Terengganu International Finance and Economics Journal
Volume 2, Issue 1: 15-27, 2012

A Cointegration Tests on Malaysian Government Securities (MGS) Spreads and Inflation

[1]Cheng Fan Fah* and [1]Annuar Nasir
[1]Department of Accounting and Finance, Faculty of Economics and Management,
Universiti Putra Malaysia, 43400 Serdang, Selangor, Malaysia.
*Corresponding e-mail: chengfanfah@yahoo.com

Abstract

The purpose of this research is to study the relationship between yield spreads of Malaysian Government Securities (MGS) and inflation dynamics over the period of 1976 to 2008. The study used various statistical techniques to determine the predictive power of yield spreads between 1-year MGS and 10-years MGS in inflation movement. The quarterly data provide evidences that the cointegration test explains that there is a long-run cointegration relationship between the MGS spreads and GDP deflator. The result is further supported by the Granger causality test where there is a unidirectional relationship running from GDP deflator to spreads. The evidence found here is consistent with the theory that inflation is Granger-caused by spreads. The result from regression indicates that linear relationship exists between MGS quarterly yield spreads and inflation. The efficiency of regression model is confirmed by Durbin-Watson test and residual plots.

Keywords*: Malaysian Government Securities, Bonds, Yield to maturity, Yield spreads, GDP deflator, Inflation rates, Unit root, Cointegration, Granger causality*

1. INTRODUCTION

This research paper is about a study on Malaysian Government Securities (MGS). It investigates the relationship between yield spreads of Malaysian Government Securities and inflation dynamics from year 1976 to 2008. An attempt to determine the predictive power of yield spread between1-year MGS and 10-years MGS in inflation movement. In achieving this objective, this study will propose to use some statistical tests to analyze the MGS spread and inflation relationship, which include the unit roots test, cointegration test, Granger causality test and also regression analysis. In this section, a general phenomenon of Malaysian Bond Market will be briefly discussed. The market infrastructures, which include the systems used for securities market trading, will be discussed as well.

1.1 Industry background

Malaysia is a developing country and is one of the most developed countries in South East Asia. Malaysia is approaching Vision 2020 where the economy of the country is completely formed and with a Malaysian-centric developed nation. Malaysian Government Securities (MGS) are marketable debt instruments issued by the Government of Malaysia to raise funds from the domestic capital market to finance the Government's development expenditure and working capital. The central bank, Bank Negara Malaysia in its role as banker and adviser to the Government, advises on the details of Government securities issuance and facilitates such issuance through various market infrastructures that it owns and operates. Currently, the various forms of Government securities in Malaysia are:

a. Malaysian Government Securities (MGS) - interest bearing long-term bonds issued by the Government of Malaysia to raise funds from the domestic capital market for development expenditure.
b. Malaysian Treasury Bills (MTB) - short-term securities issued by the Government of Malaysia for working capital.

c. Government Investment Issues (GII) and Malaysian Islamic Treasury Bills (MITB) - long-term and short-term non-interest bearing Government securities, respectively, issued based on Islamic principles by the Government of Malaysia.

MGS were initially issued to meet the investment needs of the Employees Provident Fund (EPF), local banks and insurance companies. In the late 1970s and early 1980s, MGS were issued to finance the public sector's development expenditure. In contrast, by 1990s, the purpose of MGS issuance was extended to funding part of the Government's budget deficit and prepayment of some of the Government's external loans. The Government continued to issue MGS during the fiscal surplus of 1993-1997 to meet the market demand for MGS. GII and MITB, on the other hand, were issued to allow Islamic banks to hold liquid papers that meet their statutory liquidity requirements. The issuance of these papers also enabled them to invest their liquid funds in instruments that are issued based on Shariah principles as they do not prefer to purchase or trade in Malaysian Government Securities (MGS), Malaysian Treasury Bill (MTB) or other interest-bearing instruments. This will concentrate in investigating Malaysian Government Securities (MGS).

