

The Impact of Changes in Financial and Macroeconomic Variables on Term Structure of Interest Rates in Malaysia

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Abstract

Based on time series model, the connection between term structures of interest rate, financial and macroeconomic variables is explored for Malaysia from 1997Q1 to 2009Q2. The behavior of maturity spreads is examined in detail and regression model is established using Ordinary Least Square (OLS) method. The findings show that some macroeconomic variables do not have significant impact on maturity spreads. The money supply affect maturity spread positively while current account influence maturity spread negatively. The other variables, namely stock market return, gross domestic product, industrial production index, inflation rate and trade balance, have no relations with maturity spread. Future work should seek out the effects of maturity spreads on macroeconomic conditions.

Keywords: term structure, interest rate, financial variables, macroeconomic variables, Malaysia.

Journal of Economic Literature (JEL) codes: G10

Introduction

In major financial markets around the world, trading in the bond market has gained popularity as a way of life to earn huge profits. Besides that, structured bond markets are progressively more important to raise capital for the investors, firms and government in Malaysia. The term structure of interest rates has been a key research issue in academics and practitioners field in various developed economies for over 70 years. The term structure of interest rates begins with the ideas of Nobel laureates Fisher and Hicks in the 1930s. There are noteworthy conventional theories with strong empirical evidence about the term structure behavior, which suggests fundamental conclusion about bond market behavior in those developed economies.

Various studies have been documented to examine the relationship between the economic fundamentals and bond market. Cherif and Kamoun (2007), Dewachter *et al.* (2006), Diebold *et al.* (2006), Hordahl *et al.* (2006), Ang and Piazzesi (2003) and many more modeled the relation between bond yields and macroeconomic data such as output gap, inflation, foreign exchange and so on. The findings revealed that macroeconomic variables can influence the term structure of interest rates but the degree of significance varies for the different maturity. Nonetheless, there is no thorough study on the term structure behavior in emerging ones like Malaysia. Therefore, this paper intends to identify the contributions of the financial and economic variables to the term structure behavior in this economy.

Malaysian Economy

Malaysia is a relatively small South East Asian country with a total land area of about 330,000 square kilometers. The country is rich with natural resources, including crude petroleum and natural gas. The country is mainly driven by private enterprise, with the government playing an active role in planning to promote balanced growth and social progress. The utilization and development of the nation's natural, mineral and human resources, aided by prudent fiscal and monetary management in an environment of political stability, has made Malaysia on the relatively more progressive, prosperous and one of the fastest growing economies in Asia. Malaysia is an upper middle-income country with a target of transforming itself into a high-income and developed nation by 2020. The economy recorded a growth of 4.7% in 2008. Nevertheless, in 2009, gross domestic product (GDP) contracted by 1.7% as a result of Global Financial Crisis (2008/2009). The country's dependence on world trade causes Malaysia to be affected by the downturn in world economic activity. The unfavorable external demand contributed to the poor performance in the trade accounts that push Malaysia into a recession. Malaysia's exports dipped sharply about 10.4% in 2009 while investment was severely affected as well. 17.2% drop in fixed capital formation of private sector also is one of the main factors that contract the growth of Malaysia economy. It is an indication that many firms postponed or blocked planned investments to protect their balance sheets.

As a measures of real production output, industrial production index is expressed as a percentage of real output. The index included the mining, manufacturing and electricity sectors. Industrial output plunged sharply in May 2009 but faced a steeper fall of 17.9% in January 2009 as compared with January 2008.

Problem Statement

It is often argued that bond yield is determined by some fundamental financial and macroeconomic factors such as stock market indices, interest rate and exchange rate. The econometric framework in most of the earlier studies is to specify a linear model between the interest rate and macroeconomic variables on behalf of the world's countries especially in developed countries. Numerous studies such as Cherif and Kamoun (2007), Dewachter *et al.* (2006), Diebold *et al.* (2006) and Bernhardsen (2000) modeled the relationship between interest rate and economy data in terms of GDP, inflation, unemployment rate, monetary policy instrument, current account etc. Their findings revealed that the variation of interest rate was basically influenced by the changes in economic fundamentals. However, some studies concluded that the certain macroeconomic factors only have impact on either short-term or long-term interest rate but not both [see Hordahl *et al.* (2006), Ang and Piazzesi (2003), etc]. These inconsistencies are one of the major concerns in this paper.

