sub-problem 2.

4.3. The short rate, R_t^S (being the bond equivalent yield of the 3 month T-Bill) and the JSE Securities Exchange All-Share Index were added as additional predictor variables.

5. The model coefficients were tested for significance at the 5% level. There is supporting evidence in the literature for this level.
6. All the standard regression assumptions apply (Albright, Winston and Zappe 2003:621):
   6.1. "For any fixed values of the explanatory variables, the mean of the errors is zero".
   6.2. "For any values of the explanatory variables, the standard deviation of the response variables is a constant, the same for all such values"
   6.3. "For any values of the explanatory variables, the response variables is normally distributed"
   6.4. "The errors are probabilistically independent"
7. The Newey-West technique was utilised to avoid overstating the significance of coefficients derived by regression in the presence of autocorrelation.

3.3 Delimitations

1. The necessary data was easily obtainable, from the public domain.
2. The tools for analysing regression models are well understood and documented.
3. The published literature seems to support the notion that economies and their yield curves are linked.

CHAPTER 4: THE DATA

4.1 Data required for the Proposed Research

All data used for the research is continuous, numeric data. The data is valid and reliable as the data is available from recognised organisations in the public domain.

4.2 Data Gathering

Please refer to Appendix A for a list of the raw data used in the study.

Statistics South Africa publishes the GDP figures for the economy. The data set used was the seasonally adjusted and annualised data in constant 2000 prices. This report covered the entire period of the study, and the data is summarised below:

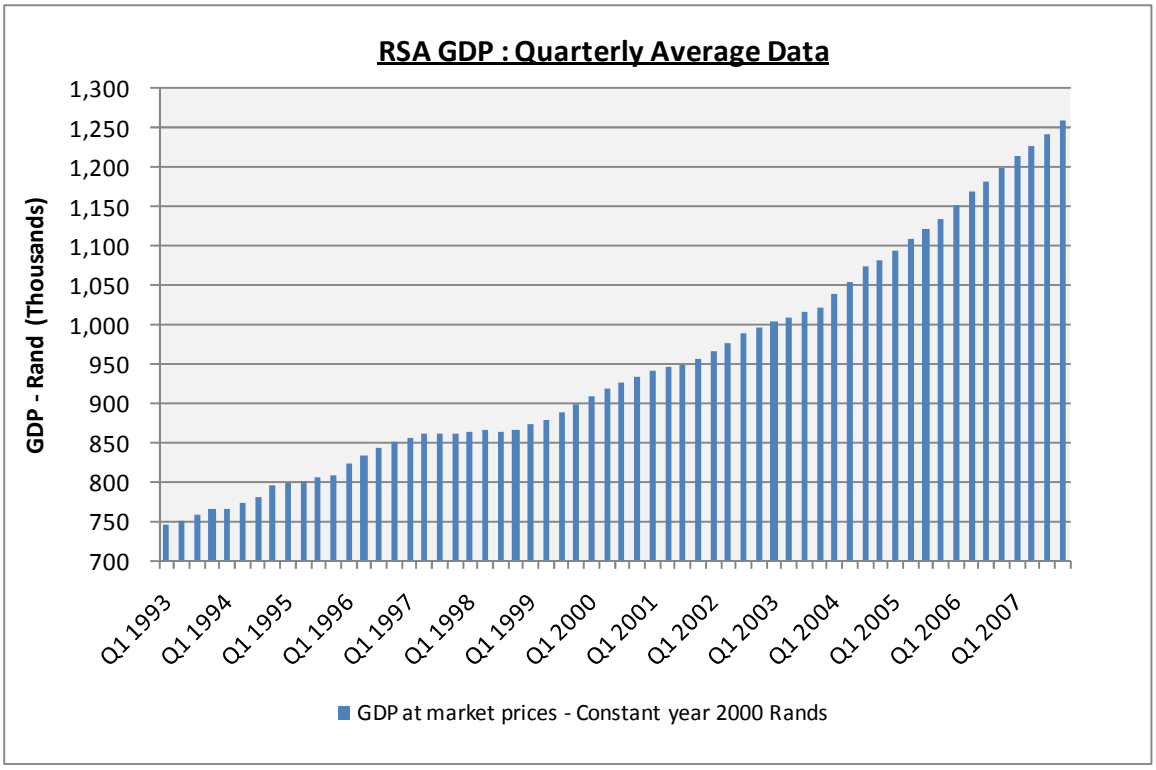


Figure 1: Seasonally adjusted and annualised RSA quarterly gross domestic product at constant 2000 prices

One can see that in the period under consideration, the South African GDP approximately doubled and seems to increase at a reasonably steady rate. The one conspicuously different period stretched from approximately Q3-1997 through to Q1-1999 where the GDP remains relatively flat and there is a small decrease reduction in GDP towards the end of this period before the resumption of growth.

The reserve bank of South Africa maintains a free, online database. The discount rate on the 91 day T-bill and the yields on different maturity government bonds are available. Unfortunately, the reserve bank bulks the various government bonds into the following categories:

Table 1: South African Reserve Bank datasets for interest bearing instruments

Code	Description
KBP1405W	Discount rates on 91-day Treasury Bills
KBP2000M	Yield on loan stock traded on the bond exchange: Government stock - 0 to 3 years
KBP2001M	Yield on loan stock traded on the bond exchange: Government stock - 3 to 5 years
KBP2002M	Yield on loan stock traded on the bond exchange: Government stock - 5 to 10 years
KBP2003M	Yield on loan stock traded on the bond exchange: Government stock - 10 years and over

These bulked categories are referred to as the 3 year, 5 year, 10 year and 25 year bonds respectively in this report.

The government stock yields are summarised in Figures 2 and 3 below, and the tables of data appear in the appendix:

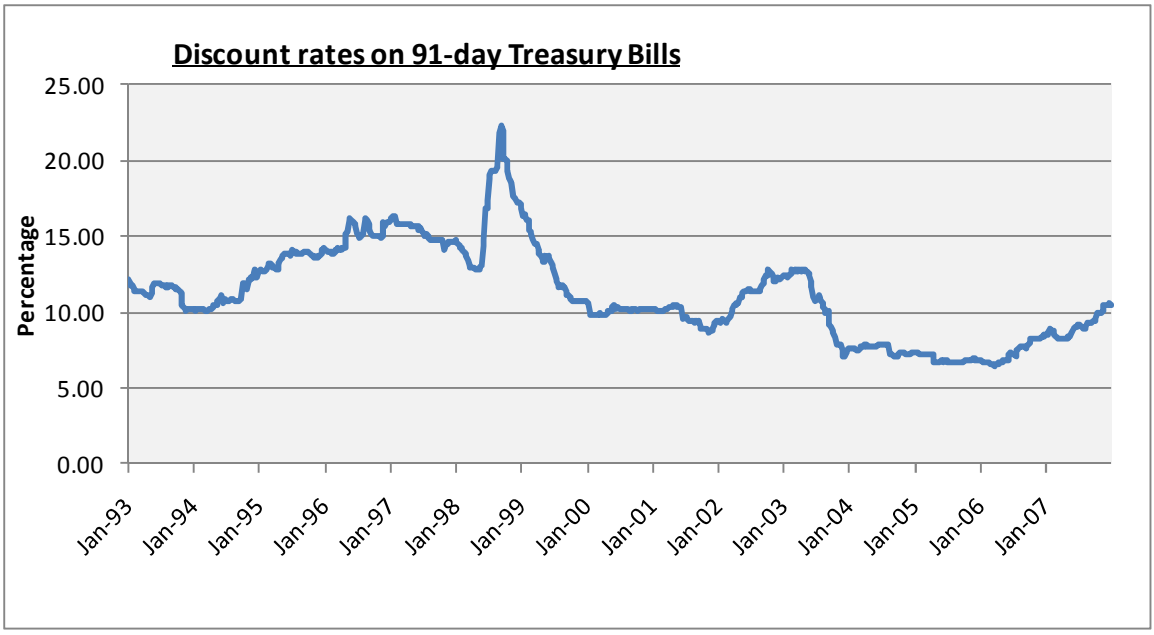


Figure 2: Discount rates on 91-day Treasury Bills

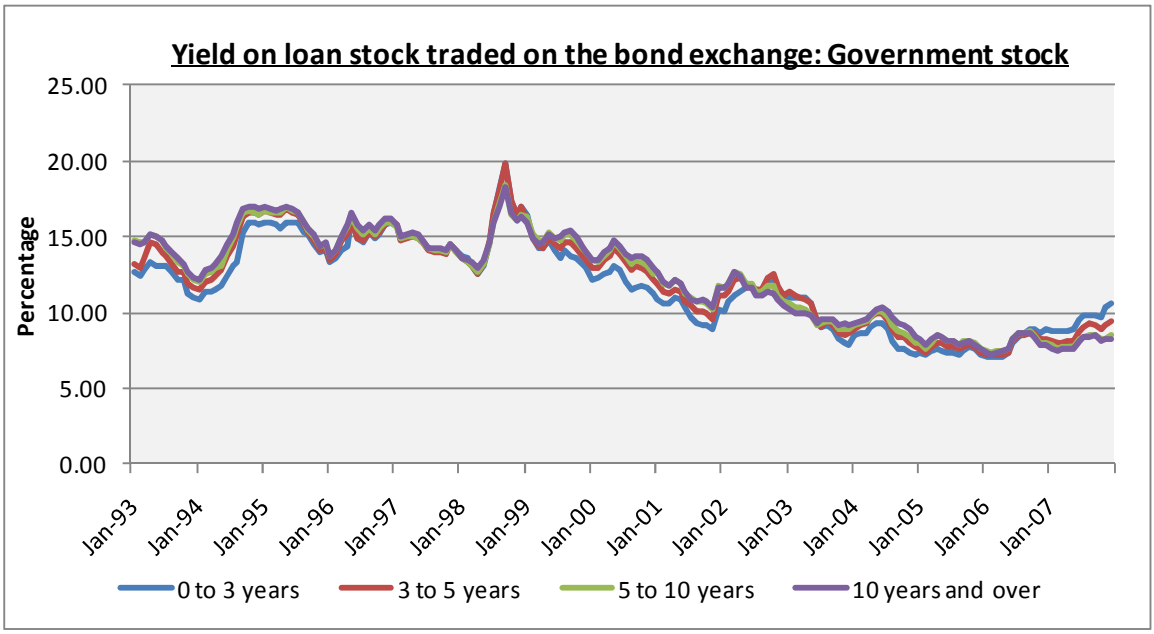


Figure 3: Yield on loan stock traded on the bond exchange: Government stock

As can be seen, interest rates have been volatile. The short-rate has been both higher than 20% and as low as 7% during the period under consideration – a swing of over 200%. However, it would appear that, on average, yields have

decreased through the period under consideration. There is also clear evidence of inversions in the yield curve happening through the period. Literature (Harvey 1988 and Estrella and Trubin 2006) suggests that under "normal" conditions – that is when GDP is growing – the yield of long-term bonds should be higher than short-term bonds. The curve below clearly shows this behaviour more clearly:

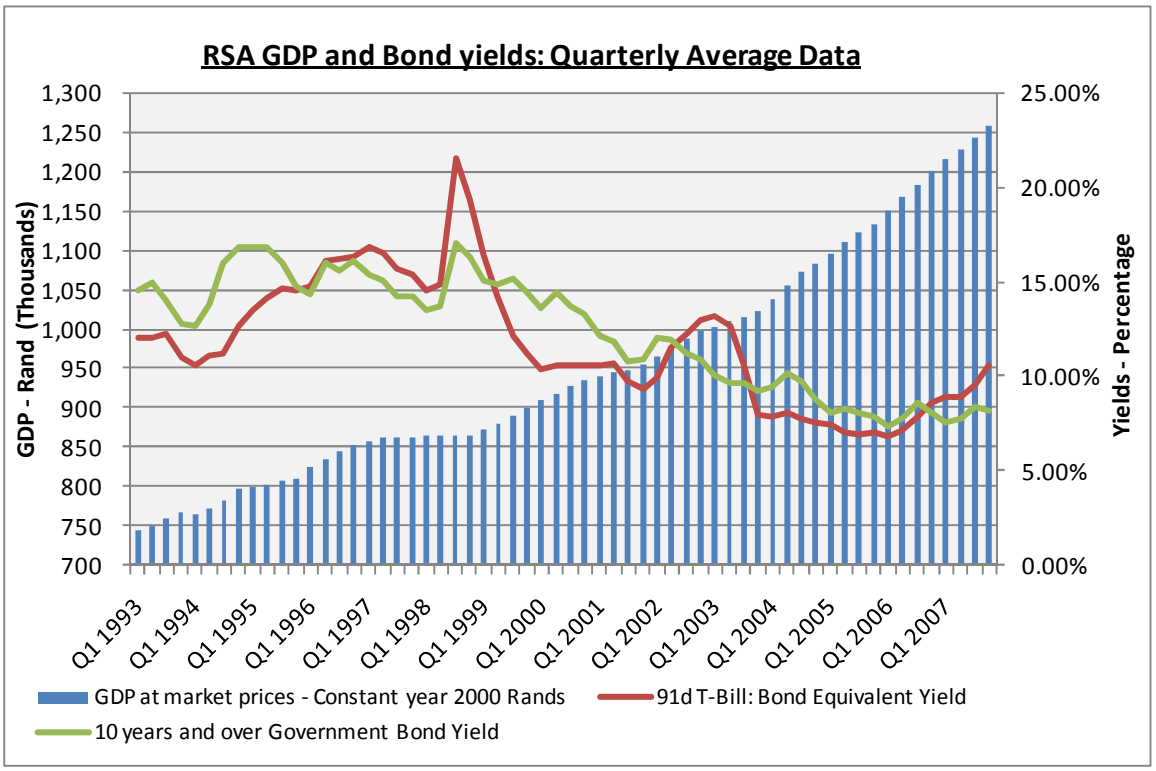


Figure 4: RSA GDP plotted against the short and long yields.

Visually, it would appear that during the late 1990's, during a period of flat GDP growth, the short-yield was higher than the 10-year yield. Whilst at most other times the 10 year bond's yield is higher than the T-Bill rate.

The JSE Securities Exchange publishes index values on a daily basis. The All Share Index, index value is shown in Figure 5 below:

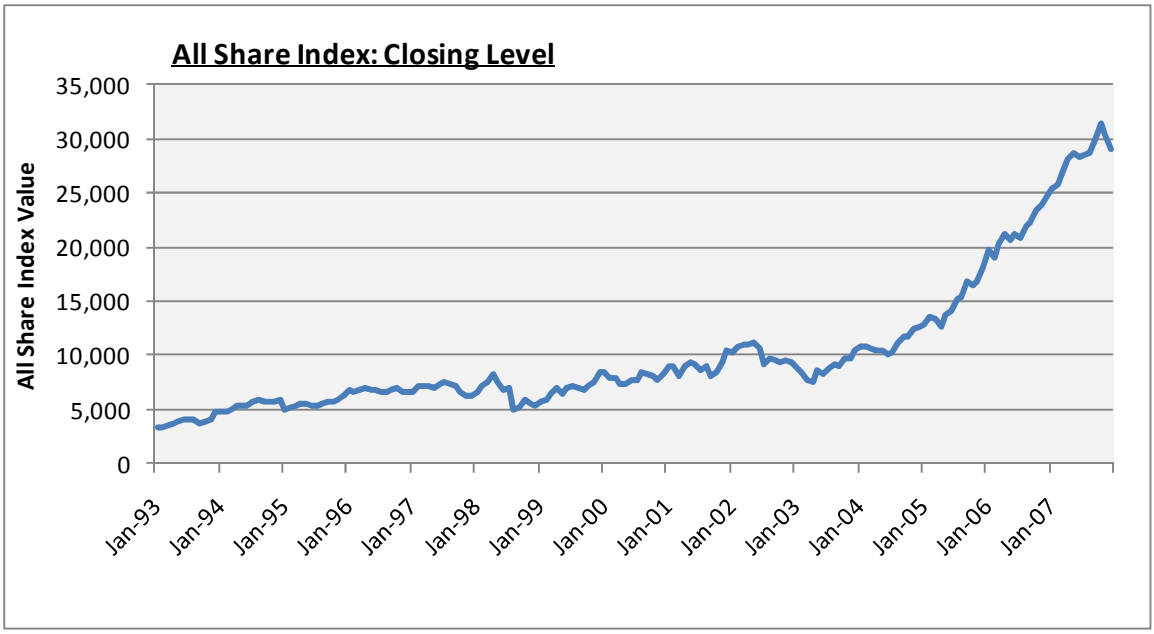


Figure 5: All Share Index Value

It almost seems that there were two periods. The index increased steadily until the early 2000's – with a large drop off in the late 1990's. However, from the early 2000's, the rate of increase in the index is much stronger.

The conclusions that can be drawn from the brief analysis of the raw data are:

1. The GDP grew at a seemingly consistent rate.
2. There was a slow-down in the late 1990's that coincided with a strong spike in yields. During this period the yield curve was inverted. This observation is expected in light of the literature's assertions that inversions of the yield curve signal economic slowdowns (Estrella and Hardouvelis 1991).
3. Whilst the growth in GDP seems to have been relatively stable, the same cannot be said of the level of the yields on bonds and T-Bills. These were very volatile during the period under review.
4. The stock market appears to have been in two different modes. There is evidence of steady growth at the start of the period, with the expected

drop off in the late 1990's. However the rate of change of the ALSI index changes remarkably from the early 2000's on.

5. There is evidence that the behaviours predicted in the literature are observable in the data.

As discussed under each hypothesis, the principle data analysis method employed was multiple linear regression analysis and the associated hypothesis tests.