1.2 Problems statement

Inflation rate is generally refers as a rise in prices measured against a standard level of purchasing power. The two most recognized measures of inflation are the CPI which measures consumer prices, and the GDP deflator, which measures inflation as a whole of the domestic economy. In economies, all are in their efforts to maintain low inflation rate, including Malaysia. In ordinary economics views, the inflation is caused by the interaction of the supply of money with output and interest rates. Mainstream economist views can be broadly divided into two, one who believes that monetary effects dominate all others in setting the rate of inflation. While another group believes that the interaction of money, interest and output dominate over other effects. There are also economics believe that an inflation of overall prices is a result from an increase in the supply of money by central banking authorities. All opinions are back to grounds for different economist arguments and views. The current monotonous situation in Malaysia bond market has raise up concerns to the bond market analysts. The bond yields at present are not attractive to issuers and investors are demanding higher returns. Typically higher interest rates would result in higher yields and cheaper bonds but higher inflation would also have the same effect. At the present economy environment the bond market is being affected by any count of factors and not solely the issue of inflation. For this reason the attempt to identify the real cause of various macroeconomic variables is a continuous study and assessment.

1.3 Research questions

Based on the review of the preceding literature, some research questions appeared.

a. What is the relationship between yield spreads of Malaysian Government Securities (MGS) and inflation dynamics?
b. How efficient is the predictive power of yield spreads between 1-year MGS and 10-years MGS in inflation movement?
c. How significant is the directional relationship between MGS spreads and inflation?
d. How efficient is the long run relationships between the yield to maturity of 1 1-year MGS and 10-years MGS in quarterly basis?

1.4 Research objectives

This research paper intends to provide evidences on the long-term relationship between the yield curves and inflation over the past 33 years. This paper studies the predictive power of the spread between 1-year MGS and 5-years MGS as well as 1-year MGS and 10-years MGS and inflation by using cointegration. The direction of the relationship will be determined by using Granger causality test. Understanding these relationships is important. The first reason is the results of this study will provide evidences on the liquidity term premia in

relation to the country state of economies. Second, the results will assist the pricing and risk management of Malaysia Debt Securities in international markets. Third, the finding will be able to explain the controversial issue of long-term equilibrium of the term structure of interest rates for Malaysia.

1.5 Significant of study

This study makes contribution to the literature in several ways. It studies the relationship between yield spreads of Malaysian Government Securities and inflation dynamics in a quarterly basis. This study fundamentally is an added value to the research paper by Cheng, Lee, and Royfaizal (2008) which conducted the similar research in a yearly basis. Both results contribute to the literature and proved that the relationships are significant between inflation and MGS spreads in Malaysia. The study is looking at the yield to maturity of Malaysian government bond for research purpose. The returns of bond yields are believed to be investors' interest as the risk-free rate of MGS provide a big advantage for them. On average, higher interest rates would result in higher yields and cheaper bonds but higher inflation would also have the same effect. For that reason, the research provides evidence on the relationship between the yield curves and inflation and thus shows that the pricing of bonds are efficient in an economy such as Malaysia. Besides, the slope of yield curve, which obtained by the difference between long-term and short-term government bonds rates, can effectively predict the inflation in developed countries. However, there are limited studies in developed countries in general as well as for Malaysia case. Hence, this study will provide useful viewpoint for the Malaysia bond market in accessing the relationship between yield spreads and inflation dynamics.

2. LITERATURE REVIEW

This chapter will discuss about the theoretical background and research concept, methodology used by other researchers as well as their result findings. Some relevant models have been inserted to give further understanding for researchers to test the relationships among variables. For the literature review purposes, the researcher referred to several journals, books as well as some previous studies of different researchers. The objective of this literature review is to determine the previous studies done by those researchers and continuously help to improve the clarification of the study.

Ciner (2007) examined the linkage between international bond markets. They investigated interactions among the government bond markets of the US, Japan, Germany and the UK between 1988 and 2005. The research paper stated that interest rate differences are likely due to expected changes in currency values and the currency risk premium; in fact the exchange rate depreciation is the factor. While equalization of interest rates may be unlikely under flexible exchange rates, a weaker form of convergence requires that interest rate differentials are stationary. In other words, if the currency risk premium is not time-varying and would be consistent with the statistical cointegration property, a linear combination of two nonstationary series is stationary. They tested the cointegration between the bond indexes and conducted causality tests to examine spill over dynamics. The causality analysis reveals that the bond markets are sensitive to international innovations, particularly from the US, and hence, it can be argued that the global conduct of monetary policy exhibits dependencies. The causality dynamics between the indexes at multiple horizons is examined and tested both direct and indirect causality from the US to the other countries as well as relations between the indexes. The results showed that although the indexes are not cointegrated in the full sample, there is evidence for a stable relation in the latter part of the sample. Also, relying on recently developed causality tests, they uncovered significant direct and indirect lead–lag relations between the markets. The findings clearly suggested that the US market is more influential in the information transmission process since there is causality

from the US to all others in both sample periods. This seems to imply that the US monetary policy innovations are transmitted internationally. Conversely, Japan's impact has decreased in the latter part of the sample, likely as a result of the policies employed in Japan after 2001.