Little is known about the term structure of interest rates in developing countries like Malaysia. The only Malaysian market study, which analyzes the term structure from 1984 to 1999, is presented by Ghazali and Low (2002). The results demonstrate that the interest rate of different maturities is connected together so their parallel movement is not a matter of coincidence. Therefore, Malaysian government securities market is more efficient to be testing the Expectation Hypothesis. Nonetheless, the authors only examine the validity of Expectation Hypothesis in Malaysia but not considering the impact of changes in economic activity on the term structure of interest rates. There is no research thus far that examines the behavior of Malaysia towards the term spread. This paper aims to fill this gap by testing the expectations hypothesis, as well as examining the movements between short-term and long-term interest rate and their causal relationship with the financial and macroeconomic factors in the Malaysia securities market.

Objective of the Study

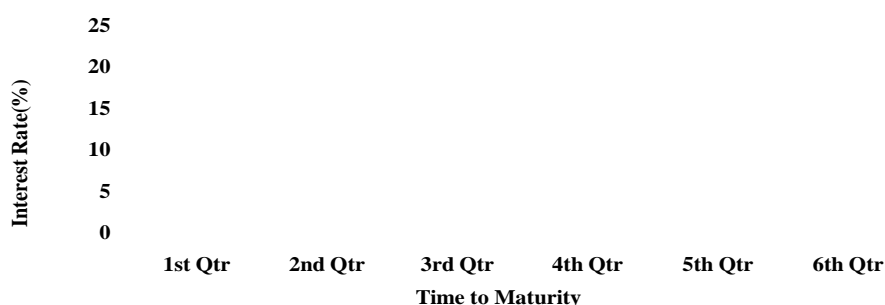
In this paper, the relationship between the term structure of interest rates, financial and macroeconomic variables in Malaysia will be studied. The presence of a relationship between these variables is tested using Ordinary Least Square model. The Expectation Hypothesis will be examined its validity in the case of Malaysia. It is to observe the spread between long-term and short term rates that can reflects the forecast of changes in short term rates. By probing the movements of long-term and short-term interest rate, their causal relationship with the financial and macroeconomic factors can be determined. GDP growth rate, industrial production

index, inflation rate, money supply, current account and trade balance are the macroeconomic variables while stock market index is the financial variable. Thus, the research question will focus on whether the changes in bond yields of different terms to maturity can be explained by the sign and magnitude of these financial and macroeconomic factors.

Term Structure of Interest Rates

The term structure of interest rates commonly is cited as an indicator of monetary policy stance, as well as a leading indicator of economic activity and inflation. One of the factors that influence the interest rate on a bond is its term to maturity or the duration. The bonds may have different interest rate because the time remaining to maturity different from each other. The yield on bonds different at terms to maturity but it has the same risk, liquidity and tax considerations. A yield curve describes the term structure of interest rates or the way the interest rates varies with terms. The Figure 1 below exhibit the upward trends of yield curve when the time to maturity become longer.

Figure 1: Yield Curve



There are three empirical facts to be explained by a good theory of term structure.

1. Interest rates for different maturities move together over time.
2. Yield curves tend to have steep upward slope when short-term interest rates are low and downward slope when short-term interest rates are high.
3. Yield curve is typically upward sloping.

There are three theories of term structure to explain the facts above. Expectations hypothesis theory can explain fact 1 and 2 while market segmentation theory can explain fact 3. Liquidity premium theory combines features of both theories to explain all facts.

Expectation Hypothesis Theory

Expectations hypothesis theory states that the interest rate on a long term bond will equal an average of short-term interest rates that people expect to occur over the life of the long term bond. The key assumption of this theory is bonds of different maturities are perfect substitutes. It implicates that expected return on bonds of different maturities must be equal. The equation for n -period bond:

$$i_{nt} = \frac{i_t + i_{t+1} + i_{t+2} + \dots + i_{t+(n-1)}}{n}$$

n

This theory can explain the fact 1 - a rise in short term interest rates will raise people's expectations of future short-term rates. Because long term rates are related to the average of expected future short term rates, a rise in short term rates will also raise long term rates, causing short and long term rates to move together. It also explains fact 2. When short term rates are low, the rates are expected to rise in the future, and the average of expected future short-term rates is high relative to the current short term rates. Therefore, long term rates will be substantially above current short term rates and the yield curve would have an upward slope.

Market Segmentation Theory

Market Segmentation Theory's key assumption is bonds of different maturities are not substitutes at all. It implicates that the markets for different maturities bonds are completely separated and segmented; hence the interest rate for each bond with different maturity is determined by the supply of and demand for that bond. Investors generally prefer shorter maturities bond that have less interest rate risk, and thus have higher demand for short-term bonds. Hence demand for long term bonds is relatively lower than short term, and thus long term bonds have lower prices and higher interest rate. This explains the fact 3 that the yield curve is typically upward sloping. However, it does not explain fact 1 or 2 because it assumes long-term and short-term rates are determined independently.