The data gathered had to be transformed into the correct format for use in equation 1:

1. $Y_{t,\ t+k}$ is the dependant variable in the regressions. It is the change in GDP between quarter t and t+k. Statistics SA publishes the GDP in constant Rands (refer to Appendix A), but $Y_{t,t+k}$, had to be calculated from the raw data.
2. SPREAD is one of the independent variables in equation 1. It was calculated as the difference between a long term instrument's yield and a short term instrument's yield. The yield data required was the average quarterly rate as opposed to point-in-time rates as suggested by the literature. These data sets were calculated from the point in time data sets published by the South African Reserve Bank.
3. The Reserve bank publishes the discount Rate on the 91 day T-Bill. This had to be converted into a Bond Equivalent yield by the following formula:

   (4) $$\text{Bond Equivalent Yield} = \frac{365}{\left(\frac{360}{\text{discount rate}} - \text{days to maturity}\right)}$$

   (Mortgage-x.com 2008)

4. The All Share Index data also had to be converted to average quarterly change in the All Share index.

The change in GDP, k-quarters ahead is shown below for selected values of k:

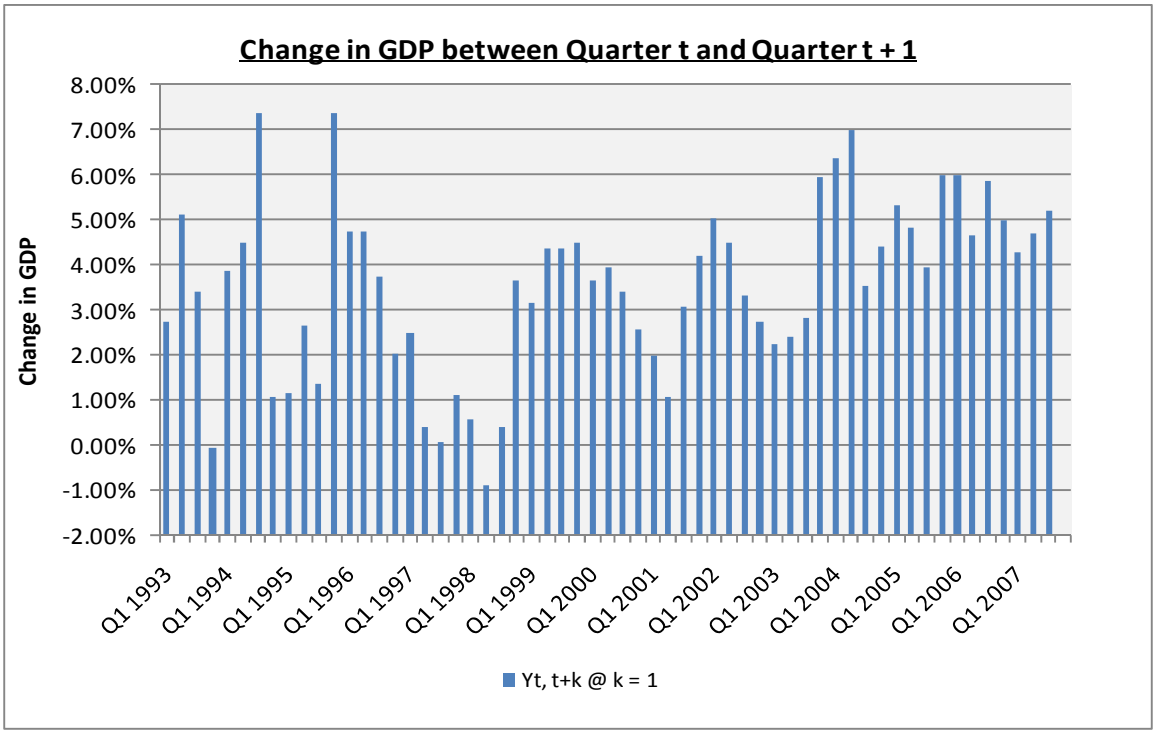


Figure 6: Change in quarterly average RSA GDP, one quarter ahead.

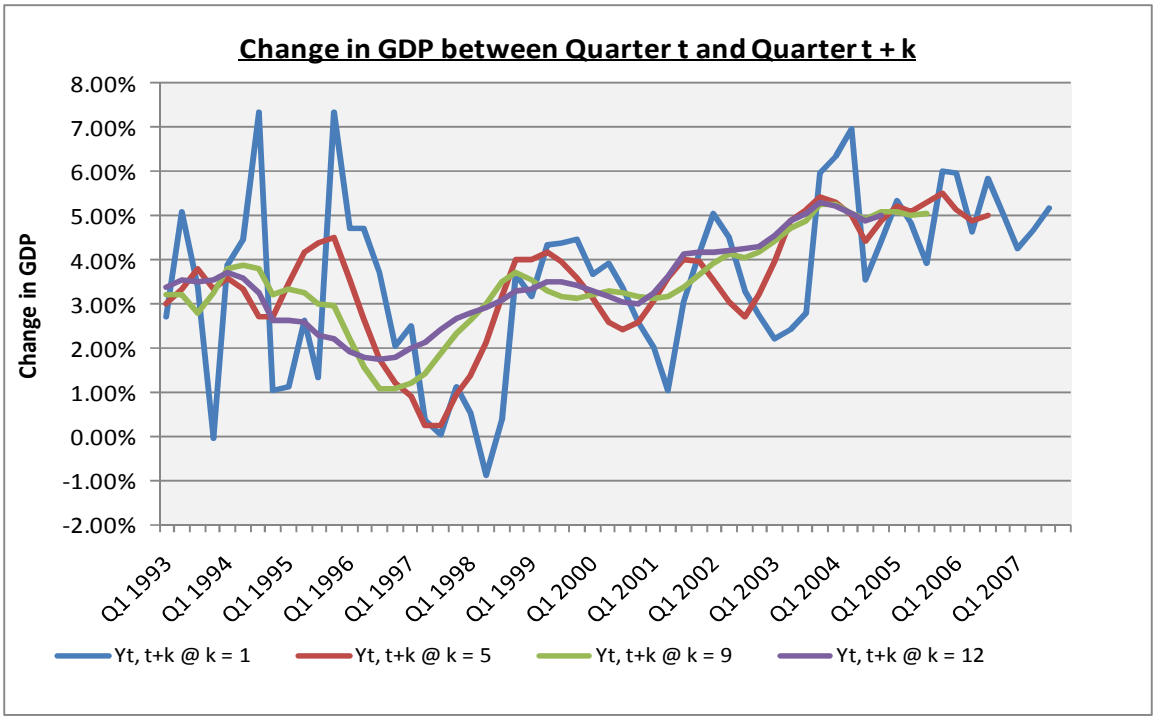


Figure 7: Change in quarterly average RSA GDP, k quarters ahead.

The change in GDP highlights some of the observations made previously. The drop off in the rate of GDP growth in the late 1990's is shown quite clearly by the 1 quarter ahead data. The graph also shows that the further apart the quarters used to construct the variable $Y_{t,t+k}$ are, the lower the observable variability seems to be. The statistics shown below reinforce this observation:

Table 2: Statistics: Change in RSA GDP, k quarters ahead.

	Yt, t+k @ k =					
	1	2	3	4	5	6
Min	-0.88%	-0.25%	0.02%	0.22%	0.25%	0.27%
Mean	3.56%	3.55%	3.53%	3.52%	3.52%	3.51%
Max	7.37%	6.66%	6.43%	5.70%	5.50%	5.43%
Std. Dev.	1.92%	1.68%	1.54%	1.43%	1.33%	1.26%
CoV	0.54	0.47	0.44	0.41	0.38	0.36
	7	8	9	10	11	12
Min	0.59%	0.77%	1.09%	1.30%	1.52%	1.76%
Mean	3.50%	3.47%	3.45%	3.44%	3.43%	3.42%
Max	5.34%	5.20%	5.26%	5.33%	5.27%	5.32%
Std. Dev.	1.20%	1.15%	1.10%	1.06%	1.02%	0.98%
CoV	0.34	0.33	0.32	0.31	0.30	0.29

The average change in GDP stays very much the same, no matter how large the value of k is. This indicates reversion around a trend.

The SPREAD between the RSA Government bond yield and the 91-Day T-Bill bond equivalent yield is shown below for the available values of the Government Bond term:

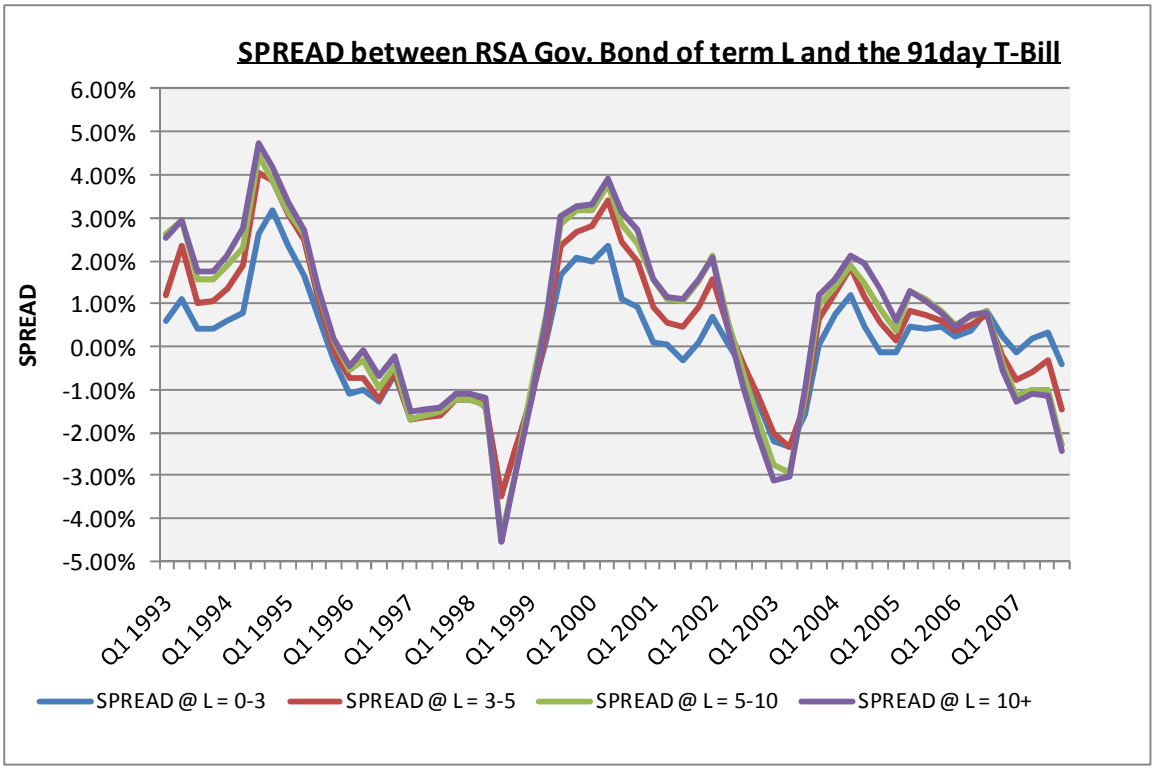


Figure 8: SPREADs between the 91-Day T-Bill BEY and the RSA Government Bond of different terms.

The SPREAD exhibits the expected behaviour. In periods of low GDP growth – such as the late 1990's – the difference between the long-yield and the short-yield reduces, indicating a flattening of the yield curve. However in the expansionary periods – such as the early 2000's – the SPREAD values are much higher, which indicates an upward sloping yield curve.

There does not seem to be a large difference between the different sets of SPREAD values, except that the coefficient's of variance decline for the SPREAD calculated using the longer bond's yields. This implies a lower variability the wider the SPREAD, which is in-line with literature's suggestion that SPREAD's be calculated using the maximal difference in yield terms (Ang, Piazzesi and Wei 2005). The coefficient of variance is also much higher than that seen for the change in GDP previously.

Table 3: Statistics: SPREADs between the 91-Day T-Bill BEY and the RSA Government Bond of different terms.

	SPREAD @ L =			
	0-3	3-5	5-10	10+
Min	-3.46%	-3.47%	-4.39%	-4.53%
Mean	0.05%	0.39%	0.55%	0.62%
Max	3.18%	4.06%	4.45%	4.73%
Std. Dev.	1.31%	1.65%	1.93%	2.03%
CoV	27.89	4.19	3.50	3.24

The quarterly average change in the T-Bill bond equivalent yield is shown below.

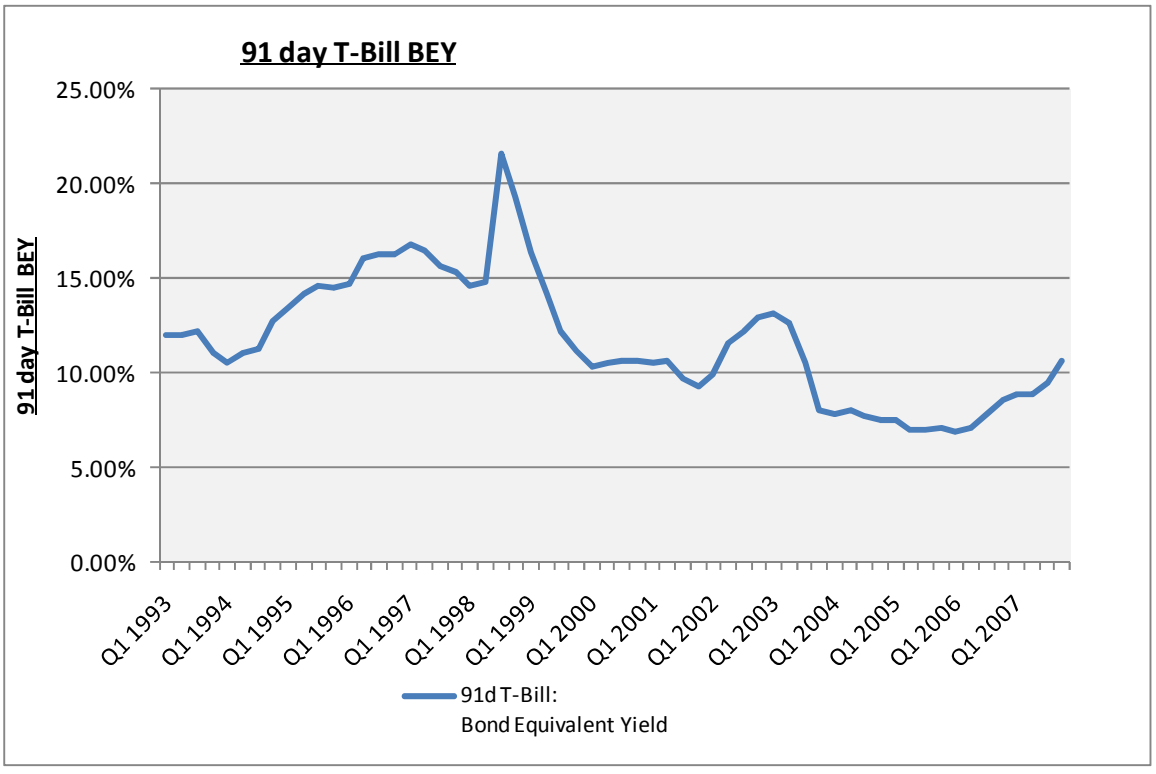


Figure 9: 91 day RSA T-Bill, Bond equivalent yield.

The T-Bill rate exhibits the expected behaviour. In the late 90's the interest rate was very high – coinciding with the previously mentioned economic slowdown. One can clearly see though that the T-Bill rate has been declining on average. In addition, the T-Bill rate seems less variable than the SPREAD.

The statistics below seem to support this finding. The coefficient of variation of the T-Bill BEY is 0.29, which is very low compared to those calculated for the SPREAD.

Table 4: Statistics: 91-Day T-Bill BEY.

	91d T-Bill: Bond Equivalent Yield
Min	6.86%
Mean	11.71%
Max	21.58%
Std. Dev.	3.34%
CoV	0.29

The quarterly average change in the All Share Index is shown below.

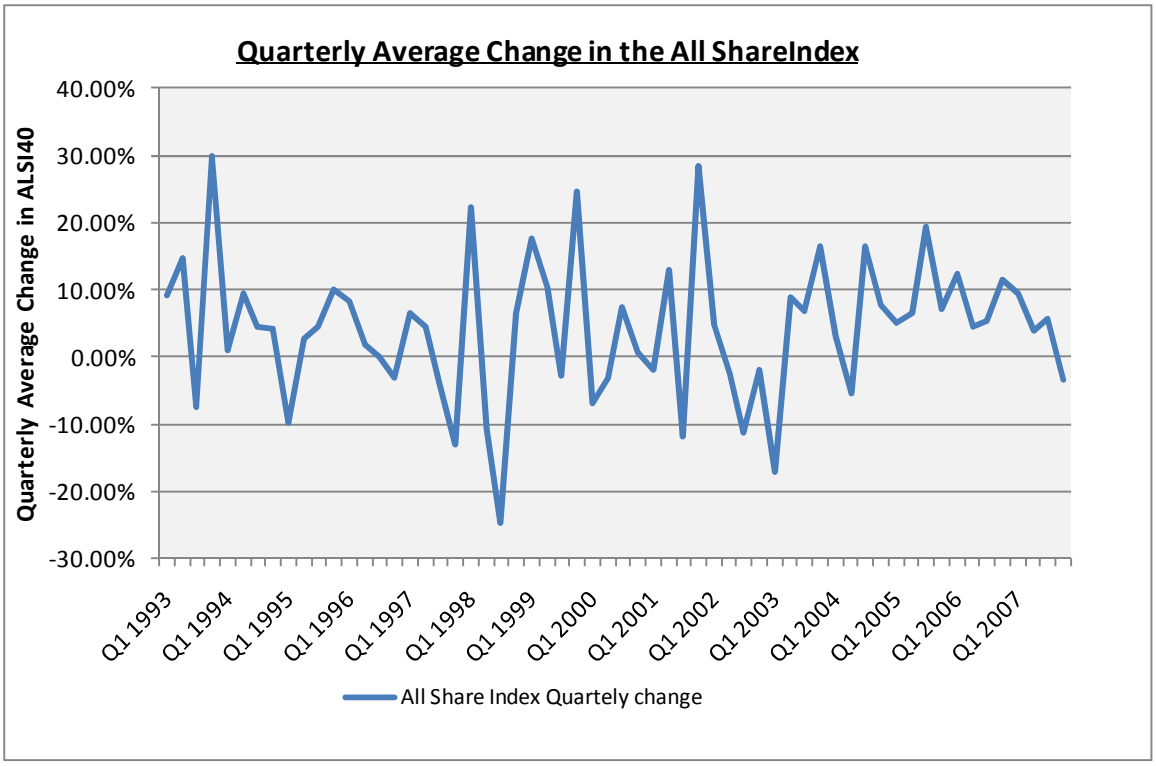


Figure 10: Quarterly average change in the JSE All Share Index

The data shows that the change in ALSI has been variable, but the average growth rate has been consistent over the period. There were no extended periods of growth, or clearly discernable trends.