Another research from Jian (2005) studied relationships between government bond markets of five industrialized countries (US, Japan, Germany, UK and Canada) during the period of January 1986 to December 2000. The research of the dynamic linkage pattern is based on data-determined forecast error variance decomposition. This paper more comprehensively examined international bond market linkages, including long-run cointegration relationships between bond yields, dynamic causal linkages between bond yield changes and contemporaneous relationships between bond yield innovations. The cointegration test was based on a vector autoregression (VAR) framework. Since the individual coefficients of a VAR model are hard to interpret, forecast error variance decomposition is used to summarize short-run dynamic linkages among the five bond markets. The cointegration analysis showed that no long-run relationship exists among the five bond markets during the sample period. Besides, there exist strong correlations between bond yield innovations. The causal pattern of such strong instantaneous relationships was uncovered, building on the recent advance in VAR analysis. In addition, the recent research paper prepared by Cheng, Lee, and Royfaizal (2008) discussed the empirical analysis Malaysia Government Securities (MGS) spreads in a numbers of directions.

The research intended to provide evidences on the relationship between the yield curves and inflation and thus show that the pricing of bonds are efficient in an economy like Malaysia. Cointegration and Granger-causality test are used to show the movement and the predicting power of the MGS bond spreads on inflation. The paper proposed to use cointegrations and Granger-causality test to find long run and short run relationships between the spread of 1-year and 10-years yield to maturity of Malaysia Government Securities. Time period of issues are 30 years, which are from year 1976 to 2007. From the descriptive statistics results, MGS spread between 1 year and 10 year bonds are all positively rated. This showed that there is no negative spread and the yield curves are all upward sloping. The rejection of null hypothesis indicates there is cointegration between MGS spreads and inflation rates in Malaysia. Moreover, there is a short-run unidirectional relationship running from inflation to spread, which proved the theory that the inflation is Granger-caused by spread. Arturo (2005) studied the predictive power of the yield curve for output and inflation. The research explained why there are these empirical relationships between real economic activity, inflation and the pattern of yields on bonds of different maturities – and whether they are likely to persist under changing economic conditions. The research purpose was to construct a suitable model to incorporate the main relevant economy features to be solved by certain analytical technique and to interpret the key economic relationships. The model includes the private sector economy tools, the monetary authority, and the financial sector. The analysis in this study suggested that the interaction of monetary policy with some features of the real economy gave rise to the predictive power of the yield curve. Though precise numerical formulas may vary with changes in monetary policy or economic parameters, the existence of some form of predictive power for both output and inflation is robust.

Moon and Ravi (2006) studied the framework to explain the cross-sectional variation in the relation between international security returns and expected inflation based on their sensitivities to world stock and bond factors. The researchers regressed inflation sensitivities of returns on country indexes and international mutual funds on their sensitivities to world stock and bond indexes. The paper used the Fisher equation and a two-factor market model for hypothesis testing. From the results, they found out that the inflation sensitivity of securities is negatively related to their stock market sensitivity and positively related to their

bond market sensitivity. The results of the tests with international stock returns of 23 countries and 83 international equity mutual funds support the hypothesis. Hence, the results allow one to assess the inflation sensitivity of a security using its sensitivity to the bond and the stock market. The more bond-like a security is, the higher its sensitivity to inflation. Hibiki (2003) conducted a research to prove that term spreads of interest rates provides information about three different future economic variables: output growth, inflation, and interest rates, for various sample periods and countries. Although there are many studies give evidence that term spreads of interest rates have information about these three different future economic variables, yet the literatures examining the predictability of all these three variables have been quite distinctive. Hence the main purpose of this paper is to integrate these predictability results in an attempt to determine why the term structure can predict future movements in economic variables. This study enables us understand the information contained in the term structure of interest rates, and the relationship between the term structure and business cycle.

The method used began with the simple Affine Term Structure Model (ATSM) with observable factors. Later on the method proceeded with the VAR-ATSM for examining the predictabilities of not only output growth, but also inflation and short rates. The VAR-ATSM can be interpreted as either a VAR model with no-arbitrage restrictions or ATSM with observable factors obeying VAR. There are three findings in the research paper: (i) When the inflation rate is higher, consumers are willing to pay a higher premium for output growth risk hedge, which may be explained by a simple model with money in the utility function and a monetary policy rule. This causes term spreads to react to recent inflation shocks. (ii) Term spreads using the short end of the yield curve have less predictive power than many spreads between longer rates. (iii) It is hard to predict output growth with term spreads at short horizons, because the monetary policy shock affects output growth with a lag while the term structure responds to the shock immediately. In conclusion, the paper suggested that term spreads help predict output growth, inflation, and interest rates. Term spreads using the short end of the yield curve have less predictive power than many other spreads.

Fama and French (1989) examined the business conditions and expected returns on stocks and bonds. They intended to prove that the stock and bond returns are related to the variation of business conditions. The variation of expected returns was measured with linear regressions of returns on the forecasting variables. Plots of the forecasting variables represented the components of expected returns. The autocorrelations of the variables used to forecast returns are information about the behaviour of expected returns. The findings illustrate that the default spread is a business-conditions variable, high during periods like the Great Depression when business was persistently poor and low during 1953-1973 when the economy was persistently strong. The dividend yield is correlated with the default spread and moves in a similar way with long-term business conditions. For most of the 1927-1987 periods, the term spread was related to shorter-term measured business cycles. It was low near business-cycle peaks and high near troughs. With the results obtained, they suggested that the implied variation in expected returns is largely common across securities, and is negatively related to long- and short-term variation in business conditions.

Narayan and Smyth (2004) conducted a research on temporal causality and the dynamics of exports, human capital and real income in China. The purpose of the study was to employ cointegration and error-correction modelling to test the causal relationship between real income, exports and human capital stock using data for China over the period 1960 to 1999. The results of the cointegration and causality testing suggested that (1) real exports, human capital and real income were cointegrated when real exports was the dependent variable, but were not cointegrated when human capital or real income were the dependent variable. (2) In the long-run, both human capital and real income Granger caused real exports. (3) In

the short-run, there was bi-directional Granger causality between human capital and real exports, unidirectional Granger causality running from real income to human capital and neutrality between real exports and real income. The results recommended that in the long-run China's exceptional economic performance over the last 25 years was not driven by export expansion with, instead, causality running from human capital stock and real income to real exports. In recent research, Basse (2009) examined the relationship between dividend policy and inflation in Australia. The study was conducted by testing cointegration between these two variables. The empirical evidence indicated that there was a stable long-run relationship between dividend payments and the price level examined data from Australia. The reported results suggested that inflation was contributing to dividend growth. There were two interpretations in the findings. Optimal Australian firms would try to follow a dividend policy which was perceived to be and believed that there was a desirable level of real dividend income to be paid out to their investors. A second possible interpretation of the results would be that inflation simply increased the nominal volume of corporate earnings and leaded to higher dividend payments

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3. RESEARCH METHODOLOGY

This chapter will enlighten the methods and techniques that will be carry out to collect and analyze the data in order to complete the study with the intention of accomplish the goals and objectives of this study. The investors gain benefits when investing in bond markets. The return of the bond market investment measures in the form of yield to maturity, YTM. The YTM depends on the time to maturity, the prevailing interest rates and the risk of the bonds. Risk of the bond is the measure of the default risk of the issuer as to whether the issuer is able to pay back the principal plus interest in full and on time. The scopes of this chapter include research framework, research method, research design, yield to maturity (YTM) and mechanism of estimation of YTM, unit root test, cointegration framework, Granger causality test, linear regression, sampling and procedure, data collection, as well as hypothesis testing.

3.1 Research framework

The framework for this study is fundamentally based on hypothesis testing. Types of statistical methods used will determine by the existence of unit roots in the series. If the series has a unit root, the cointegration technique will be used to test relationships among variables. The analysis proceeds with the Granger causality test to figure out the directional relationships among variables.