Analysis of the statistics reveals that the coefficient of variance is much higher than that observed for the T-Bill BEY.

Table 5: Statistics: Quarterly average change in the ALSI index.

	ALSI
Min	-24.70%
Mean	4.24%
Max	29.79%
Std. Dev.	10.54%
CoV	2.49

4.3 Data analysis

Since regression analysis was applied, the outputs had to be tested to ensure that the regression assumptions were not violated. Albright, Winston and Zappe (2003) proposed the following tests (refer to the section 6 of the assumptions section):

1. To test for heteroskedasticity, a scatter plot of the response variable versus the explanatory variable was drawn and inspected for a fan-shape or other evidence of non constant error variance.
2. The errors were tested for normality using a Shapiro-Wilk test.

The Newey-West method, as proposed by Estrella and Hardouvelis (1991) and McMillan (2002), was used to adjust the errors in all the cases as the assumptions were violated.

CHAPTER 5: RESULTS AND DISCUSSION

5.1 Hypothesis 1

Burnett (2001) proposed that the spread between the 3 month T-bill yield and the 10 year RSA bond yield had predictive power over the South African GDP, 4 quarters ahead. Hypothesis 1 proposed to test whether the yield curve had predictive power over the South African economy under these criteria, in the new study period.

Linear regression analysis revealed that the following equation best described the data in question.

(5) $Y_{t,\,t+4} = 0.034 + 0.141 \cdot SPREAD_t$

$(15.66)^1 \quad (1.48)$

The coefficient of SPREAD is positive. This is in line with the literature prediction that a yield curve with an upward slope (that is that the long yield is higher than the short yield) indicates an increasing GDP. The relevant t values at the 5% significance level are shown below the coefficients.

The plot of model prediction against the actual change in GDP and the ANOVA analysis results are presented below.

[1] The bracketed figures below the coefficient value indicate the t value calculated at the 5% significance level.

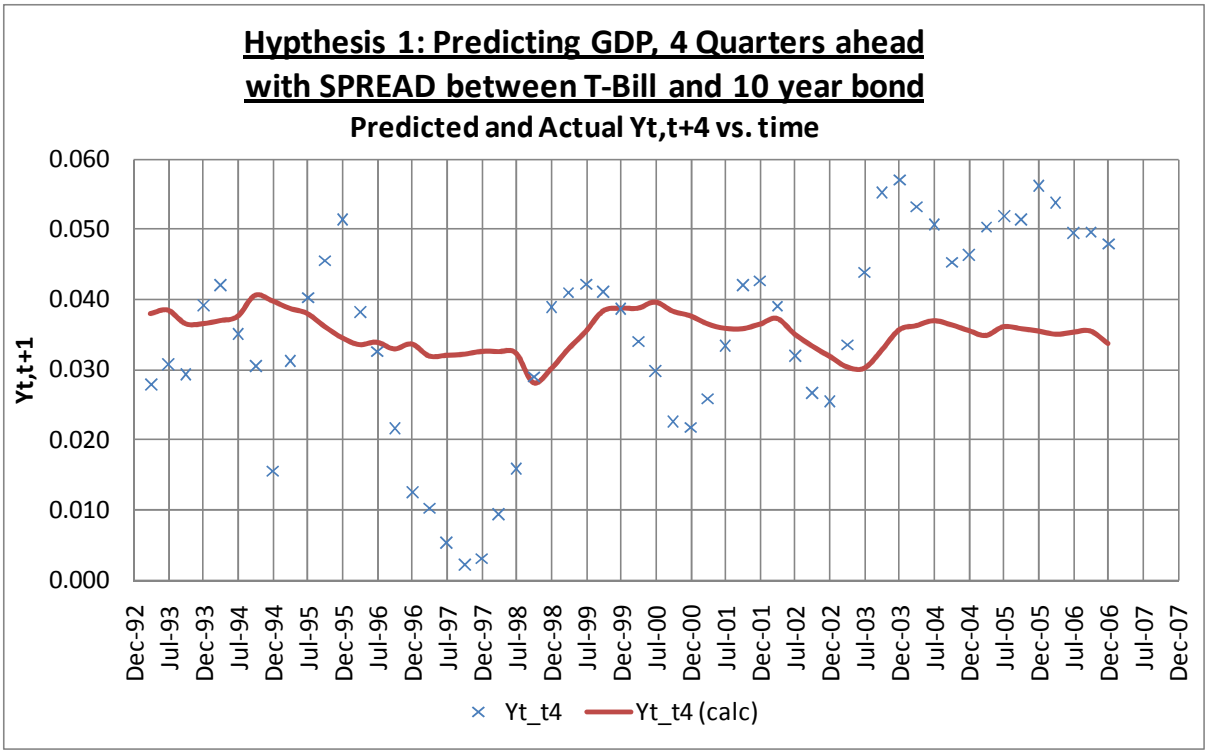


Figure 11: Hypothesis 1 results

Table 6: Hypothesis 1 results – Regression results for $Y_{t,\,t+4}=0.034+0.14\cdot SPREAD_t$.[2]

k	α_0	α_1	Adjusted R^2	Newey-West [95% Conf. Interval]		OLS [95% Conf. Interval]	
4	0.0342	0.1410	0.0184	-0.0504	0.3324	-0.0575	0.3395
(2.005)	(15.66)	(1.48)					

[2] The values in parentheses below the coefficients show the t-statistic associated with the coefficient, while the value in parenthesis in the first column is the critical value of t against which the hypothesis test at the 5% significance level is performed. Note that the confidence intervals are for the coefficient of SPREAD, not for the model, as are the t values. The confidence intervals shown are calculated via the Newey-West Method and via the Ordinary Least Squares method.

The model does not fit the data well. This observation is supported by the fact that the coefficient of determination after adjustment for degrees of freedom is only 0.0184, implying that this equation can explain only 1.8% of the actual data. The ANOVA analysis utilising the adjusted standard errors calculated via the Newey-West method further supports this finding. The hypothesis being tested is whether the coefficient of spread has significance to the model at the 5% level. The critical t value at this level is 2.005. Since the actual t value is lower than the critical value, the null hypothesis cannot be rejected and one is forced to conclude that the spread between the 3-month T-bill yield and the 10 year RSA bond yield has no explanatory power over the RSA GDP 4 quarters hence.

Plots of the residuals generated by a standard ordinary least squares model are shown below, to support the assertion that the Newey-West methodology is required.

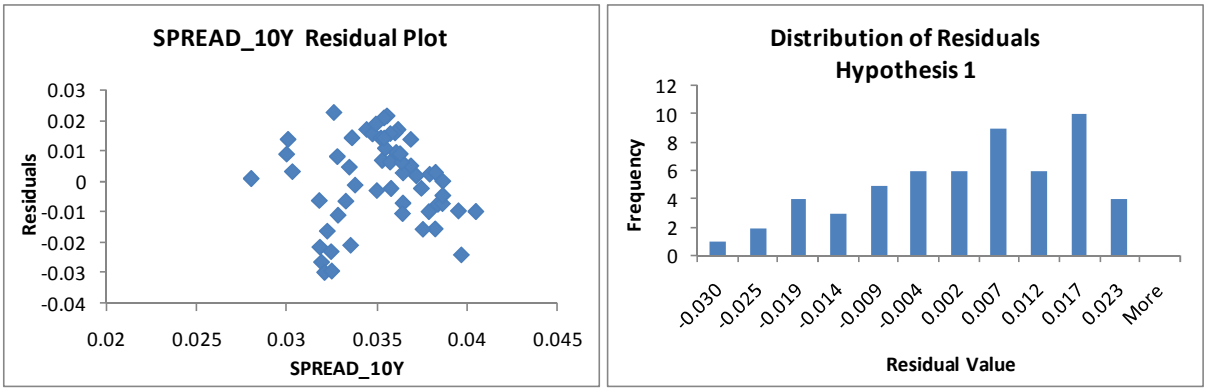


Figure 12: Hypothesis 1 – Analysis of residuals

OLS regression requires that the standard deviation of the response variables is constant for all values of the explanatory variables and that the response variables are normally distributed (Albright, Winston and Zappe 2003:621). Visual inspection of the residual plot shows no evidence of non-constant error variance. However, the residuals do not appear to be normally distributed, as the histogram is skewed to the high end.

A Shapiro-Wilk z-test indicates that the probability of the residuals being normally distributed is 92.3%, below the 95% hurdle rate above which it would be possible to conclude that the residuals are normally distributed.

Table 7: Shapiro-Wilk test for normality on the residuals generated in Hypothesis 1

	Shapiro-Wilk W test for normal data				
Variable	Obs	W	V	z	Prob>z
residuals	56	0. 96234	1. 937	1. 420	0. 07787

This result was expected, and provides validation for the need to transform the standard errors via the Newey-West methodology to avoid overstating the significance of the regression results.

5.2 Hypothesis 2

Hypothesis 2 proposed to investigate how far into the future a regression model based on the spread between the 3-month T-bill yield and the 10 year RSA bond yield has predictive power over the South African GDP. Table 8 summarises the relevant regression data.

Table 8: Hypothesis 2 results – $Y_{t,t+k} = \alpha_0 + \alpha_1 \cdot SPREAD_t$.[3]

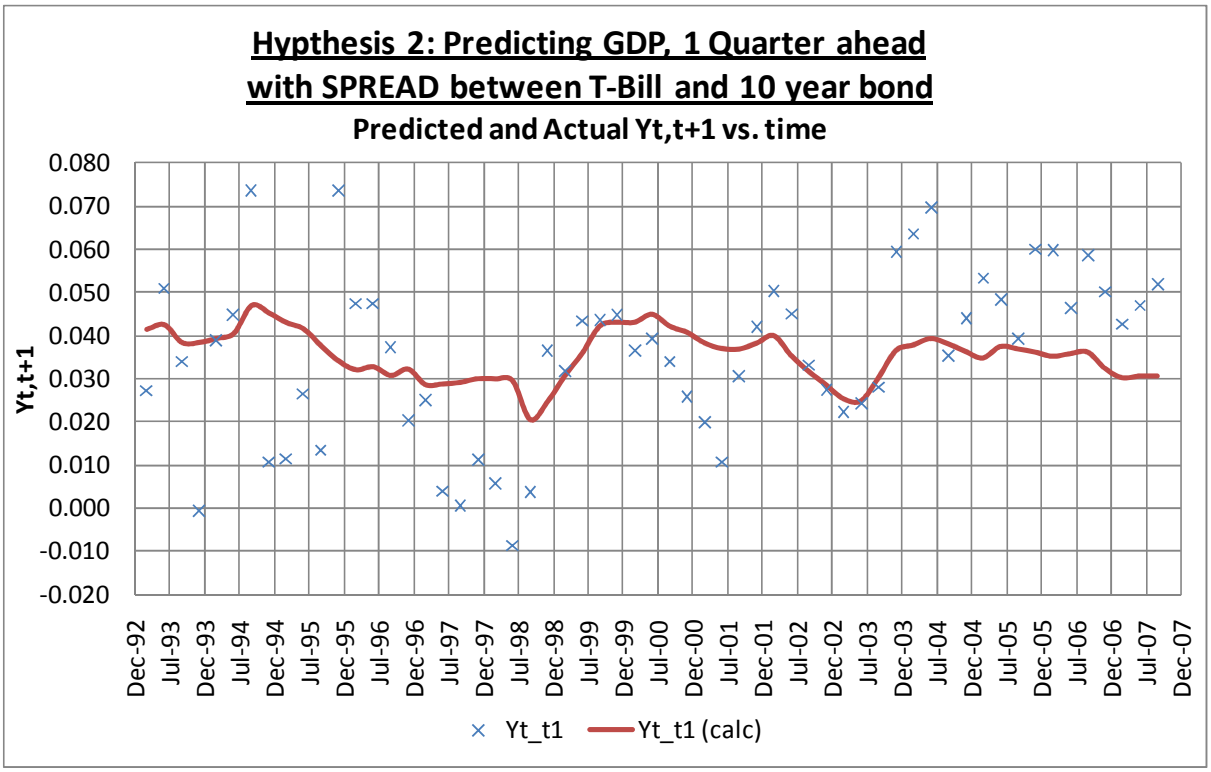
k	α_0	α_1	Adjusted R^2	Newey-West [95% Conf. Interval]		OLS [95% Conf. Interval]	
1	0.0337	0.3004	0.0741	0.0523	0.5485	0.0471	0.5537
(2.002)	(13.77)	(2.420)					
2	0.0340	0.2384	0.0578	0.0356	0.4412	0.0132	0.4636
(2.003)	(15.03)	(2.350)					
3	0.0341	0.1824	0.0349	-0.0123	0.3772	-0.0278	0.3927
(2.004)	(15.47)	(1.880)					
4	0.0342	0.1410	0.0184	-0.0504	0.3324	-0.0575	0.3395
(2.005)	(15.66)	(1.480)					

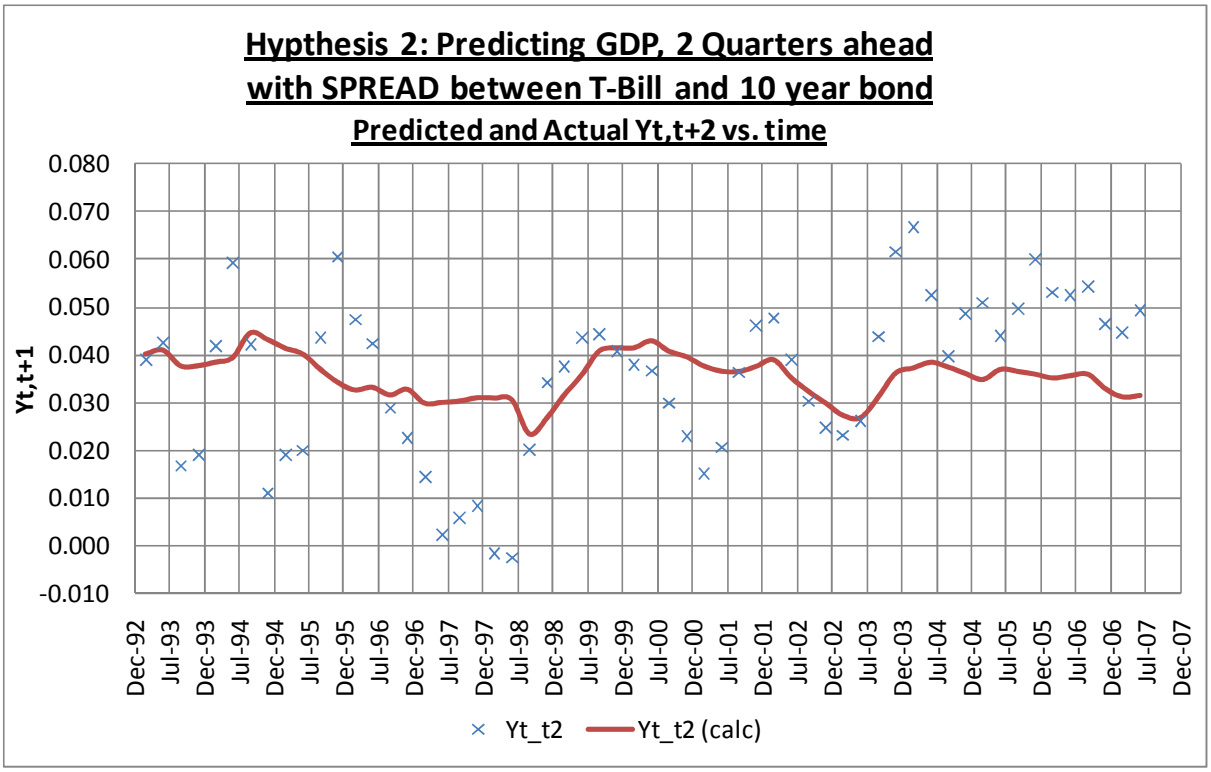
The SPREAD between the 3-month T-bill yield and the 10 year RSA bond yield has predictive power over the South African GDP up to 2 quarters into the future. At longer forecasting horizons, the t values calculated for the coefficient of SPREAD are not significantly different from zero at the 5% level.

The model is weak, as only 5.8% of the variance is explained by the 2 quarter ahead model. The fit of the 1 and 2 quarter ahead models are shown below in Figure 13.

[3] The values in parentheses below the coefficients show the t-statistic associated with the coefficient, while the value in parenthesis in the first column is the critical value of t against which the hypothesis test at the 5% significance level is performed. Note that the confidence intervals are for the coefficient of SPREAD, not for the model, as are the t values. The confidence intervals shown are calculated via the Newey-West Method and via the Ordinary Least Squares method.

Figure 13: Hypothesis 2 results





As expected, the forecasting ability of the regression model drops the further forward one attempts to project, as evidenced by the decreasing value of R^2 as k increases. As a result there is no need to test forecasts further into the future than 4 quarters, based on the results above.

5.3 Hypothesis 3

Hypothesis 3 proposes to investigate whether a regression model based on a spread other than that between the 3-month T-bill yield and the 10 year RSA bond yield has predictive power over the South African GDP. Table 9 summarises the relevant statistical data[4].

[4] The values in parentheses below the coefficients show the t-statistic associated with the coefficient, while the value in parenthesis in the first column is the critical value of t against which the hypothesis test at the 5% significance level is performed. Note that the confidence intervals are for the coefficient of SPREAD, not for the model, as are the t values. The confidence intervals shown are calculated via the Newey-West Method and via the Ordinary Least Squares method.