3.2 Research method

The tools used for this research paper is based on secondary data, which can be obtained from the source of Bank Negara Malaysia. The data is on quarterly basis whereby yield to maturity of quarterly Malaysian Government Securities (MGS) has been selected from 1976 to 2008. The technique that will be practiced here is 100 percent quantitative method. In other words, a few selected statistical methods will be used to prove significance of figures between the two parameters, which are the MGS spread and inflation dynamics. The methods include unit root test, cointegration test and Granger causality test. The unit root, cointegration and Granger causality test will be conducted by using EVeiws 6. The reason of using quantitative research method instead of qualitative method is simple. First, quantitative method which focuses on describe, explain and predict, is more appropriate in this study as the research objective is to explain the relationship between MGS spreads and inflation dynamics and to provide evidence on the long-term relationship between the yield curves and inflation over the past 33 years. Second, there is a clear distinction between facts and judgments in this research, in which fulfil one of the characteristics of quantitative research method. Third, the measurement process focuses on the quantitative data as the

fundamental resource to provide relationships among all variables, and the results are based on observations and mathematical expressions for conclusion.

3.3 Research design

Type of research that concerned here is a formal study, where the design of the research is fundamentally begin with a hypothesis and involves precise procedures and data source specifications. As the research purpose is to examine how one variable produces changes in another, it is considered as a causal-explanatory study. This study will try to explain relationships among Malaysian Government Securities yields and inflation dynamics and whether the MGS spread will Granger cause inflation in Malaysia. Time dimension involved is the longitudinal studies where the analysis will be repeated over an extended period of total 33 years in quarterly basis. The statistical studies of this research paper comprised of testing hypotheses quantitatively and findings are presented based on representativeness of samples. The research environment of the research design occurs under actual environment conditions or known as field conditions. All data are obtained in actual conditions without passing through any manipulated conditions.

3.4 Yield to maturity (YTM)

Investors can assess the value of a bond by its coupon rates and its current yield. Yet, this is not an accurate measurement of the actual rate of return of the bond. The yield to maturity (YTM) is commonly used to give the total return investors will hope to receive if bondholders hold the bonds until full maturity from the date of purchase either at the time of the issue or at a later date. The cash flow comprise of interim coupon interest payments, the income from reinvesting the coupon proceeds at the yield to maturity, and the maturity level, up to the period when the bond is redeemed. The yield for the bonds data is thus computed from the bond price formula.

3.4.1 Mechanism of estimation of yield to maturity (YTM)

The basic bond analysis is to understand the relationship between the price and yield of the bond. Considering a case of a single cash flow, the bond price equation is given simply as:

$$P = \frac{FV}{(1+r)^n} \tag{1}$$

Where P is the price of the bond which is the present value of its expected cash flow, FV is the future value, r is the rate of return and n is the number of periods invested. In practice, most bonds have more than one cash flow; in fact they have multiple cash flows. Each cash flow therefore is similarly discounted to obtain the present value. Extending the basic bond price Equation 1, the present value of a n-period bond is:

$$P_d = \frac{C}{(1+y)^1} + \frac{C}{(1+y)^2} + \frac{C}{(1+y)^3} + \ldots + \frac{C+R}{(1+y)^n} \tag{2}$$

Where P_d is the "dirty price" which includes accrued interest, C is the annual coupon payment, y is the redemption yield or the yield to maturity, and R is the redemption payment at time n.

3.5 Unit root test

To study the direction of causality between MGS spreads and inflation, the first stage is to determine the existence of unit root in the linear stochastic process's characteristic equation. If the process has a unit root of 1, the process will be non-stationary. In some statistical models like ARMA model, the data must be transformed to stationary form prior to analysis. If the data are trending, the removal of trend can be done by first differencing and time-trend regression. First differencing is appropriate for I(1) time series and time-trend regression is appropriate for trend stationary I(0) time series. Unit root tests can be used to determine if trending data should be first differenced or regressed on deterministic functions of time to make the data stationary. Additionally, many economic and finance theory often suggests

the existence of long-run equilibrium relationships among non-stationary time series variables. If these variables are I(1), then cointegration techniques can be used to model these long-run relations. For this reason, pre-testing for unit roots is often a first step in the cointegration modeling. In this study, the order of integration is tested by using the Augmented Dickey-Fuller (ADF) unit root test. The ADF test tests the null hypothesis that a time series y_t is I(1) against the alternative that it is I(0). The ADF test is applied to the following model:

$$y_t = \beta' D_t + \emptyset\, y_{t-1} \sum_{j=1}^{p} \psi_j \Delta y_{t-j} + \varepsilon_t \quad (3)$$

Where D_t is a vector of deterministic terms (constant, trend etc.). The p lagged difference terms, Δy_{t-j}, are used to approximate the ARMA structure of the errors, and the value of p is set so that the error ε_t is serially uncorrelated. The error term is also assumed to be homoskedastic. The specification of the deterministic terms depends on the assumed behavior of y_t under the alternative hypothesis of trend stationarity.

3.6 Cointegration framework

In this section, this paper presents a cointegration framework to analyze the relationship between bond spreads and inflations. Cointegration is based on the idea that while a set of variables are individually non-stationary, a linear combination of the variables might be stationary. The stationary combination arises from a long-run statistical relationship that links the cointegration variables together. Cointegration also implies the short-term movements of the variables will be affected by the lagged deviation from the long-run relationship between the variables. This includes mean reversion around the long-run relationship, but in the absence of economic restriction, there is no causality in a cointegration model. An innovation in any one variable affects the other variables in the system.

Testing for cointegration is undertaken by the Johansen approach. This is an establish procedure to estimate and testing the number of cointegrating relationships and common stochastic trends among the components of a vector x_t of n potentially endogenous variables, it is possible to specify the following data generating process, and model x_t as an unrestricted vector autoregression (VAR) involving up to *k*-lags of x:

$$x_t = A_1 x_{t-1} + A_2 x_{t-2} + \ldots + A_k x_{t-k} + u_t \quad (4)$$

Where x_t is a (n x 1) matrix, and each of A_i is a (n x n) matrix of parameters. Eq. (4) can be retranslated into a vector error correction (VECM) form:

$$\Delta x_t = \sum_{i=1}^{k-1} \Gamma_i \Delta x_{t-i} + \Pi x_{t-k} + u_t \quad (5)$$

Where $\Gamma_i = -(I - A_1 - \ldots - A_i)$ $(i = 1, \ldots, k-1)$, Γ_i are interim multipliers, and $\Pi = -(I - A_1 - \ldots - A_k)$. Testing for cointegration is related to the consideration of the rank of Π, that is finding the number of r linearly independent columns in Π (cointegration vectors).

3.7 Granger causality test

The ECM describes the feedback process of deviation adjusting towards long-run equilibrium and reveals the mechanism which ties cointegrated series together in the sense of "Granger causality". Short-run deviations from the long-run equilibrium will feed back on the changes in the dependent variable, in order to force the movement towards the long-run equilibrium. The VECM is a dynamic model of the differenced I(l) variables included in the cointegrating vector and provides significant insight into the lead-lag behavior between MGS spreads and inflation.

$$\Delta y_t = \alpha_1 + \sum_{i=1}^{m_1} \beta_{1i} \Delta y_{t-i} + \sum_{i=1}^{m_2} \beta_{2i} \Delta z_{t-i} + \gamma_1 x_{t-1} + u_{1t} \quad (6)$$

$$\Delta z_t = \alpha_1 + \sum_{i=1}^{m_3} \beta_{3i} \Delta z_{t-i} + \sum_{i=1}^{m_4} \beta_{4i} \Delta y_{t-i} + \gamma_2 x_{t-1} + u_{1t} \quad (7)$$

If y 'Granger causes' z, then changes in y should precede changes in z and past values (lags) of y are statistically significant in explaining current z. The cointegrating vector x_{t-1} is the error correction term (ECT) that ensures deviations from long-run equilibrium are corrected gradually through a series of the coefficients γ_1 and γ_2 determines the speed of adjustment back to the long-run equilibrium.

3.8 Sampling design and procedure

As far as the sampling design of the research is concerned, target population for the study will be focusing on quarterly yield to maturity of MGS. The size of sampling design is 33 years which indeed the usable respond to statistical analysis is at least 33 years of quarterly data, or in summation, a total number of 132 data will be obtained for each variable. For these two parameters we concerned, MGS spreads and inflation dynamics will be tested under confident level of 95 percent. In other words, the allowable error of the statistical results should not be more than 5 percent.

3.9 Data Collection

This study collected the MGS quarterly data from Bank Negara Malaysia website from year 1976 to 2008. The data of GDP deflator obtained from World Bank as well as Department of Statistics, Malaysia websites. The GDP deflator is used as a measurement of inflation.
The (10,1) MGS spreads obtained from the equation as follow:

$$\text{MGS Spread}_{1,10} = YTM_{10} - YTM_1 \quad (8)$$

Where YTM_1 = yield to maturity of 1-year MGS, YTM_{10} = yield to maturity of 10-years MGS. The equation are repeated throughout all quarters from Q1 1976 to Q4 2008.
The inflation rate can be obtained by the equation as follow:

$$\text{Inflation} = \frac{\text{GDP Deflator}_2 - \text{GDP Deflator}_1}{\text{GDP Deflator}_1} \quad (9)$$

Whereby the data will be repeated over every quarter from Q1 1976 to Q4 2008.