Table 9: Hypothesis 3 results $Y_{t,t+k} = \alpha_0 + \alpha_1 \cdot SPREAD_t$

k	SPREAD between T-Bill and Bond of x years	α_0	α_1	Adjusted R^2	Newey-West [95% Conf. Interval]		OLS [95% Conf. Interval]	
1	3	0.0353	0.4949	0.1013	0.0783	0.9114	0.1339	0.8559
(2.002)		(15.05)	(2.380)					
1	5	0.0340	0.3609	0.0807	0.0449	0.6769	0.0681	0.6537
(2.002)		(14.18)	(2.290)					
1	10	0.0337	0.3004	0.0741	0.0523	0.5485	0.0471	0.5537
(2.002)		(13.77)	(2.420)					
1	25	0.0337	0.2730	0.0653	0.0367	0.5093	0.0298	0.5161
(2.002)		(13.64)	(2.310)					
2	3	0.0353	0.3630	0.0670	0.0193	0.7067	0.0408	0.6853
(2.003)		(16.62)	(2.120)					
2	5	0.0343	0.2674	0.0535	0.0055	0.5293	0.0067	0.5281
(2.003)		(15.42)	(2.050)					
2	10	0.0340	0.2384	0.0578	0.0356	0.4412	0.0132	0.4636
(2.003)		(15.03)	(2.350)					
2	25	0.0340	0.2157	0.0499	0.0247	0.4067	-0.0005	0.4320
(2.003)		(14.94)	(2.260)					
3	3	0.0352	0.2700	0.0387	-0.0396	0.5796	-0.0298	0.5698
(2.004)		(17.56)	(1.750)					
3	5	0.0344	0.1979	0.0289	-0.0465	0.4423	-0.0449	0.4407
(2.004)		(15.92)	(1.620)					
3	10	0.0341	0.1824	0.0349	-0.0123	0.3772	-0.0278	0.3927
(2.004)		(15.47)	(1.880)					
3	25	0.0341	0.1626	0.0278	-0.0195	0.3446	-0.0394	0.3645
(2.004)		(15.37)	(1.790)					

The data presented in Table 9 shows that the yield curve displays weak predictive power over the South African economy, as evidenced by the uniformly low coefficient of determination values for all the models. Models based on various SPREADs – utilising the 3, 5, 10 and 25 year bond yield against the 3-month T-bill – are only useful in explaining GDP growth 2 quarter ahead. t-Tests carried out on all SPREAD coefficients for models predicting 3 quarters ahead, fail the 95% confidence test. The highest adjusted coefficient of determination value is achieved using a SPREAD between the 3-month T-Bill yield and the 3-Year Government Bond Yield. Even then, this SPREAD can only account for 10.1% of the observed variance in $Y_{t,t+1}$, one quarter ahead.

This set of tests verifies the previous finding that the forecasting ability of the regression model drops the further forward one attempts to project, as evidenced by the decreasing value of R^2 as k increases. Analysis of the R^2 values reveals that the SPREAD variable constructed using the 3 year bond yield appears to be the most powerful predictive variable.

5.4 Hypothesis 4

Hypothesis 4 was intended as a test to check where another variable should be incorporated into the best yield curve model, thereby improving its accuracy.

SPREAD has been shown to have limited predictive power. The best model utilised the SPREAD between the T-Bill rate and the 3 Year Bond Yield to predict the change in the South African GDP, one quarter ahead. This model was augmented with the quarterly average T-Bill rate and the quarterly average change in the JSE All Share Index. The results of the Newey-West regression on this extended dataset and ANOVA analysis are shown below in Table 10:

Table 10: ANOVA Results, initial test of Hypothesis 4[5].

	Coef.	Std. Err.	t	Newey-West [95% Conf. Interval]	
$SPREAD_t$	0.1214	0.2049	0.5900	-0.2936	0.53641
TBillRate	-0.2716	0.0820	-3.5700	-0.4238	-0.1193
ALSI	0.0104	0.0245	0.4100	-0.0411	0.0619
Const.	0.0669	0.0091	7.8300	0.0498	0.0840
Adjusted R^2 = 0.2602					
$T_{critical, 5\%}$ = 2004					

This model is 100% more effective now that the additional variables have been added. The adjusted coefficient of determination indicates that the extended model can explain 26% of the variance. Without the TBillRate and the ALSI, the $SPREAD_t$ alone could only explain 11% of the 1 quarter ahead GDP.

However, in this case, it is clear that the variables ALSI and $SPREAD_t$ should actually be excluded from the model as the t values that the ANOVA ascribes to these variables' coefficients have absolute values smaller than the critical value of t – indicating that the coefficient value is not statistically significantly different enough to zero that one could reject the null hypothesis for these coefficients. This implies a model based solely on the TBillRate.

SPREAD's between the TBillRate and the 5, 10 and 25 year bond yield had previously been shown to have significant prediction ability over the 1 quarter ahead GDP. As a result, extensions of these models were tested to confirm if there was a model of the following form that better fitted the 1 quarter ahead GDP data:

$$Y_{t,t+k} = \alpha_0 + \alpha_1 \cdot SPREAD_t + \beta_1 \cdot TBillRate + \beta_2 \cdot ALSI$$

[5] Note that the confidence intervals are for the coefficient of SPREAD, not for the model, as are the t values.

Table 11: Hypothesis 4 results

$$Y_{t,t+k} = \alpha_0 + \alpha_1 \cdot SPREAD_t + \beta_1 \cdot TBillrate + \beta_2 \cdot ALSI$$ [6]

k	$SPREAD_t$ between T-Bill and Bond of x years		Coef.	Adj. R^2	t value	t_{crit}	Newey-West [95% Conf. Interval]		OLS [95% Conf. Interval]	
1	3 Years	α_0	0.0669	0.2602	7.8300	2.0040	0.0498	0.0840	0.0474	0.0864
1	3 Years	α_1	0.1214		0.5900		-0.2936	0.5364	-0.2620	0.5048
1	3 Years	β_1	-0.2716		-3.5700		-0.4238	-0.1193	-0.4280	-0.1152
1	3 Years	β_2	0.0104		0.4100		-0.0411	0.0619	-0.0329	0.0537
1	5 Years	α_0	0.0672	0.2591	8.0100	2.0040	0.0504	0.0840	0.0477	0.0867
1	5 Years	α_1	0.0842		0.5400		-0.2286	0.3971	-0.2139	0.3824
1	5 Years	β_1	-0.2768		-3.8200		-0.4221	-0.1315	-0.4290	-0.1245
1	5 Years	β_2	0.0106		0.4100		-0.0410	0.0621	-0.0328	0.0539
1	10 Years	α_0	0.0678	0.2574	8.2800	2.0040	0.0514	0.0842	0.0483	0.0873
1	10 Years	α_1	0.0569		0.4600		-0.1918	0.3055	-0.2008	0.3146
1	10 Years	β_1	-0.2816		-3.9700		-0.4237	-0.1395	-0.4327	-0.1305
1	10 Years	β_2	0.0100		0.3900		-0.0418	0.0618	-0.0335	0.0535
1	25 Years	α_0	0.0682	0.2565	8.3900	2.0040	0.0519	0.0845	0.0488	0.0876
1	25 Years	α_1	0.0436		0.3700		-0.1901	0.2774	-0.2010	0.2883
1	25 Years	β_1	-0.2848		-4.0400		-0.4262	-0.1435	-0.4349	-0.1347
1	25 Years	β_2	0.0101		0.3900		-0.0418	0.0620	-0.0334	0.0537
2	3 Years	α_0	0.0673	0.3241	9.5700	2.0049	0.0532	0.0813	0.0508	0.0837
2	3 Years	α_1	-0.0314		-0.2200		-0.3159	0.2532	-0.3524	0.2897
2	3 Years	β_1	-0.2773		-4.4700		-0.4018	-0.1528	-0.4087	-0.1459
2	3 Years	β_2	0.0202		0.9500		-0.0225	0.0629	-0.0161	0.0565

[6] Note that the confidence intervals are for the regression coefficients, not for the model, as are the t values.

k	$SPREAD_t$ between T-Bill and Bond of x years		Coef.	Adj. R^2	t value	t_{crit}	Newey-West [95% Conf. Interval]		OLS [95% Conf. Interval]	
2	5 Years	α_0	0.0672	0.3240	9.9300	2.0049	0.0537	0.0808	0.0507	0.0838
2	5 Years	α_1	-0.0236		-0.2200		-0.2378	0.1907	-0.2747	0.2276
2	5 Years	β_1	-0.2765		-4.6200		-0.3965	-0.1564	-0.4049	-0.1480
2	5 Years	β_2	0.0202		0.9500		-0.0226	0.0629	-0.0161	0.0564
2	10 Years	α_0	0.0673	0.3241	10.1800	2.0049	0.0540	0.0805	0.0507	0.0838
2	10 Years	α_1	-0.0218		-0.2400		-0.2018	0.1582	-0.2405	0.1968
2	10 Years	β_1	-0.2767		-4.7000		-0.3948	-0.1585	-0.4045	-0.1489
2	10 Years	β_2	0.0204		0.9500		-0.0226	0.0634	-0.0160	0.0568
2	25 Years	α_0	0.0676	0.3246	10.2400	2.0049	0.0544	0.0809	0.0512	0.0841
2	25 Years	α_1	-0.0297		-0.3500		-0.1987	0.1392	-0.2373	0.1779
2	25 Years	β_1	-0.2788		-4.7200		-0.3972	-0.1604	-0.4056	-0.1520
2	25 Years	β_2	0.0206		0.9600		-0.0225	0.0636	-0.0158	0.0569

The results of this test – presented in Table 11 – show that the coefficients of both SPREAD and ALSI are not significantly different enough to zero to justify including them in any model attempting to predict either the 1 or 2 quarter ahead GDP, whist the T- Bill rate is included as variable.

SPREAD's constructed at various long bond yields are known to have no significant predictive ability over the GDP further into the future than two quarters. It is thus safe to assume that any model attempting to predict the future South African change in GDP, that includes the T-Bill rate as a variable, should not include the SPREAD as a variable. The same cannot be said for the change in ALSI, even though the tests above indicate that this possibility is unlikely.

As a result it is necessary to test whether the quarterly average T-Bill yield or the quarterly average change in the ALSI is able to predict the future GDP and how far into the future that predictive power extends in order to satisfy the initial expectations of hypothesis 4.

The following model was fitted to the data:

$$Y_{t,t+k} = \alpha_0 + \beta_1 \cdot \text{TBillRate} + \beta_2 \cdot \text{ALSI}$$

k, the forecasting horizon, was allowed to vary between 1 and 12 quarters ahead.

The results are presented below.

Table 12: Hypothesis 4 results for the model –
$Y_{t,t+k} = \alpha_0 + \beta_1 \cdot TBillRate + \beta_2 \cdot ALSI$[7]

k		Coef.	Adj. R^2	t value	t_{crit}	Newey-West [95% Conf. Interval]		OLS [95% Conf. Interval]	
1	α_0	0.0698	0.2681	8.9500	2.00324	0.0542	0.0854	0.0527	0.0869
1	β_1	-0.2960		-4.4100		-0.4304	-0.1615	-0.4313	-0.1606
1	β_2	0.0108		0.4200		-0.0405	0.0621	-0.0322	0.0538
2	α_0	0.0665	0.3359	9.4500	2.00404	0.0524	0.0806	0.0521	0.0809
2	β_1	-0.2710		-4.3400		-0.3961	-0.1459	-0.3844	-0.1576
2	β_2	0.0201		0.9500		-0.0222	0.0624	-0.0158	0.0560
3	α_0	0.0645	0.3754	9.5700	2.00488	0.0510	0.0780	0.0516	0.0774
3	β_1	-0.2553		-4.1900		-0.3775	-0.1331	-0.3568	-0.1538
3	β_2	0.0222		1.1700		-0.0158	0.0602	-0.0097	0.0542
4	α_0	0.0630	0.3777	9.8200	2.00575	0.0501	0.0758	0.0509	0.0750
4	β_1	-0.2406		-4.0700		-0.3593	-0.1220	-0.3352	-0.1460
4	β_2	0.0187		1.2000		-0.0126	0.0501	-0.0109	0.0484
5	α_0	0.0631	0.3681	9.9500	2.00665	0.0504	0.0758	0.0517	0.0746
5	β_1	-0.2367		-4.0500		-0.3539	-0.1195	-0.3262	-0.1472
5	β_2	0.0075		0.5200		-0.0213	0.0364	-0.0204	0.0354
6	α_0	0.0634	0.3790	10.0000	2.00758	0.0507	0.0761	0.0524	0.0743
6	β_1	-0.2356		-4.0800		-0.3517	-0.1196	-0.3209	-0.1504
6	β_2	0.0007		0.0500		-0.0273	0.0287	-0.0255	0.0269
7	α_0	0.0638	0.4011	10.0200	2.00856	0.0510	0.0766	0.0533	0.0744
7	β_1	-0.2372		-4.1500		-0.3521	-0.1223	-0.3187	-0.1557
7	β_2	-0.0039		-0.3000		-0.0299	0.0221	-0.0284	0.0206

[7] Note that the confidence intervals are for the regression coefficients, not for the model, as are the t values.

k		Coef.	Adj. R^2	t value	t_{crit}	Newey-West [95% Conf. Interval]		OLS [95% Conf. Interval]	
8	α_0	0.0647	0.4307	10.2200	2.00958	0.0520	0.0774	0.0546	0.0748
8	β_1	-0.2424		-4.3200		-0.3552	-0.1297	-0.3200	-0.1648
8	β_2	-0.0101		-0.8200		-0.0346	0.0145	-0.0330	0.0129
9	α_0	0.0647	0.4609	10.4000	2.01063	0.0522	0.0773	0.0551	0.0744
9	β_1	-0.2427		-4.4600		-0.3521	-0.1332	-0.3168	-0.1685
9	β_2	-0.0091		-0.8100		-0.0316	0.0135	-0.0304	0.0123
10	α_0	0.0652	0.4904	5.8100	2.01174	0.0426	0.0878	0.0559	0.0744
10	β_1	-0.2448		-2.7700		-0.4223	-0.0672	-0.3155	-0.1741
10	β_2	-0.0111		-1.5700		-0.0252	0.0031	-0.0313	0.0091
11	α_0	0.0648	0.4908	11.2800	2.01290	0.0532	0.0763	0.0555	0.0740
11	β_1	-0.2408		-4.9700		-0.3384	-0.1432	-0.3112	-0.1704
11	β_2	-0.0093		-0.9600		-0.0288	0.0102	-0.0288	0.0102
12	α_0	0.0638	0.4703	11.2900	2.01410	0.0524	0.0752	0.0543	0.0733
12	β_1	-0.2322		-5.0100		-0.3257	-0.1388	-0.3037	-0.1608
12	β_2	-0.0086		-0.9300		-0.0273	0.0100	-0.0279	0.0106

The first encouraging result is that the R^2 values are quite high, indicating that the tested model is able to explain a significant portion of the underlying data (up to 49% of the data, 11 quarters ahead). The signs of the coefficients are also interesting. The model suggests that the GDP rises when the T-Bill rate drops and when the ALSI decreases. This observation is not unexpected in the case of the T-Bill rate. Central authorities routinely reduce the interest rate to positively influence the economy. However, it is most unexpected that a drop in the All Share Index would indicate economic strengthening. As Table 12 shows though, an ANOVA test indicates that the coefficient of the ALSI variable should not be included in the model. In all cases the t values are too low to reject the null hypothesis that the coefficient of ALSI is not zero.

It is thus clear that the only significant variable that should be included in a model attempting to predict the future change in South African GDP is the T-Bill rate. It remains to confirm how far into the future this predictive ability extends.

Table 13, below, shows the results when the following model is fitted to the available date:

$$Y_{t,t+k} = \alpha_0 + \beta_1 \cdot TBillRate$$

Table 13: Hypothesis 4 results for the model – $Y_{t,t+k} = \alpha_0 + \beta_1 \cdot TBillRate$[8]

k		Coef.	Adj. R^2	t	t_{crit}	Newey-West [95% Conf. Interval]		OLS [95% Conf. Interval]	
1	α_0	0.0715	0.2777	11.2400	2.0025	0.0588	0.0843	0.0560	0.0871
1	β_1	-0.3069		-5.2500		-0.4239	-0.1898	-0.4342	-0.1795
2	α_0	0.0698	0.3328	12.1400	2.0032	0.0583	0.0813	0.0566	0.0829
2	β_1	-0.2913		-5.3400		-0.4007	-0.1820	-0.3989	-0.1838
3	α_0	0.0682	0.3646	12.0500	2.0040	0.0568	0.0795	0.0563	0.0801
3	β_1	-0.2782		-5.1200		-0.3871	-0.1693	-0.3750	-0.1813
4	α_0	0.0660	0.3706	11.4000	2.0049	0.0544	0.0776	0.0549	0.0771
4	β_1	-0.2597		-4.6800		-0.3711	-0.1484	-0.3499	-0.1696
5	α_0	0.0643	0.3765	10.8600	2.0057	0.0524	0.0763	0.0538	0.0748
5	β_1	-0.2442		-4.3600		-0.3566	-0.1318	-0.3287	-0.1597
6	α_0	0.0635	0.3909	10.4900	2.0066	0.0513	0.0756	0.0535	0.0735
6	β_1	-0.2363		-4.1800		-0.3497	-0.1230	-0.3165	-0.1562
7	α_0	0.0632	0.4116	10.2700	2.0076	0.0508	0.0755	0.0536	0.0728
7	β_1	-0.2330		-4.1300		-0.3462	-0.1199	-0.3096	-0.1565

[8] Note that the confidence intervals are for the regression coefficients, not for the model, as are the t values.

k		Coef.	Adj. R^2	t	t_{crit}	Newey-West [95% Conf. Interval]		OLS [95% Conf. Interval]	
8	α_0	0.0631	0.4333	10.0100	2.0086	0.0504	0.0757	0.0537	0.0724
8	β_1	-0.2321		-4.1000		-0.3459	-0.1183	-0.3058	-0.1584
9	α_0	0.0632	0.4639	10.0400	2.0096	0.0506	0.0759	0.0543	0.0722
9	β_1	-0.2331		-4.1800		-0.3452	-0.1211	-0.3035	-0.1627
10	α_0	0.0635	0.4881	10.2200	2.0106	0.0510	0.0760	0.0548	0.0722
10	β_1	-0.2343		-4.3400		-0.3428	-0.1258	-0.3025	-0.1661
11	α_0	0.0633	0.4917	10.5200	2.0117	0.0512	0.0754	0.0546	0.0720
11	β_1	-0.2318		-4.5300		-0.3347	-0.1288	-0.2995	-0.1641
12	α_0	0.0624	0.4724	10.8400	2.0129	0.0508	0.0740	0.0535	0.0713
12	β_1	-0.2235		-4.6600		-0.3200	-0.1270	-0.2920	-0.1549

Table 13 shows that, in all the cases tested, the null hypothesis can be accepted. The quarterly average yield of the RSA 3 month T-Bill can thus be used to forecast the RSA GDP. This model is able to explain between 29% and 49% of the underlying data – depending on the forecast horizon.