3.10 Hypothesis

The major hypothesis in this study is that a strong relationship exists between MGS spread, which represents the difference between 1-yr MGS and 10-yr MGS; with inflation rates. The strategic hypotheses involved are:

a. Null Hypothesis 1 – These series have a unit root.
b. Null Hypothesis 2 – There is no long-term relationship between MGS spreads and inflation.
c. Null Hypothesis 3 – The MGS spread cannot Granger cause inflation in Malaysia.

The proved of hypothesis 1 is by Augmented Dickey-Fuller Test of Unit Roots, the second hypothesis is tested by using cointegration technique. Granger causality test is used to analyze the third hypothesis.

4. RESULTS

The outcome of this study is primarily on the relationships between the MGS yield spreads and the inflation rates in Malaysia from year 1976 to 2008, in a quarterly basis. The results are obtained by using several statistical tests such as Augmented Dickey-Fuller Test of Unit Roots, Johansen Cointegration test, Granger causality test,

4.1 Descriptive Statistics

First of all, the descriptive statistics displays an overall picture of each concerned variable in this study. From the quarterly data obtained throughout the past 33 years, the summarize statistics of spreads between 1-year and 5-years MGS, 1-year and 10-years MGS, GDP

deflators as well as inflation rates are shown in Table 1. For the 1-year and 5-years MGS spreads, the spreads range from a minimum of -1.69 percent in Q2 1998 to a maximum of 2.3581 percent in Q2 1999. The average spreads for these 33 years is 0.9677 percent. While for the 1-year and 10-years spreads, the spreads have a minimum of -1.9912 percent and achieve a maximum number of 3.531 percent, within the same period of time with (5,1) MGS spreads. The negative and positive spreads indicate that the yield curves have both upward and downward slopping. By differencing GDP deflators, inflation rates are calculated and the data fall within -7.3612 percent and 6.9491 percent. The average change in GDP deflators is 0.9399 percent. Total count for each of the variable is 132 where the data used over the past 33 years are all in quarterly basis.

Table 1: Descriptive statistics of (5,1) MGS spreads, (10,1) MGS spreads, GDP deflator, and inflation rate from Q1 1976 to Q4 2008

	(10,1) Spreads	GDP Deflator	Inflation
Mean	1.484	102.430	0.9398
S.D	1.002	16.416	1.6420
Minimum	-1.991	67.85	-7.361
Maximum	3.531	145.842	6.949
Count	132	132	132

4.2 Test of unit root

In any econometrics analysis, the experiment has to be started with the Unit Root test in order to determine the stationary of the time series data. The series is said to be non-stationary if there is unit root in the variables. When a series is non-stationary, it can only be studied for the desire time period and is not possible to generalize it to other periods. There are several stationary tests available for hypothesis testing. In this research, Augmented Dickey-Fuller test of Unit Roots is employed. EViews 6 is used to test the existence of unit root in each variable of the study, which comprise of the (5,1) MGS spreads, (10,1) MGS spreads, GDP deflator and inflation. The null hypothesis of the Unit Root test is that the series contains a unit root, and the alternative is that the series is stationary.

H_0: The series has a unit root
H_1: The series is stationary

Table 2: Augmented Dickey-Fuller test of unit roots for MGS spreads, GDP deflator and inflation from Q1 1976 to Q4 2008

Variable	ADF Test Critical Values - 5% level	t-Statistics	Prob. *
_10_1__Spread	-3.444487	-3.409224	0.0545
GDP_Deflator	-3.444487	-2.181466	0.4955
Inflation	-3.444487	-7.405378	0.0000**

Notes: * MacKinnon (1996) one-sided p-values.
** denotes rejection of the null hypothesis at 5% significance level.

Table 2 shows the results obtained from the Augmented Dickey-Fuller Test of Unit Roots for MGS (10,1) spreads, GDP deflator and inflation rates from first quarter 1976 to fourth quarter 2008. The null hypothesis will be rejected if p-value is smaller than 0.05. The results explain that the null hypothesis for both (10,1) spreads and GDP deflator are fail to be rejected. In other words, the unit roots exist in the series of (10,1) spreads and GDP deflator whereas the inflation series are stationary.

4.3 Johansen cointegration test

After performing the unit root test, the time series data will be continue with the cointegration test. The cointegration test is implemented based on the Johansen and Juselius (1990) procedure, which considered as a well-accepted approach. From the results of unit roots test obtained, the unit roots only exist in the series of quarterly (10,1) spreads and GDP deflator, hence these two series are used in the Johansen cointegration test to study the relationship among them. The null hypothesis for cointegration test is there is no cointegration and the alternative hypothesis is that there is at least one cointegration vector. On the basis of Johansen cointegration test, the r denotes the number of significant cointegrating vectors. Hence the Johansen statistics test analyzes the hypothesis of at most one and zero cointegrating vectors, using the maximum eigenvalue. The 5% critical value for null hypothesis: $r \leq 1$ is 3.8415 and null hypothesis for r=0 is 14.265. In this study, p-value is used to determine the rejection of hypothesis. If the p-value is smaller than 0.05, the null hypothesis will be rejected.

H_0: There is no cointegration

H_1: There is at least one cointegration vector

From EViews 6, the result from the trace statistics indicates that the null hypothesis is rejected using 5% critical value for the time period, where the p-value is 0.0395. The result concludes that there is a long-run relationship between the quarterly MGS spreads and GDP deflator from year 1976 to 2008.

Table 3: Cointegration Test for (10,1) MGS spreads and GDP deflator from Q1 1976 to Q4 2008

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.097687	16.16846	15.49471	0.0395*
At most 1	0.024219	3.113627	3.841466	0.0776

Notes: Trace test indicates 1 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

** MacKinnon-Haug-Michelis (1999) p-values

4.4 Granger causality test

After performing the cointegration test, the study proceeds with the Granger causality test, in which the directional relationship between (10,1) spread and GDP deflator will be determined. The Granger causality test will be conducted in both directions. Hence the first null hypothesis of Granger causality test is (10,1) spread does not Granger cause GDP deflator. While the second null hypothesis is GDP deflator does not Granger cause (10,1) spread.

Null Hypothesis 1 - (10,1) MGS spread does not Granger cause GDP deflator

Null Hypothesis 2 - GDP deflator does not Granger cause (10,1) MGS spread

Table 4: Pairwise Granger Causality test for (10,1) spread and GDP deflator from Q11976 to Q4 2008

Null Hypothesis	Obs	F-Statistic	Prob.
_10_1__Spread does not Granger Cause GDP_deflator	131	0.03652	0.8488
GDP_Deflator does not Granger Cause _10_1__Spread		5.20196	0.0242*

Notes: * denotes rejection of the hypothesis at 5% significance level

From the result generated by EViews 6, the first hypothesis is not significant and conclude that (10,1) spread does not Granger cause GDP deflator. However, in the second hypothesis, the null hypothesis is rejected where p-value equals to 0.0242. Hence, the outcome of the Granger causality test conclude that the GDP deflator Granger cause (10,1) spread. In

conclusion, there is a unidirectional relationship running from GDP deflator to (10,1) MGS spread. The evidence found here consistent with the theory that inflation is Granger-caused by spreads.

5. SUMMARY OF RESULTS AND FINDINGS

The studies on the spreads of bond yields and inflation rates are limited in developing countries. Apart from the seminar paper prepared by Cheng, Lee, and Royfaizal (2008) that used annual data, this study uses the quarterly spreads of the 1-year and 10-years MGS spreads for the first time instead and OLS regression is added for analysis.

The results find that the inflation are stationary while unit roots exist in the quarterly spreads of the 1-year and 10-years MGS spreads and GDP deflator. The research test for cointegration between the series of quarterly (10,1) spreads and GDP deflator. The results reject the null hypothesis and conclude that there is cointegration between the spreads and GDP deflator in Malaysia. The trace statistics is significant at 5% level. The results consistent with the previous findings and conclude that the yield spreads have the ability to predict the future inflation in the long term in Malaysia. The finding is further supported by the Granger causality test where there is a unidirectional relationship running from GDP deflator to MGS (10,1) spreads. The evidence found here is consistent with the theory that the expected inflation is Granger-caused spread.

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