The statistics again show that the T-bill rate is inversely correlated to the change in GDP. It is somewhat puzzling that the statistics indicate that the model becomes more powerful, the further into the future one tries to forecast, up to 11 months.

In order to explain this unexpected behaviour, the observations made earlier in regards the variable $Y_{t,t+k}$ (section 4.2) – particularly Figure 7 (reproduced below) are illuminating.

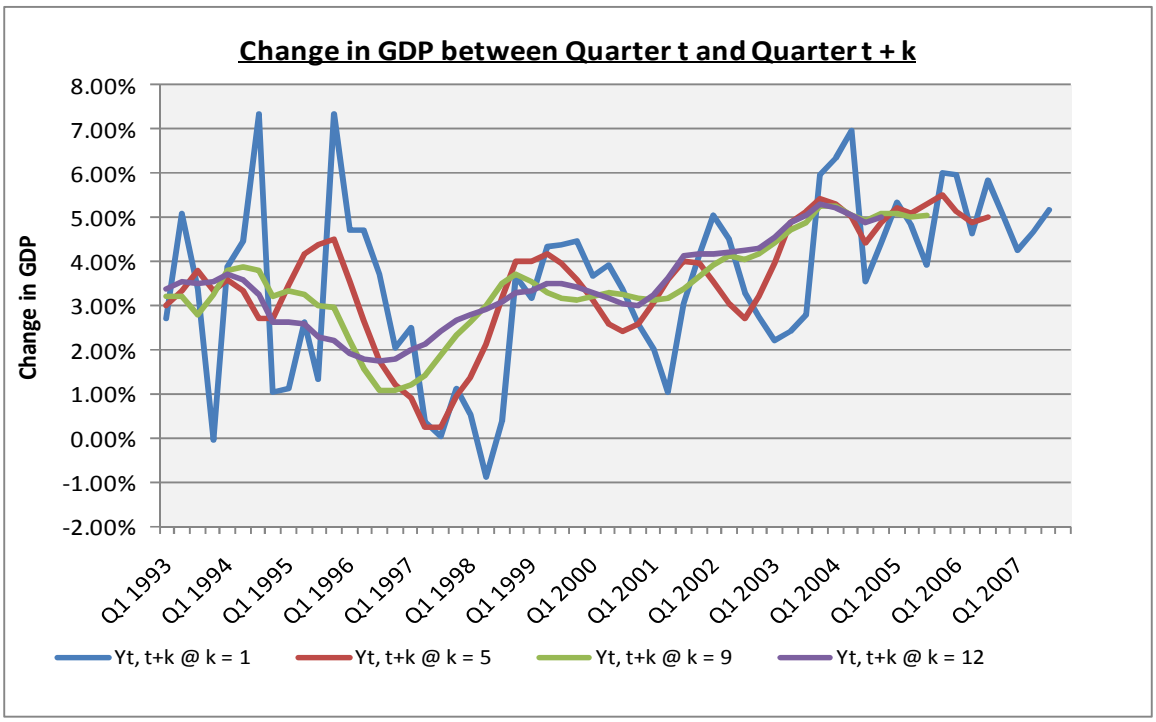


Figure 7: Change in quarterly average RSA GDP, k quarters ahead.

The statistics showed that the further apart the quarters used to construct the variable $Y_{t,t+k}$ are, the lower the observable variability is. The graphs below clearly show that, as the forecasting horizon increases, the regression equation is better able to fit the transformed variable.

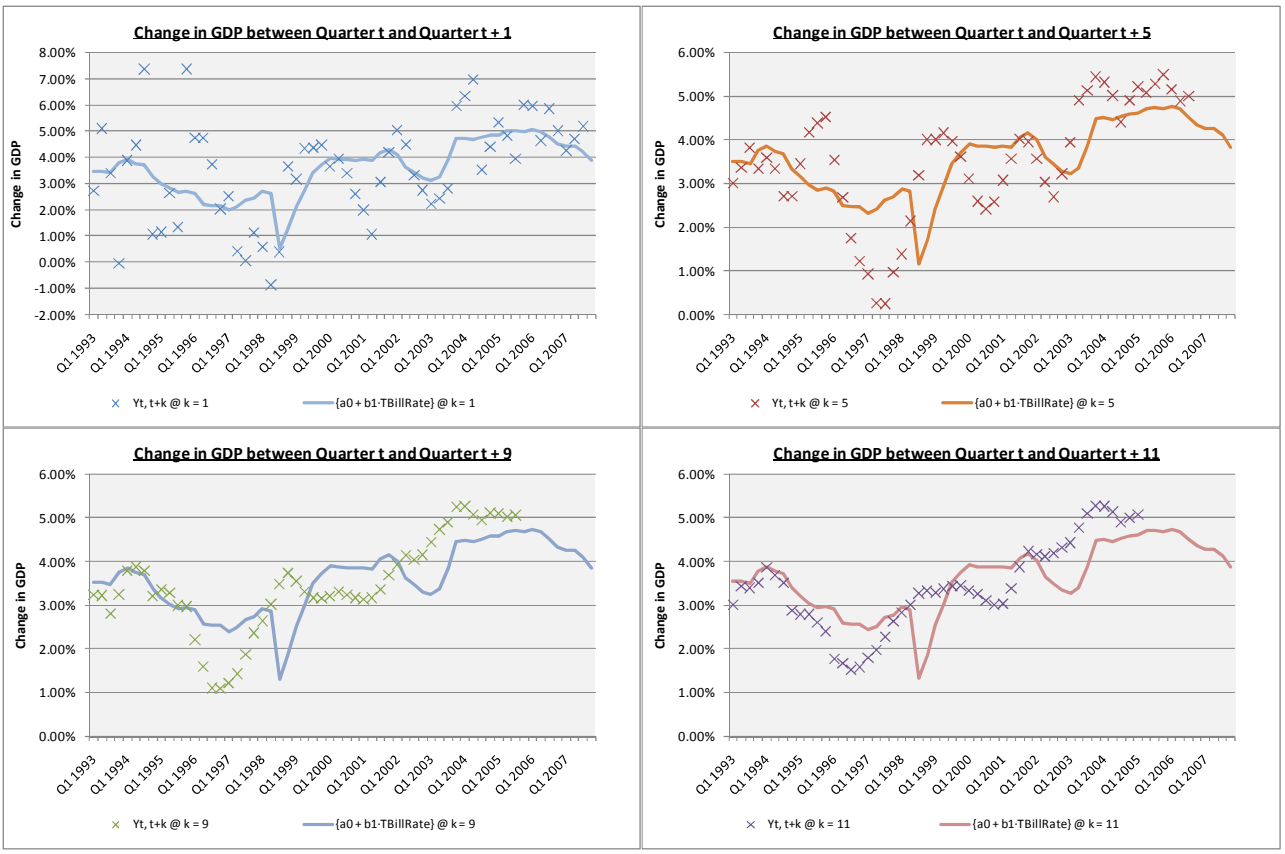


Figure 14: Fit of the regression model $\alpha_o+\beta_1 \cdot$TBillRate to the variable $Y_{t,t+k}$ at various forecasting horizons.

It is clear that the 90-Day T-Bill rate is a statistically significant predictor of the change in South African GDP, quite far into the future.

CHAPTER 6: CONCLUSION

The stated purpose of this report was to establish if the South African GDP could be predicted at a future date using a model based on the yield curve. The advantages of such a method are:

1. The data used to construct the model is freely available in the public domain.
2. The methodology used to build the model is simple and does not involve the use of complex multivariate regression modelling.

The first conclusion that can be drawn from the analysis is that the SPREAD has very limited predictive power over the change in the South African GDP. The analysis shows that SPREAD is only able to predict the GDP two quarters ahead. This finding is at odds with the reported literature. However, as stated by Stock and Watson (2003:822), the fact that a model worked previously is no guarantee that it will work in a different period. A possible clue as to why this unexpected outcome has been reached is provided by comparing the coefficient of variances reported for the different variables (Table 2, Table 3, Table 4 and Table 5 reproduced below).

Table 2: Statistics: Change in RSA GDP, k quarters ahead.

	Yt, t+k @ k =					
	1	2	3	4	5	6
Min	-0.88%	-0.25%	0.02%	0.22%	0.25%	0.27%
Mean	3.56%	3.55%	3.53%	3.52%	3.52%	3.51%
Max	7.37%	6.66%	6.43%	5.70%	5.50%	5.43%
Std. Dev.	1.92%	1.68%	1.54%	1.43%	1.33%	1.26%
CoV	0.54	0.47	0.44	0.41	0.38	0.36
	7	8	9	10	11	12
Min	0.59%	0.77%	1.09%	1.30%	1.52%	1.76%
Mean	3.50%	3.47%	3.45%	3.44%	3.43%	3.42%
Max	5.34%	5.20%	5.26%	5.33%	5.27%	5.32%
Std. Dev.	1.20%	1.15%	1.10%	1.06%	1.02%	0.98%
CoV	0.34	0.33	0.32	0.31	0.30	0.29

Table 3: Statistics: SPREADs between the 91-Day T-Bill BEY and the RSA Government Bond of different terms.

	SPREAD @ L =			
	0-3	3-5	5-10	10+
Min	-3.46%	-3.47%	-4.39%	-4.53%
Mean	0.05%	0.39%	0.55%	0.62%
Max	3.18%	4.06%	4.45%	4.73%
Std. Dev.	1.31%	1.65%	1.93%	2.03%
CoV	27.89	4.19	3.50	3.24

Table 4: Statistics: 91-Day T-Bill BEY.

	91d T-Bill: Bond Equivalent Yield
Min	6.86%
Mean	11.71%
Max	21.58%
Std. Dev.	3.34%
CoV	0.29

Table 5: Statistics: Quarterly average change in the ALSI index.

	ALSI
Min	-24.70%
Mean	4.24%
Max	29.79%
Std. Dev.	10.54%
CoV	2.49

Y_t, being the change in GDP – the dependant variable – exhibited much lower variability over the period than SPREAD and ALSI, whilst TBillRate showed similar low variability. The theories proposed by Harvey (1988) and Estrella and Trubin (2006) as to why the yield curve should predict economy (outlined in section 2.2.2) showed that market participants tend to focus on the longer term and react to changes in the present to mitigate their perceived risk. It may well also be that there is greater inherent instability in the South African economy at the short end or that South Africans are more prone to overreaction relative to the first world economies where these studies have proved reliable. This type of investigation was outside the scope of this study, but it is one area of possible future research. If one considers that the South African Reserve Bank followed an inflation targeting policy through most of this period, perhaps this

result is explicable. The inflation target was 3 to 6 percent and the primary mechanism that the reserve bank used to influence inflation was the Repurchase Rate[9] - the level of which has an effect on the T-Bill rate (and other short-term rates) (Estrella and Trubin 2006). Estrella (2005) showed that if the monetary authority is focussed on the level of the interest rate rather than on changes to it, then the predictive power of the yield curve is compromised.

This work showed that the short rate itself is a significant predictor of future South African GDP. This is in line with Ang, Piazzesi and Wei's (2005) findings. It was unexpected that the short rate turned out to have more predictive power over the long term growth in GDP (up to 11 quarters ahead) than in the short-term growth. The monetary actions of the Reserve Bank could again offer clues as to why this may be the case. Cheaper money tends to fuel growth as economic participants can afford to borrow more, whilst expensive debt tends to contribute to an economic contraction. Perhaps the Reserve Bank's actions on inflation have contributed to smoothing out the long term growth in GDP? This is a topic that merits further investigation.

[9] The rate at which the Reserve Bank lends to the retail banks.

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APPENDIX A: Raw Data

Notes on tables that follow:

Table 14: The data set used was the seasonally adjusted and annualised RSA quarterly gross domestic product data in constant 2000 prices published by Statistics South Africa.

Table 15: The data set used was the Discount rates on 91-day Treasury Bills published by the South African Reserve Bank.

Table 16: The data set used was The Yield on loan stock traded on the bond exchange: Government stock published by the South African Reserve Bank

Table 17: The data set used was The All-Share Index Closing Values published by the Johannesburg Stock Exchange.

Table 14 Seasonally adjusted and annualised RSA quarterly gross domestic product at constant 2000 prices

Year	Quarter	GDP at market prices		Year	Quarter	GDP at market prices
1993	1	744,767		2001	1	940,768
	2	749,852			2	945,469
	3	759,468			3	947,981
	4	765,950			4	955,274
1994	1	765,839		2002	1	965,347
	2	773,311			2	977,595
	3	782,007			3	988,660
	4	796,539			4	996,886
1995	1	798,653		2003	1	1,003,734
	2	800,949			2	1,009,318
	3	806,263			3	1,015,433
	4	808,975			4	1,022,569
1996	1	824,017		2004	1	1,037,913
	2	833,834			2	1,054,528
	3	843,769			3	1,073,080
	4	851,685			4	1,082,592
1997	1	856,030		2005	1	1,094,593
	2	861,400			2	1,109,277
	3	862,257			3	1,122,778
	4	862,376			4	1,133,894
1998	1	864,791		2006	1	1,151,045
	2	866,014			2	1,168,364
	3	864,117			3	1,181,999
	4	864,949			4	1,199,455
1999	1	872,905		2007	1	1,214,574
	2	879,853			2	1,227,577
	3	889,460			3	1,242,075
	4	899,244			4	1,258,283
2000	1	909,362				
	2	917,728				
	3	926,816				
	4	934,703				

Table 15: Discount rates on 91-day Treasury Bills

Time series	KBP1405W
Friday No. X of month	Value
1983/12/02	17.47
1983/12/05	17.62
1984/01/03	17.67
1984/02/01	17.47
1984/02/04	17.75
1984/03/02	17.74
1984/03/05	17.75
1984/04/03	17.8
1984/05/01	17.79
1984/05/04	17.81
1984/06/02	17.72
1984/06/05	17.64
1984/07/03	18.76
1984/08/01	21.6
1984/08/04	21.78
1984/09/02	21.77
1984/09/05	Closed
1984/10/03	21.78
1984/11/01	21.78
1984/11/04	20.64
1984/12/02	20.69
1984/12/05	Closed
1985/01/03	21.78
1985/02/01	21.75
1985/02/04	21.8
1985/03/02	21.8
1985/03/05	21.26
1985/04/03	21.08
1985/05/01	20.47
1985/05/04	19.17
1985/06/02	17.69
1985/06/05	Closed
1985/07/03	16.32
1985/08/01	17.04
1985/08/04	15.97

Time series	KBP1405W
Friday No. X of month	Value
1983/12/03	17.56
1984/01/01	17.63
1984/01/04	17.73
1984/02/02	17.74
1984/02/05	Closed
1984/03/03	17.75
1984/04/01	17.78
1984/04/04	17.81
1984/05/02	17.82
1984/05/05	Closed
1984/06/03	17.64
1984/07/01	18.18
1984/07/04	18.77
1984/08/02	21.72
1984/08/05	21.77
1984/09/03	21.75
1984/10/01	21.77
1984/10/04	21.78
1984/11/02	21.72
1984/11/05	20.69
1984/12/03	20.74
1985/01/01	20.82
1985/01/04	21.79
1985/02/02	21.75
1985/02/05	Closed
1985/03/03	21.8
1985/04/01	20.95
1985/04/04	20.78
1985/05/02	19.65
1985/05/05	18.78
1985/06/03	16.81
1985/07/01	16.12
1985/07/04	16.48
1985/08/02	16.88
1985/08/05	15.72

Time series	KBP1405W
Friday No. X of month	Value
1983/12/04	17.61
1984/01/02	17.75
1984/01/05	Closed
1984/02/03	17.74
1984/03/01	17.72
1984/03/04	17.75
1984/04/02	17.77
1984/04/05	Closed
1984/05/03	17.82
1984/06/01	17.75
1984/06/04	17.67
1984/07/02	18.72
1984/07/05	Closed
1984/08/03	21.76
1984/09/01	21.77
1984/09/04	21.77
1984/10/02	21.78
1984/10/05	Closed
1984/11/03	20.56
1984/12/01	20.68
1984/12/04	20.8
1985/01/02	21.74
1985/01/05	Closed
1985/02/03	21.77
1985/03/01	21.76
1985/03/04	21.75
1985/04/02	20.93
1985/04/05	Closed
1985/05/03	19.54
1985/06/01	17.47
1985/06/04	16
1985/07/02	16.3
1985/07/05	Closed
1985/08/03	16.88
1985/09/01	15.09

Time series	KBP1405W
Friday No. X of month	Value
1985/09/02	15.16
1985/09/05	Closed
1985/10/03	14.16
1985/11/01	13.51
1985/11/04	12.71
1985/12/02	12.93
1985/12/05	Closed
1986/01/03	11.94
1986/02/01	12.02
1986/02/04	11.96
1986/03/02	12.02
1986/03/05	Closed
1986/04/03	11.05
1986/05/01	10.85
1986/05/04	11
1986/06/02	10.85
1986/06/05	Closed
1986/07/03	10.51
1986/08/01	10.05
1986/08/04	9.75
1986/09/02	8.97
1986/09/05	Closed
1986/10/03	9.13
1986/11/01	9.11
1986/11/04	8.62
1986/12/02	8.29
1986/12/05	Closed
1987/01/03	8.91
1987/02/01	8.74
1987/02/04	8.79
1987/03/02	8.6
1987/03/05	Closed
1987/04/03	8.65
1987/05/01	8.6
1987/05/04	8.81
1987/06/02	8.54
1987/06/05	Closed

Time series	KBP1405W
Friday No. X of month	Value
1985/09/03	15.22
1985/10/01	14.33
1985/10/04	13.87
1985/11/02	12.99
1985/11/05	12.9
1985/12/03	12.98
1986/01/01	12.73
1986/01/04	12.04
1986/02/02	12.03
1986/02/05	Closed
1986/03/03	12.02
1986/04/01	11.82
1986/04/04	11.58
1986/05/02	10.99
1986/05/05	11.02
1986/06/03	10.72
1986/07/01	10.76
1986/07/04	10.22
1986/08/02	9.93
1986/08/05	9.51
1986/09/03	9.09
1986/10/01	9.09
1986/10/04	9.17
1986/11/02	8.78
1986/11/05	Closed
1986/12/03	8.46
1987/01/01	8.84
1987/01/04	8.8
1987/02/02	8.77
1987/02/05	Closed
1987/03/03	8.42
1987/04/01	8.49
1987/04/04	8.74
1987/05/02	8.68
1987/05/05	8.96
1987/06/03	8.5
1987/07/01	8.72

Time series	KBP1405W
Friday No. X of month	Value
1985/09/04	14.85
1985/10/02	14.42
1985/10/05	Closed
1985/11/03	12.77
1985/12/01	12.87
1985/12/04	12.99
1986/01/02	12.03
1986/01/05	12.02
1986/02/03	11.99
1986/03/01	11.95
1986/03/04	11.97
1986/04/02	11.02
1986/04/05	Closed
1986/05/03	10.95
1986/06/01	10.95
1986/06/04	10.75
1986/07/02	10.88
1986/07/05	Closed
1986/08/03	9.99
1986/09/01	9.03
1986/09/04	9.2
1986/10/02	9.23
1986/10/05	9.18
1986/11/03	8.62
1986/12/01	8.24
1986/12/04	8.66
1987/01/02	8.78
1987/01/05	8.77
1987/02/03	8.78
1987/03/01	8.72
1987/03/04	8.26
1987/04/02	8.53
1987/04/05	Closed
1987/05/03	8.8
1987/06/01	8.82
1987/06/04	8.64
1987/07/02	8.82

Time series	KBP1405W
Friday No. X of month	Value
1987/07/03	8.79
1987/08/01	8.54
1987/08/04	8.7
1987/09/02	8.69
1987/09/05	Closed
1987/10/03	8.7
1987/11/01	8.66
1987/11/04	8.74
1987/12/02	8.94
1987/12/05	Closed
1988/01/03	9.4
1988/02/01	9.5
1988/02/04	9.95
1988/03/02	10.5
1988/03/05	Closed
1988/04/03	10.53
1988/05/01	11.45
1988/05/04	11.61
1988/06/02	11.85
1988/06/05	Closed
1988/07/03	11.99
1988/08/01	12.53
1988/08/04	12.71
1988/09/02	12.79
1988/09/05	12.93
1988/10/03	13.43
1988/11/01	14.4
1988/11/04	14.49
1988/12/02	15.2
1988/12/05	15.28
1989/01/03	15.16
1989/02/01	15.15
1989/02/04	15.6
1989/03/02	15.96
1989/03/05	16
1989/04/03	16.15
1989/05/01	16.77

Time series	KBP1405W
Friday No. X of month	Value
1987/07/04	8.82
1987/08/02	8.61
1987/08/05	Closed
1987/09/03	8.62
1987/10/01	8.7
1987/10/04	8.7
1987/11/02	8.64
1987/11/05	Closed
1987/12/03	9.02
1988/01/01	9.24
1988/01/04	9.49
1988/02/02	9.55
1988/02/05	Closed
1988/03/03	10.49
1988/04/01	10.51
1988/04/04	10.65
1988/05/02	11.49
1988/05/05	Closed
1988/06/03	11.9
1988/07/01	11.94
1988/07/04	12.06
1988/08/02	12.58
1988/08/05	Closed
1988/09/03	13.25
1988/10/01	12.97
1988/10/04	13.87
1988/11/02	14.45
1988/11/05	Closed
1988/12/03	15.3
1989/01/01	15.21
1989/01/04	15.08
1989/02/02	15.12
1989/02/05	Closed
1989/03/03	15.98
1989/04/01	16
1989/04/04	16.48
1989/05/02	16.99

Time series	KBP1405W
Friday No. X of month	Value
1987/07/05	8.74
1987/08/03	8.71
1987/09/01	8.6
1987/09/04	8.72
1987/10/02	8.7
1987/10/05	8.68
1987/11/03	8.64
1987/12/01	8.76
1987/12/04	9.18
1988/01/02	9.21
1988/01/05	9.49
1988/02/03	9.75
1988/03/01	10.23
1988/03/04	10.49
1988/04/02	10.51
1988/04/05	10.97
1988/05/03	11.49
1988/06/01	11.73
1988/06/04	11.91
1988/07/02	11.97
1988/07/05	12.47
1988/08/03	12.59
1988/09/01	12.76
1988/09/04	12.88
1988/10/02	13.03
1988/10/05	Closed
1988/11/03	14.48
1988/12/01	15.02
1988/12/04	15.33
1989/01/02	15.22
1989/01/05	Closed
1989/02/03	15.27
1989/03/01	15.91
1989/03/04	16
1989/04/02	16
1989/04/05	Closed
1989/05/03	17.04

Time series	KBP1405W
Friday No. X of month	Value
1989/05/04	17.11
1989/06/02	17.11
1989/06/05	17.15
1989/07/03	17.19
1989/08/01	17.17
1989/08/04	17.11
1989/09/02	17.12
1989/09/05	17.11
1989/10/03	17.99
1989/11/01	18
1989/11/04	18
1989/12/02	18.01
1989/12/05	18
1990/01/03	18
1990/02/01	18
1990/02/04	18.01
1990/03/02	18
1990/03/05	17.9
1990/04/03	18
1990/05/01	18
1990/05/04	18
1990/06/02	17.96
1990/06/05	17.97
1990/07/03	17.83
1990/08/01	17.71
1990/08/04	17.65
1990/09/02	17.55
1990/09/05	Closed
1990/10/03	17.7
1990/11/01	17.8
1990/11/04	17.59
1990/12/02	17.37
1990/12/05	Closed
1991/01/03	17.33
1991/02/01	17.29
1991/02/04	16.98
1991/03/02	17.04

Time series	KBP1405W
Friday No. X of month	Value
1989/05/05	Closed
1989/06/03	17.18
1989/07/01	17.09
1989/07/04	17.17
1989/08/02	17.06
1989/08/05	Closed
1989/09/03	17.14
1989/10/01	17.09
1989/10/04	17.99
1989/11/02	18
1989/11/05	Closed
1989/12/03	18
1990/01/01	18
1990/01/04	18
1990/02/02	18
1990/02/05	Closed
1990/03/03	17.94
1990/04/01	18
1990/04/04	17.99
1990/05/02	18.01
1990/05/05	Closed
1990/06/03	17.98
1990/07/01	17.91
1990/07/04	17.75
1990/08/02	17.69
1990/08/05	17.69
1990/09/03	17.37
1990/10/01	17.32
1990/10/04	17.95
1990/11/02	17.82
1990/11/05	17.5
1990/12/03	17.42
1991/01/01	17.23
1991/01/04	17.33
1991/02/02	17.21
1991/02/05	Closed
1991/03/03	16.85

Time series	KBP1405W
Friday No. X of month	Value
1989/06/01	17.05
1989/06/04	17.21
1989/07/02	17.18
1989/07/05	Closed
1989/08/03	17.17
1989/09/01	17.19
1989/09/04	17.11
1989/10/02	17.98
1989/10/05	Closed
1989/11/03	18
1989/12/01	18
1989/12/04	18
1990/01/02	18
1990/01/05	Closed
1990/02/03	18.01
1990/03/01	18.01
1990/03/04	17.91
1990/04/02	18
1990/04/05	Closed
1990/05/03	18
1990/06/01	17.99
1990/06/04	18
1990/07/02	17.85
1990/07/05	Closed
1990/08/03	17.65
1990/09/01	17.62
1990/09/04	17.39
1990/10/02	17.34
1990/10/05	Closed
1990/11/03	17.69
1990/12/01	17.41
1990/12/04	17.35
1991/01/02	17.29
1991/01/05	Closed
1991/02/03	17.06
1991/03/01	17.06
1991/03/04	16.85

Time series	KBP1405W
Friday No. X of month	Value
1991/03/05	16.87
1991/04/03	16.75
1991/05/01	16.61
1991/05/04	16.69
1991/06/02	16.66
1991/06/05	Closed
1991/07/03	16.67
1991/08/01	16.72
1991/08/04	16.65
1991/09/02	16.58
1991/09/05	Closed
1991/10/03	16.36
1991/11/01	16.25
1991/11/04	16.19
1991/12/02	16.17
1991/12/05	Closed
1992/01/03	15.94
1992/02/01	15.94
1992/02/04	15.69
1992/03/02	15.57
1992/03/05	Closed
1992/04/03	15.19
1992/05/01	14.9
1992/05/04	13.93
1992/06/02	14.02
1992/06/05	Closed
1992/07/03	13.4
1992/08/01	13.21
1992/08/04	12.03
1992/09/02	12.03
1992/09/05	Closed
1992/10/03	12.08
1992/11/01	12.36
1992/11/04	11.78
1992/12/02	12.07
1992/12/05	Closed
1993/01/03	11.82

Time series	KBP1405W
Friday No. X of month	Value
1991/04/01	16.84
1991/04/04	16.73
1991/05/02	16.61
1991/05/05	16.69
1991/06/03	16.66
1991/07/01	16.72
1991/07/04	16.73
1991/08/02	16.69
1991/08/05	16.62
1991/09/03	16.55
1991/10/01	16.5
1991/10/04	16.26
1991/11/02	16.26
1991/11/05	16.16
1991/12/03	16.15
1992/01/01	16.09
1992/01/04	16.06
1992/02/02	15.8
1992/02/05	Closed
1992/03/03	15.48
1992/04/01	14.97
1992/04/04	14.98
1992/05/02	14.76
1992/05/05	13.97
1992/06/03	14.03
1992/07/01	13.38
1992/07/04	13.39
1992/08/02	12.77
1992/08/05	Closed
1992/09/03	12.11
1992/10/01	12.13
1992/10/04	12.03
1992/11/02	12.16
1992/11/05	Closed
1992/12/03	12.21
1993/01/01	12.09
1993/01/04	11.79

Time series	KBP1405W
Friday No. X of month	Value
1991/04/02	16.86
1991/04/05	Closed
1991/05/03	16.66
1991/06/01	16.68
1991/06/04	16.77
1991/07/02	16.67
1991/07/05	Closed
1991/08/03	16.65
1991/09/01	16.61
1991/09/04	16.5
1991/10/02	16.4
1991/10/05	Closed
1991/11/03	16.24
1991/12/01	16.14
1991/12/04	16.13
1992/01/02	16
1992/01/05	16.02
1992/02/03	15.77
1992/03/01	15.63
1992/03/04	15
1992/04/02	14.95
1992/04/05	Closed
1992/05/03	14.2
1992/06/01	13.99
1992/06/04	14.07
1992/07/02	13.52
1992/07/05	13.34
1992/08/03	11.99
1992/09/01	11.98
1992/09/04	12.15
1992/10/02	12.12
1992/10/05	12.02
1992/11/03	11.67
1992/12/01	11.86
1992/12/04	12.26
1993/01/02	11.9
1993/01/05	11.54

Time series	KBP1405W
Friday No. X of month	Value
1993/02/01	11.42
1993/02/04	11.32
1993/03/02	11.38
1993/03/05	Closed
1993/04/03	11.12
1993/05/01	11.28
1993/05/04	11.9
1993/06/02	11.86
1993/06/05	Closed
1993/07/03	11.77
1993/08/01	11.67
1993/08/04	11.72
1993/09/02	11.61
1993/09/05	Closed
1993/10/03	11.35
1993/11/01	10.27
1993/11/04	10.21
1993/12/02	10.17
1993/12/05	10.17
1994/01/03	10.16
1994/02/01	10.17
1994/02/04	10.15
1994/03/02	10.13
1994/03/05	Closed
1994/04/03	10.31
1994/05/01	10.47
1994/05/04	11
1994/06/02	10.75
1994/06/05	Closed
1994/07/03	10.71
1994/08/01	10.81
1994/08/04	10.73
1994/09/02	10.76
1994/09/05	11.84
1994/10/03	11.48
1994/11/01	12.13
1994/11/04	12.27

Time series	KBP1405W
Friday No. X of month	Value
1993/02/02	11.34
1993/02/05	Closed
1993/03/03	11.36
1993/04/01	11.21
1993/04/04	11.08
1993/05/02	11.59
1993/05/05	Closed
1993/06/03	11.89
1993/07/01	11.82
1993/07/04	11.73
1993/08/02	11.7
1993/08/05	Closed
1993/09/03	11.57
1993/10/01	11.45
1993/10/04	11.27
1993/11/02	10.17
1993/11/05	Closed
1993/12/03	10.17
1994/01/01	10.13
1994/01/04	10.16
1994/02/02	10.16
1994/02/05	Closed
1994/03/03	10.13
1994/04/01	10.16
1994/04/04	10.52
1994/05/02	10.68
1994/05/05	Closed
1994/06/03	10.6
1994/07/01	10.69
1994/07/04	10.81
1994/08/02	10.73
1994/08/05	Closed
1994/09/03	10.84
1994/10/01	11.81
1994/10/04	12.07
1994/11/02	12.18
1994/11/05	Closed

Time series	KBP1405W
Friday No. X of month	Value
1993/02/03	11.32
1993/03/01	11.35
1993/03/04	11.27
1993/04/02	11.16
1993/04/05	11.02
1993/05/03	11.85
1993/06/01	11.87
1993/06/04	11.87
1993/07/02	11.75
1993/07/05	11.67
1993/08/03	11.71
1993/09/01	11.7
1993/09/04	11.52
1993/10/02	11.39
1993/10/05	10.42
1993/11/03	10.07
1993/12/01	10.18
1993/12/04	10.25
1994/01/02	10.16
1994/01/05	Closed
1994/02/03	10.15
1994/03/01	10.12
1994/03/04	10.14
1994/04/02	10.22
1994/04/05	10.41
1994/05/03	10.87
1994/06/01	11.1
1994/06/04	10.91
1994/07/02	10.71
1994/07/05	10.89
1994/08/03	10.73
1994/09/01	10.73
1994/09/04	10.9
1994/10/02	11.87
1994/10/05	Closed
1994/11/03	12.25
1994/12/01	12.77

Time series	KBP1405W
Friday No. X of month	Value
1994/12/02	12.23
1994/12/05	12.69
1995/01/03	12.66
1995/02/01	12.73
1995/02/04	13.19
1995/03/02	13
1995/03/05	12.83
1995/04/03	13.19
1995/05/01	13.6
1995/05/04	13.89
1995/06/02	13.82
1995/06/05	14.07
1995/07/03	13.94
1995/08/01	13.88
1995/08/04	13.88
1995/09/02	14
1995/09/05	13.96
1995/10/03	13.77
1995/11/01	13.64
1995/11/04	13.65
1995/12/02	13.81
1995/12/05	14.22
1996/01/03	13.94
1996/02/01	13.94
1996/02/04	13.97
1996/03/02	14.15
1996/03/05	14.18
1996/04/03	14.2
1996/05/01	15.23
1996/05/04	16.1
1996/06/02	15.78
1996/06/05	Closed
1996/07/03	15.03
1996/08/01	15.31
1996/08/04	16.09
1996/09/02	15.17
1996/09/05	Closed

Time series	KBP1405W
Friday No. X of month	Value
1994/12/03	12.32
1995/01/01	12.81
1995/01/04	12.62
1995/02/02	12.84
1995/02/05	Closed
1995/03/03	12.97
1995/04/01	12.79
1995/04/04	13.47
1995/05/02	13.71
1995/05/05	Closed
1995/06/03	13.79
1995/07/01	14.01
1995/07/04	13.9
1995/08/02	13.85
1995/08/05	Closed
1995/09/03	13.99
1995/10/01	13.87
1995/10/04	13.68
1995/11/02	13.61
1995/11/05	Closed
1995/12/03	14.07
1996/01/01	14.14
1996/01/04	13.94
1996/02/02	13.9
1996/02/05	Closed
1996/03/03	14.18
1996/04/01	14.14
1996/04/04	15.09
1996/05/02	16.02
1996/05/05	16.06
1996/06/03	15.7
1996/07/01	14.95
1996/07/04	15.11
1996/08/02	15.99
1996/08/05	15.79
1996/09/03	15.05
1996/10/01	15.04

Time series	KBP1405W
Friday No. X of month	Value
1994/12/04	12.66
1995/01/02	12.69
1995/01/05	Closed
1995/02/03	13.01
1995/03/01	13.19
1995/03/04	12.9
1995/04/02	12.82
1995/04/05	Closed
1995/05/03	13.82
1995/06/01	13.85
1995/06/04	13.73
1995/07/02	13.96
1995/07/05	Closed
1995/08/03	13.85
1995/09/01	13.97
1995/09/04	14
1995/10/02	13.87
1995/10/05	Closed
1995/11/03	13.6
1995/12/01	13.72
1995/12/04	14.15
1996/01/02	13.97
1996/01/05	Closed
1996/02/03	13.88
1996/03/01	14.07
1996/03/04	14.16
1996/04/02	14.18
1996/04/05	Closed
1996/05/03	16.21
1996/06/01	15.95
1996/06/04	15.1
1996/07/02	14.94
1996/07/05	Closed
1996/08/03	16.19
1996/09/01	15.36
1996/09/04	15.06
1996/10/02	15.04

Time series	KBP1405W
Friday No. X of month	Value
1996/10/03	15.01
1996/11/01	14.98
1996/11/04	15.97
1996/12/02	15.94
1996/12/05	Closed
1997/01/03	16.28
1997/02/01	15.82
1997/02/04	15.8
1997/03/02	15.82
1997/03/05	Closed
1997/04/03	15.77
1997/05/01	15.7
1997/05/04	15.65
1997/06/02	15.45
1997/06/05	Closed
1997/07/03	15.08
1997/08/01	14.82
1997/08/04	14.75
1997/09/02	14.72
1997/09/05	Closed
1997/10/03	14.69
1997/11/01	14.53
1997/11/04	14.59
1997/12/02	14.6
1997/12/05	Closed
1998/01/03	14.36
1998/02/01	14.16
1998/02/04	13.69
1998/03/02	13.07
1998/03/05	Closed
1998/04/03	12.86
1998/05/01	12.81
1998/05/04	13.07
1998/06/02	16.79
1998/06/05	Closed
1998/07/03	19.28
1998/08/01	19.32

Time series	KBP1405W
Friday No. X of month	Value
1996/10/04	14.95
1996/11/02	14.93
1996/11/05	15.71
1996/12/03	15.98
1997/01/01	16.18
1997/01/04	16.27
1997/02/02	15.74
1997/02/05	Closed
1997/03/03	15.82
1997/04/01	15.78
1997/04/04	15.69
1997/05/02	15.7
1997/05/05	15.64
1997/06/03	15.47
1997/07/01	15.11
1997/07/04	14.98
1997/08/02	14.81
1997/08/05	14.74
1997/09/03	14.7
1997/10/01	14.69
1997/10/04	14.1
1997/11/02	14.55
1997/11/05	Closed
1997/12/03	14.61
1998/01/01	14.65
1998/01/04	14.28
1998/02/02	13.97
1998/02/05	Closed
1998/03/03	12.9
1998/04/01	12.96
1998/04/04	12.84
1998/05/02	12.78
1998/05/05	14.4
1998/06/03	16.84
1998/07/01	18.84
1998/07/04	19.24
1998/08/02	19.5

Time series	KBP1405W
Friday No. X of month	Value
1996/10/05	Closed
1996/11/03	14.99
1996/12/01	15.93
1996/12/04	16.1
1997/01/02	16.26
1997/01/05	15.84
1997/02/03	15.78
1997/03/01	15.82
1997/03/04	15.79
1997/04/02	15.79
1997/04/05	Closed
1997/05/03	15.7
1997/06/01	15.46
1997/06/04	15.24
1997/07/02	15.07
1997/07/05	Closed
1997/08/03	14.79
1997/09/01	14.73
1997/09/04	14.69
1997/10/02	14.72
1997/10/05	14.49
1997/11/03	14.59
1997/12/01	14.6
1997/12/04	14.79
1998/01/02	14.49
1998/01/05	14.25
1998/02/03	13.88
1998/03/01	13.51
1998/03/04	12.92
1998/04/02	12.95
1998/04/05	Closed
1998/05/03	12.91
1998/06/01	14.79
1998/06/04	17.4
1998/07/02	19.08
1998/07/05	19.32
1998/08/03	19.67

Time series	KBP1405W
Friday No. X of month	Value
1998/08/04	21.76
1998/09/02	22.3
1998/09/05	Closed
1998/10/03	19.28
1998/11/01	18.5
1998/11/04	17.43
1998/12/02	17.24
1998/12/05	Closed
1999/01/03	16.5
1999/02/01	16.04
1999/02/04	15.08
1999/03/02	14.45
1999/03/05	Closed
1999/04/03	13.71
1999/05/01	13.26
1999/05/04	13.7
1999/06/02	13.35
1999/06/05	Closed
1999/07/03	11.99
1999/08/01	11.71
1999/08/04	11.65
1999/09/02	11.13
1999/09/05	Closed
1999/10/03	10.72
1999/11/01	10.71
1999/11/04	10.7
1999/12/02	10.7
1999/12/05	10.71
2000/01/03	9.76
2000/02/01	9.8
2000/02/04	9.77
2000/03/02	9.88
2000/03/05	9.83
2000/04/03	9.95
2000/05/01	10.1
2000/05/04	10.47
2000/06/02	10.24

Time series	KBP1405W
Friday No. X of month	Value
1998/08/05	Closed
1998/09/03	21.9
1998/10/01	20.09
1998/10/04	18.75
1998/11/02	17.57
1998/11/05	Closed
1998/12/03	17.24
1999/01/01	16.78
1999/01/04	16.32
1999/02/02	15.42
1999/02/05	Closed
1999/03/03	14.51
1999/04/01	14.12
1999/04/04	13.45
1999/05/02	13.67
1999/05/05	Closed
1999/06/03	13.06
1999/07/01	12.58
1999/07/04	11.74
1999/08/02	11.72
1999/08/05	Closed
1999/09/03	11.09
1999/10/01	10.83
1999/10/04	10.74
1999/11/02	10.71
1999/11/05	Closed
1999/12/03	10.69
2000/01/01	10.56
2000/01/04	9.78
2000/02/02	9.78
2000/02/05	Closed
2000/03/03	9.87
2000/04/01	9.84
2000/04/04	10.11
2000/05/02	10.12
2000/05/05	Closed
2000/06/03	10.29

Time series	KBP1405W
Friday No. X of month	Value
1998/09/01	22.23
1998/09/04	20.09
1998/10/02	19.89
1998/10/05	18.5
1998/11/03	17.5
1998/12/01	17.19
1998/12/04	17.03
1999/01/02	16.25
1999/01/05	16.04
1999/02/03	15.31
1999/03/01	14.74
1999/03/04	14.43
1999/04/02	13.81
1999/04/05	13.35
1999/05/03	13.64
1999/06/01	13.53
1999/06/04	12.9
1999/07/02	12.12
1999/07/05	11.62
1999/08/03	11.68
1999/09/01	11.37
1999/09/04	10.93
1999/10/02	10.76
1999/10/05	10.73
1999/11/03	10.7
1999/12/01	10.71
1999/12/04	10.71
2000/01/02	9.96
2000/01/05	Closed
2000/02/03	9.78
2000/03/01	9.83
2000/03/04	9.83
2000/04/02	9.84
2000/04/05	Closed
2000/05/03	10.3
2000/06/01	10.28
2000/06/04	10.29

Time series	KBP1405W
Friday No. X of month	Value
2000/06/05	10.25
2000/07/03	10.23
2000/08/01	10.17
2000/08/04	10.13
2000/09/02	10.16
2000/09/05	10.18
2000/10/03	10.25
2000/11/01	10.23
2000/11/04	10.21
2000/12/02	10.19
2000/12/05	10.25
2001/01/03	10.11
2001/02/01	10.11
2001/02/04	10.13
2001/03/02	10.14
2001/03/05	10.32
2001/04/03	10.35
2001/05/01	10.4
2001/05/04	10.36
2001/06/02	10.37
2001/06/05	9.65
2001/07/03	9.42
2001/08/01	9.38
2001/08/04	9.38
2001/09/02	9.37
2001/09/05	Closed
2001/10/03	8.85
2001/11/01	8.83
2001/11/04	8.77
2001/12/02	9.28
2001/12/05	Closed
2002/01/03	9.52
2002/02/01	9.45
2002/02/04	9.51
2002/03/02	9.68
2002/03/05	10.44
2002/04/03	10.63

Time series	KBP1405W
Friday No. X of month	Value
2000/07/01	10.23
2000/07/04	10.21
2000/08/02	10.14
2000/08/05	Closed
2000/09/03	10.17
2000/10/01	10.13
2000/10/04	10.25
2000/11/02	10.21
2000/11/05	Closed
2000/12/03	10.16
2001/01/01	10.16
2001/01/04	10.12
2001/02/02	10.11
2001/02/05	Closed
2001/03/03	10.16
2001/04/01	10.33
2001/04/04	10.4
2001/05/02	10.4
2001/05/05	Closed
2001/06/03	9.6
2001/07/01	9.65
2001/07/04	9.38
2001/08/02	9.36
2001/08/05	9.37
2001/09/03	8.97
2001/10/01	8.88
2001/10/04	8.85
2001/11/02	8.66
2001/11/05	8.94
2001/12/03	9.4
2002/01/01	9.44
2002/01/04	9.51
2002/02/02	9.3
2002/02/05	Closed
2002/03/03	10.1
2002/04/01	10.48
2002/04/04	10.96

Time series	KBP1405W
Friday No. X of month	Value
2000/07/02	10.24
2000/07/05	Closed
2000/08/03	10.13
2000/09/01	10.13
2000/09/04	10.18
2000/10/02	10.15
2000/10/05	Closed
2000/11/03	10.21
2000/12/01	10.21
2000/12/04	10.24
2001/01/02	10.15
2001/01/05	Closed
2001/02/03	10.13
2001/03/01	10.13
2001/03/04	10.19
2001/04/02	10.32
2001/04/05	Closed
2001/05/03	10.36
2001/06/01	10.38
2001/06/04	9.64
2001/07/02	9.55
2001/07/05	Closed
2001/08/03	9.35
2001/09/01	9.35
2001/09/04	8.89
2001/10/02	8.87
2001/10/05	Closed
2001/11/03	8.73
2001/12/01	9.1
2001/12/04	9.47
2002/01/02	9.27
2002/01/05	Closed
2002/02/03	9.45
2002/03/01	9.56
2002/03/04	10.24
2002/04/02	10.53
2002/04/05	Closed

Time series	KBP1405W
Friday No. X of month	Value
2002/05/01	10.99
2002/05/04	11.38
2002/06/02	11.5
2002/06/05	Closed
2002/07/03	11.35
2002/08/01	11.35
2002/08/04	11.55
2002/09/02	12.21
2002/09/05	Closed
2002/10/03	12.61
2002/11/01	12.32
2002/11/04	12.26
2002/12/02	12.23
2002/12/05	Closed
2003/01/03	12.35
2003/02/01	12.6
2003/02/04	12.73
2003/03/02	12.71
2003/03/05	Closed
2003/04/03	12.76
2003/05/01	12.73
2003/05/04	12.39
2003/06/02	10.94
2003/06/05	Closed
2003/07/03	11.11
2003/08/01	10.63
2003/08/04	10
2003/09/02	9.21
2003/09/05	Closed
2003/10/03	7.88
2003/11/01	7.86
2003/11/04	7.14
2003/12/02	7.4
2003/12/05	Closed
2004/01/03	7.64
2004/02/01	7.52
2004/02/04	7.58

Time series	KBP1405W
Friday No. X of month	Value
2002/05/02	11.01
2002/05/05	11.39
2002/06/03	11.48
2002/07/01	11.39
2002/07/04	11.35
2002/08/02	11.35
2002/08/05	11.73
2002/09/03	12.37
2002/10/01	12.78
2002/10/04	12.49
2002/11/02	12.08
2002/11/05	12.28
2002/12/03	12.29
2003/01/01	12.41
2003/01/04	12.23
2003/02/02	12.74
2003/02/05	Closed
2003/03/03	12.74
2003/04/01	12.72
2003/04/04	12.75
2003/05/02	12.67
2003/05/05	12.03
2003/06/03	10.78
2003/07/01	10.8
2003/07/04	10.74
2003/08/02	10.28
2003/08/05	9.96
2003/09/03	8.97
2003/10/01	8.68
2003/10/04	7.8
2003/11/02	7.86
2003/11/05	Closed
2003/12/03	7.49
2004/01/01	7.56
2004/01/04	7.6
2004/02/02	7.48
2004/02/05	Closed

Time series	KBP1405W
Friday No. X of month	Value
2002/05/03	11.24
2002/06/01	11.39
2002/06/04	11.42
2002/07/02	11.35
2002/07/05	Closed
2002/08/03	11.37
2002/09/01	11.9
2002/09/04	12.41
2002/10/02	12.67
2002/10/05	Closed
2002/11/03	11.98
2002/12/01	12.17
2002/12/04	12.42
2003/01/02	12.37
2003/01/05	12.38
2003/02/03	12.73
2003/03/01	12.74
2003/03/04	12.75
2003/04/02	12.74
2003/04/05	Closed
2003/05/03	12.6
2003/06/01	11.57
2003/06/04	10.68
2003/07/02	11.03
2003/07/05	Closed
2003/08/03	10.18
2003/09/01	10.04
2003/09/04	8.81
2003/10/02	8.41
2003/10/05	7.81
2003/11/03	7.45
2003/12/01	7.02
2003/12/04	7.54
2004/01/02	7.62
2004/01/05	7.56
2004/02/03	7.46
2004/03/01	7.7

Time series	KBP1405W
Friday No. X of month	Value
2004/03/02	7.71
2004/03/05	Closed
2004/04/03	7.77
2004/05/01	7.69
2004/05/04	7.75
2004/06/02	7.84
2004/06/05	Closed
2004/07/03	7.9
2004/08/01	7.88
2004/08/04	7.15
2004/09/02	7.13
2004/09/05	Closed
2004/10/03	7.29
2004/11/01	7.27
2004/11/04	7.2
2004/12/02	7.28
2004/12/05	7.32
2005/01/03	7.27
2005/02/01	7.23
2005/02/04	7.2
2005/03/02	7.2
2005/03/05	Closed
2005/04/03	6.75
2005/05/01	6.75
2005/05/04	6.76
2005/06/02	6.76
2005/06/05	Closed
2005/07/03	6.72
2005/08/01	6.72
2005/08/04	6.71
2005/09/02	6.74
2005/09/05	6.79
2005/10/03	6.78
2005/11/01	6.85
2005/11/04	6.89
2005/12/02	6.82
2005/12/05	6.78

Time series	KBP1405W
Friday No. X of month	Value
2004/03/03	7.78
2004/04/01	7.83
2004/04/04	7.71
2004/05/02	7.71
2004/05/05	Closed
2004/06/03	7.87
2004/07/01	7.86
2004/07/04	7.91
2004/08/02	7.2
2004/08/05	Closed
2004/09/03	7.11
2004/10/01	7.2
2004/10/04	7.31
2004/11/02	7.27
2004/11/05	Closed
2004/12/03	7.3
2005/01/01	7.3
2005/01/04	7.24
2005/02/02	7.25
2005/02/05	Closed
2005/03/03	7.2
2005/04/01	7.17
2005/04/04	6.71
2005/05/02	6.75
2005/05/05	Closed
2005/06/03	6.76
2005/07/01	6.75
2005/07/04	6.73
2005/08/02	6.72
2005/08/05	Closed
2005/09/03	6.74
2005/10/01	6.79
2005/10/04	6.84
2005/11/02	6.86
2005/11/05	Closed
2005/12/03	6.82
2006/01/01	6.77

Time series	KBP1405W
Friday No. X of month	Value
2004/03/04	7.8
2004/04/02	7.78
2004/04/05	7.69
2004/05/03	7.73
2004/06/01	7.8
2004/06/04	7.87
2004/07/02	7.9
2004/07/05	7.87
2004/08/03	7.24
2004/09/01	7.13
2004/09/04	7.1
2004/10/02	7.3
2004/10/05	7.28
2004/11/03	7.23
2004/12/01	7.23
2004/12/04	7.32
2005/01/02	7.29
2005/01/05	Closed
2005/02/03	7.21
2005/03/01	7.21
2005/03/04	7.17
2005/04/02	7.21
2005/04/05	6.73
2005/05/03	6.75
2005/06/01	6.75
2005/06/04	6.76
2005/07/02	6.74
2005/07/05	6.73
2005/08/03	6.72
2005/09/01	6.72
2005/09/04	6.75
2005/10/02	6.79
2005/10/05	Closed
2005/11/03	6.97
2005/12/01	6.87
2005/12/04	6.78
2006/01/02	6.73

Time series	KBP1405W
Friday No. X of month	Value
2006/01/03	6.72
2006/02/01	6.69
2006/02/04	6.59
2006/03/02	6.56
2006/03/05	6.6
2006/04/03	6.7
2006/05/01	6.77
2006/05/04	6.83
2006/06/02	7.26
2006/06/05	7.19
2006/07/03	7.43
2006/08/01	7.7
2006/08/04	7.71
2006/09/02	7.61
2006/09/05	8
2006/10/03	8.29
2006/11/01	8.22
2006/11/04	8.26
2006/12/02	8.41
2006/12/05	8.49
2007/01/03	8.85
2007/02/01	8.82
2007/02/04	8.41
2007/03/02	8.28
2007/03/05	8.26
2007/04/03	8.29
2007/05/01	8.34
2007/05/04	8.68
2007/06/02	9.03
2007/06/05	9.1
2007/07/03	9
2007/08/01	8.84
2007/08/04	9.3
2007/09/02	9.29
2007/09/05	Closed
2007/10/03	9.96
2007/11/01	9.96

Time series	KBP1405W
Friday No. X of month	Value
2006/01/04	6.69
2006/02/02	6.71
2006/02/05	Closed
2006/03/03	6.49
2006/04/01	6.62
2006/04/04	6.74
2006/05/02	6.82
2006/05/05	Closed
2006/06/03	7.31
2006/07/01	7.16
2006/07/04	7.63
2006/08/02	7.67
2006/08/05	Closed
2006/09/03	7.75
2006/10/01	8.23
2006/10/04	8.27
2006/11/02	8.2
2006/11/05	Closed
2006/12/03	8.43
2007/01/01	8.56
2007/01/04	8.87
2007/02/02	8.77
2007/02/05	Closed
2007/03/03	8.27
2007/04/01	8.27
2007/04/04	8.29
2007/05/02	8.38
2007/05/05	Closed
2007/06/03	9.09
2007/07/01	9.1
2007/07/04	8.86
2007/08/02	9.07
2007/08/05	9.26
2007/09/03	9.41
2007/10/01	9.52
2007/10/04	9.96
2007/11/02	10.06

Time series	KBP1405W
Friday No. X of month	Value
2006/01/05	Closed
2006/02/03	6.68
2006/03/01	6.52
2006/03/04	6.51
2006/04/02	6.64
2006/04/05	Closed
2006/05/03	6.83
2006/06/01	6.82
2006/06/04	7.23
2006/07/02	7.14
2006/07/05	Closed
2006/08/03	7.7
2006/09/01	7.7
2006/09/04	7.88
2006/10/02	8.26
2006/10/05	Closed
2006/11/03	8.23
2006/12/01	8.26
2006/12/04	8.47
2007/01/02	8.67
2007/01/05	Closed
2007/02/03	8.55
2007/03/01	8.31
2007/03/04	8.25
2007/04/02	8.28
2007/04/05	Closed
2007/05/03	8.64
2007/06/01	8.84
2007/06/04	9.09
2007/07/02	9.05
2007/07/05	Closed
2007/08/03	9.32
2007/09/01	9.26
2007/09/04	9.43
2007/10/02	9.89
2007/10/05	Closed
2007/11/03	10.43

N

Time series	KBP1405W
Friday No. X of month	Value
2007/11/04	10.43
2007/12/02	10.43
2007/12/05	Closed

Time series	KBP1405W
Friday No. X of month	Value
2007/11/05	10.43
2007/12/03	10.54
2008/01/01	10.52

Time series	KBP1405W
Friday No. X of month	Value
2007/12/01	10.43
2007/12/04	10.52
2008/01/02	10.5

O

Table 16: Yield on loan stock traded on the bond exchange: Government stock

Code	Description
KBP2000M	Yield on loan stock traded on the bond exchange: Government stock - 0 to 3 years
KBP2001M	Yield on loan stock traded on the bond exchange: Government stock - 3 to 5 years
KBP2002M	Yield on loan stock traded on the bond exchange: Government stock - 5 to 10 years
KBP2003M	Yield on loan stock traded on the bond exchange: Government stock - 10 years and over

Time series	**KBP2000M**	**KBP2001M**	**KBP2002M**	**KBP2003M**
Unit of measure	**Percentage**	**Percentage**	**Percentage**	**Percentage**
Jan-93	12.65	13.25	14.73	14.65
Feb-93	12.43	12.94	14.58	14.52
Mar-93	12.84	13.57	14.63	14.56
Apr-93	13.32	14.60	15.11	15.10
May-93	13.05	14.53	15.04	15.00
Jun-93	13.01	13.98	14.79	14.77
Jul-93	13.05	13.70	14.24	14.33
Aug-93	12.62	13.20	13.85	14.01
Sep-93	12.20	12.71	13.29	13.60
Oct-93	12.11	12.72	13.07	13.25
Nov-93	11.19	11.92	12.51	12.69
Dec-93	10.97	11.57	12.20	12.34
Jan-94	10.84	11.52	12.07	12.21
Feb-94	11.33	12.05	12.56	12.80
Mar-94	11.31	12.12	12.73	12.99
Apr-94	11.45	12.47	12.97	13.24
May-94	11.74	12.74	13.02	13.76
Jun-94	12.38	13.65	14.11	14.46
Jul-94	13.00	14.39	14.83	15.11
Aug-94	13.35	15.18	15.62	15.87
Sep-94	15.24	16.29	16.59	16.89
Oct-94	15.96	16.59	16.65	16.91
Nov-94	15.93	16.60	16.62	16.94
Dec-94	15.77	16.49	16.48	16.80
Jan-95	15.87	16.67	16.72	17.02
Feb-95	15.88	16.60	16.61	16.82

Time series	KBP2000M	KBP2001M	KBP2002M	KBP2003M
Unit of measure	Percentage	Percentage	Percentage	Percentage
Mar-95	15.78	16.44	16.54	16.72
Apr-95	15.53	16.44	16.63	16.82
May-95	15.95	16.80	16.99	16.95
Jun-95	15.93	16.62	16.74	16.78
Jul-95	15.91	16.44	16.59	16.62
Aug-95	15.23	15.78	15.89	15.96
Sep-95	15.10	15.23	15.44	15.49
Oct-95	14.44	14.81	15.07	15.15
Nov-95	14.00	14.09	14.36	14.39
Dec-95	14.15	14.26	14.52	14.56
Jan-96	13.38	13.50	13.68	13.77
Feb-96	13.58	13.82	14.04	14.10
Mar-96	14.07	14.75	14.95	15.04
Apr-96	14.34	15.12	15.62	15.78
May-96	16.19	16.08	16.31	16.53
Jun-96	14.82	14.94	15.52	15.78
Jul-96	14.68	14.70	15.14	15.39
Aug-96	15.28	15.30	15.51	15.82
Sep-96	14.84	14.96	15.13	15.42
Oct-96	15.19	15.28	15.52	15.80
Nov-96	15.82	15.81	15.93	16.18
Dec-96	15.95	15.99	15.95	16.19
Jan-97	15.67	15.82	15.65	15.82
Feb-97	14.79	14.74	14.84	15.03
Mar-97	14.96	14.90	14.97	15.16
Apr-97	15.04	15.05	15.05	15.24
May-97	14.96	14.89	14.92	15.08
Jun-97	14.69	14.58	14.62	14.72
Jul-97	14.23	14.08	14.19	14.21
Aug-97	14.09	14.02	14.15	14.24
Sep-97	14.07	13.99	14.07	14.18
Oct-97	14.09	13.89	13.94	14.05
Nov-97	14.52	14.43	14.43	14.50
Dec-97	14.14	14.06	14.01	14.14
Jan-98	13.72	13.57	13.52	13.61
Feb-98	13.55	13.36	13.34	13.49
Mar-98	13.11	13.02	13.08	13.33
Apr-98	12.51	12.54	12.65	12.92

Time series	KBP2000M	KBP2001M	KBP2002M	KBP2003M
Unit of measure	Percentage	Percentage	Percentage	Percentage
May-98	13.11	13.19	13.18	13.46
Jun-98	14.65	14.72	14.48	14.60
Jul-98	16.45	16.54	15.93	15.89
Aug-98	18.11	18.02	17.25	16.95
Sep-98	19.79	19.76	18.38	18.30
Oct-98	17.35	17.38	16.50	16.51
Nov-98	16.36	16.41	16.02	16.05
Dec-98	16.91	16.99	16.42	16.36
Jan-99	16.46	16.00	16.26	15.89
Feb-99	14.93	14.89	15.19	14.88
Mar-99	14.17	14.38	14.71	14.54
Apr-99	14.17	14.27	14.68	14.58
May-99	14.69	14.90	15.21	15.14
Jun-99	14.16	14.49	14.93	14.93
Jul-99	13.59	14.26	14.79	14.97
Aug-99	14.13	14.65	15.16	15.28
Sep-99	13.72	14.63	15.12	15.35
Oct-99	13.56	14.29	14.80	15.00
Nov-99	13.19	13.75	14.23	14.30
Dec-99	12.92	13.48	13.95	13.96
Jan-00	12.17	12.98	13.43	13.49
Feb-00	12.24	12.98	13.31	13.50
Mar-00	12.58	13.46	13.75	13.92
Apr-00	12.66	13.76	14.09	14.27
May-00	13.12	14.20	14.62	14.79
Jun-00	12.80	13.82	14.20	14.33
Jul-00	11.98	13.29	13.70	13.90
Aug-00	11.46	12.85	13.22	13.52
Sep-00	11.67	13.02	13.42	13.72
Oct-00	11.77	12.97	13.34	13.72
Nov-00	11.65	12.66	13.05	13.40
Dec-00	11.23	12.18	12.57	12.88
Jan-01	10.80	11.91	12.61	12.61
Feb-01	10.54	11.31	11.94	11.97
Mar-01	10.57	11.25	11.82	11.79
Apr-01	10.96	11.55	12.14	12.17
May-01	10.81	11.31	11.90	11.93
Jun-01	10.31	10.77	11.30	11.32

Time series	KBP2000M	KBP2001M	KBP2002M	KBP2003M
Unit of measure	Percentage	Percentage	Percentage	Percentage
Jul-01	9.74	10.43	10.92	10.90
Aug-01	9.30	10.12	10.71	10.75
Sep-01	9.22	10.07	10.77	10.81
Oct-01	9.16	9.98	10.62	10.73
Nov-01	8.89	9.54	10.19	10.27
Dec-01	10.20	11.15	11.71	11.63
Jan-02	10.11	11.09	11.63	11.61
Feb-02	10.66	11.35	11.91	11.89
Mar-02	11.13	12.16	12.67	12.63
Apr-02	11.36	12.31	12.58	12.47
May-02	11.57	11.88	11.87	11.66
Jun-02	11.77	11.71	11.83	11.60
Jul-02	11.42	11.45	11.42	11.15
Aug-02	11.42	11.50	11.39	11.08
Sep-02	12.08	12.24	11.76	11.35
Oct-02	12.32	12.60	11.78	11.27
Nov-02	11.57	11.70	11.16	10.86
Dec-02	11.07	11.07	10.71	10.44
Jan-03	11.00	11.39	10.54	10.17
Feb-03	11.03	11.08	10.35	9.94
Mar-03	10.94	10.97	10.31	10.00
Apr-03	11.01	10.85	10.17	9.93
May-03	10.57	10.57	9.87	9.76
Jun-03	9.45	9.48	9.12	9.26
Jul-03	8.98	9.07	9.32	9.57
Aug-03	9.11	9.43	9.48	9.59
Sep-03	8.94	9.10	9.43	9.61
Oct-03	8.19	8.67	8.93	9.13
Nov-03	8.03	8.53	8.96	9.28
Dec-03	7.89	8.66	8.92	9.15
Jan-04	8.53	8.93	9.12	9.27
Feb-04	8.60	9.15	9.25	9.40
Mar-04	8.66	9.32	9.42	9.60
Apr-04	8.98	9.62	9.67	9.85
May-04	9.33	10.00	10.04	10.24
Jun-04	9.34	9.98	10.07	10.38
Jul-04	8.86	9.47	9.69	10.08
Aug-04	8.14	8.87	9.20	9.72

Time series	KBP2000M	KBP2001M	KBP2002M	KBP2003M
Unit of measure	Percentage	Percentage	Percentage	Percentage
Sep-04	7.60	8.39	8.75	9.28
Oct-04	7.61	8.41	8.69	9.16
Nov-04	7.32	8.04	8.44	8.96
Dec-04	7.21	7.67	8.05	8.38
Jan-05	7.31	7.63	7.93	8.20
Feb-05	7.23	7.40	7.60	7.85
Mar-05	7.52	7.77	8.05	8.21
Apr-05	7.65	8.01	8.45	8.45
May-05	7.52	7.93	8.40	8.40
Jun-05	7.33	7.67	8.06	8.08
Jul-05	7.38	7.70	8.09	8.12
Aug-05	7.25	7.57	7.92	7.90
Sep-05	7.48	7.79	8.07	8.04
Oct-05	7.69	7.90	8.14	8.10
Nov-05	7.56	7.72	7.93	7.88
Dec-05	7.27	7.40	7.60	7.57
Jan-06	7.10	7.24	7.41	7.37
Feb-06	7.07	7.19	7.29	7.26
Mar-06	7.06	7.26	7.42	7.36
Apr-06	7.13	7.23	7.44	7.46
May-06	7.28	7.40	7.63	7.63
Jun-06	7.95	8.08	8.30	8.29
Jul-06	8.43	8.46	8.59	8.58
Aug-06	8.61	8.51	8.66	8.59
Sep-06	8.85	8.66	8.72	8.64
Oct-06	8.92	8.60	8.45	8.39
Nov-06	8.67	8.19	8.01	7.87
Dec-06	8.87	8.28	7.97	7.81
Jan-07	8.78	8.17	7.81	7.65
Feb-07	8.73	7.98	7.65	7.50
Mar-07	8.72	8.04	7.68	7.59
Apr-07	8.80	8.08	7.72	7.64
May-07	8.85	8.06	7.68	7.58
Jun-07	9.54	8.80	8.22	8.10
Jul-07	9.75	9.03	8.42	8.34
Aug-07	9.84	9.26	8.52	8.37
Sep-07	9.85	9.22	8.53	8.45
Oct-07	9.74	8.87	8.20	8.12

Time series	KBP2000M	KBP2001M	KBP2002M	KBP2003M
Unit of measure	Percentage	Percentage	Percentage	Percentage
Nov-07	10.33	9.13	8.28	8.19
Dec-07	10.56	9.41	8.46	8.29

Table 17: Johannesburg Stock Exchange All-Share Index Closing Values

Date	Closing Price	Date	Closing Price	Date	Closing Price
Mar-85	1034	Apr-85	1088	May-85	1134
Jun-85	1128	Jul-85	1073	Aug-85	1162
Sep-85	1190	Oct-85	1213	Nov-85	1303
Dec-85	1323	Jan-86	1401	Feb-86	1395
Mar-86	1465	Apr-86	1359	May-86	1421
Jun-86	1500	Jul-86	1613	Aug-86	1862
Sep-86	1920	Oct-86	1898	Nov-86	1999
Dec-86	1981	Jan-87	2130	Feb-87	2096
Mar-87	2163	Apr-87	2350	May-87	2332
Jun-87	2331	Jul-87	2631	Aug-87	2704
Sep-87	2677	Oct-87	2041	Nov-87	1926
Dec-87	1819	Jan-88	1568	Feb-88	1518
Mar-88	1680	Apr-88	1605	May-88	1676
Jun-88	1755	Jul-88	1812	Aug-88	1724
Sep-88	1849	Oct-88	1968	Nov-88	1961
Dec-88	1984	Jan-89	2158	Feb-89	2285
Mar-89	2533	Apr-89	2594	May-89	2398
Jun-89	2628	Jul-89	2675	Aug-89	2784
Sep-89	2766	Oct-89	2696	Nov-89	2859
Dec-89	2976	Jan-90	3194	Feb-90	3084
Mar-90	3257	Apr-90	3032	May-90	3188
Jun-90	3077	Jul-90	3152	Aug-90	2993
Sep-90	2744	Oct-90	2667	Nov-90	2601
Dec-90	2720	Jan-91	2556	Feb-91	2803
Mar-91	2877	Apr-91	3033	May-91	3115
Jun-91	3306	Jul-91	3491	Aug-91	3349
Sep-91	3297	Oct-91	3526	Nov-91	3542
Dec-91	3440	Jan-92	3605	Feb-92	3597
Mar-92	3550	Apr-92	3454	May-92	3732
Jun-92	3655	Jul-92	3431	Aug-92	3152
Sep-92	3211	Oct-92	3017	Nov-92	3192
Dec-92	3259	Jan-93	3433	Feb-93	3418
Mar-93	3560	Apr-93	3733	May-93	3992
Jun-93	4078	Jul-93	4085	Aug-93	4034
Sep-93	3770	Oct-93	3916	Nov-93	4164
Dec-93	4893	Jan-94	4755	Feb-94	4846
Mar-94	4939	Apr-94	5359	May-94	5396

Date	Closing Price
Jun-94	5404
Sep-94	5639
Dec-94	5867
Mar-95	5282
Jun-95	5421
Sep-95	5657
Dec-95	6228
Mar-96	6749
Jun-96	6879
Sep-96	6878
Dec-96	6658
Mar-97	7095
Jun-97	7420
Sep-97	7123
Dec-97	6202
Mar-98	7579
Jun-98	6772
Sep-98	5099
Dec-98	5430
Mar-99	6383
Jun-99	7048
Sep-99	6855
Dec-99	8543
Mar-00	7957
Jun-00	7710
Sep-00	8274
Dec-00	8326
Mar-01	8159
Jun-01	9223
Sep-01	8126
Dec-01	10442
Mar-02	10949
Jun-02	10658
Sep-02	9465
Dec-02	9277
Mar-03	7680
Jun-03	8352
Sep-03	8926
Dec-03	10387

Date	Closing Price
Jul-94	5652
Oct-94	5724
Jan-95	5054
Apr-95	5479
Jul-95	5438
Oct-95	5789
Jan-96	6871
Apr-96	6976
Jul-96	6607
Oct-96	6975
Jan-97	6676
Apr-97	7131
Jul-97	7485
Oct-97	6589
Jan-98	6550
Apr-98	8235
Jul-98	7020
Oct-98	5828
Jan-99	5799
Apr-99	7065
Jul-99	7096
Oct-99	7153
Jan-00	8475
Apr-00	7445
Jul-00	7738
Oct-00	8111
Jan-01	9072
Apr-01	8978
Jul-01	8557
Oct-01	8543
Jan-02	10314
Apr-02	11030
Jul-02	9239
Oct-02	9376
Jan-03	8798
Apr-03	7510
Jul-03	8810
Oct-03	9765
Jan-04	10849

Date	Closing Price
Aug-94	5834
Nov-94	5756
Feb-95	5147
May-95	5471
Aug-95	5543
Nov-95	5972
Feb-96	6705
May-96	6818
Aug-96	6689
Nov-96	6714
Feb-97	7145
May-97	7022
Aug-97	7307
Nov-97	6326
Feb-98	7096
May-98	7630
Aug-98	4923
Nov-98	5621
Feb-99	5915
May-99	6489
Aug-99	6938
Nov-99	7553
Feb-00	7992
May-00	7364
Aug-00	8489
Nov-00	7805
Feb-01	9013
May-01	9390
Aug-01	8986
Nov-01	9441
Feb-02	10815
May-02	11219
Aug-02	9677
Nov-02	9564
Feb-03	8402
May-03	8564
Aug-03	9226
Nov-03	9730
Feb-04	10896

Date	Closing Price
Mar-04	10693
Jun-04	10109
Sep-04	11761
Dec-04	12657
Mar-05	13299
Jun-05	14155
Sep-05	16876
Dec-05	18097
Mar-06	20352
Jun-06	21238
Sep-06	22375
Dec-06	24915
Mar-07	27267
Jun-07	28337
Sep-07	29959
Dec-07	28958

Date	Closing Price
Apr-04	10386
Jul-04	10306
Oct-04	11655
Jan-05	12799
Apr-05	12556
Jul-05	15144
Oct-05	16433
Jan-06	19745
Apr-06	21136
Jul-06	20886
Oct-06	23338
Jan-07	25448
Apr-07	28171
Jul-07	28562
Oct-07	31335

Date	Closing Price
May-04	10414
Aug-04	11160
Nov-04	12491
Feb-05	13477
May-05	13787
Aug-05	15414
Nov-05	16775
Feb-06	19085
May-06	20565
Aug-06	21954
Nov-06	23950
Feb-07	25796
May-07	28628
Aug-07	28660
Nov-07	30308