Liquidity Premium Theory

Liquidity Premium Theory states that the interest rate on a long term bond will equal an average of short term interest rates expected to occur over the life of the long term bond plus a liquidity premium that responds to supply and demand conditions for that bond. The key assumption is that bonds of different maturities are substitutes, but are not perfect substitutes. Investors prefer shorter-term bonds which bear less interest rate risk; hence investors must be paid a liquidity premium to induce them to hold longer-term bonds.

Yield curve tests the relations between term structure and macro factors

There are some similarities of the previous studies to determine the relations between term structure of interest rates and macro factors by using the yield curve (Cherif and Kamoun (2007), Dewachter *et al.* (2006), Diebold *et al.* (2006), Hordahl *et al.* (2006) and Ang and Piazzesi (2003)). All of these studies have a same

conclusion that macroeconomic variables can affect the term structure of interest rates but the degree of significance differs for the different maturities.

A recent study by Cherif and Kamoun (2007) involves the study of the joint dynamics of term structure of interest rates and macroeconomic variables (GDP and Inflation) for the euro area in a vector auto regression process. The study is estimated using the Kalman Filter method and two-step recursive method for the monthly Euro Interbank Offered Rate (Euribor) and the zero-coupon yields for the different maturities from 1999 to 2006. The empirical results demonstrate that the relationship exists between yield curve latent factors and macroeconomic variables. The yield curve factors seem to be having an effect on the monetary policy. Besides, the level and slope of the yield curve seem to be responsive to real activity and monetary policy shocks. Dewachter *et al.* (2006) examine the both observable economic variables (output gap and inflation) and latent variables (the real interest rate and the stochastic central tendencies of output gap and inflation) in the continuous time term structure model. Besides that, the model is also employed to study real interest rate policy rules using information enclosed in output, inflation and the term structure of interest rates. The main objective of this paper is to find out the causes of the term structure of interest rates in terms of output gap and inflation. They analyze the data from month-end yields on zero-coupon U.S. Treasury bonds with different maturities in 1958 to 1998. The vector autoregressive VAR models draw out the conclusion that the macroeconomic dynamics are explained by the model exactly but the interest rate policy rule in observed inflation and output is not applicable within this framework. The long end of the term structure of interest rates is not explained by the observable macroeconomic variables, however is made clear by the stochastic central tendencies of these macroeconomic variables. All the factors have been found out that they determine the risk premia and thus the surplus holding returns of the bonds. Diebold *et al.* (2006) estimate the yield curve model that using latent factors (level, slope, and curvature) and observable macroeconomic variables (real activity, inflation, and the monetary policy instrument) from 1972 to 2000 using U.S. Treasury yields. Their primary goal is to determine the relationships between the macro-economy and the yield curve. Estimation by a simple nonstructural VAR representation, there is strong interactions of macro variables to affect future movements in the yield curve. However, the weaker evidence is found on yield curve to influence future macroeconomic developments. Besides that, the expectations hypothesis may hold well that the market yields have forecasting information about the Fed's policy rate during certain periods. "Term structure of interest rates is influenced by macroeconomic factors in different ways" is one of the findings suggested by Hordahl *et al.* (2006). The authors aim to estimate yield curve and risk premia dynamics in terms of macroeconomic fundamentals (inflation, the output gap and the short-term "policy" interest rate). Based on German data (1975 to 1998), monetary policy shocks have a stronger impact on yields at short maturities rather than longer maturities. The curvature of the yield curve typically changed by inflation and output shocks at medium-term maturities. Movements in the perceived inflation target likely to have a stronger effect on longer term yields. Inversely, the macroeconomic variables also have the ability to predict the yields.

These findings suggest a role for the dynamics of stochastic risk premia in determination of yield dynamics. How do macro variables change bond prices and the dynamics of the yield curve? This is the main concern of Ang and Piazzesi (2003) to determine a term structure model with inflation, economic growth factors and latent variables using a Vector Auto Regression. The model is tested for UK from 1952 to 2000 for the case of no-arbitrage restrictions. This study has shown that macro factors play a significant role in the short and middle end of the yield curve while unobservable factors have influence on the long end of the yield curve. The inflation shocks have the most power to affect the short end of the yield curve.

The Impact of Macro Factors on the Interest Rates of Term Maturities

The findings of “macro factors have effect on interest rates on different term of maturities” are performed by Caporale and Williams (2002) and Bernhardsen (2000). A number of investigations is carried out by Caporale and Williams (2002) on the determination of nominal long-term interest rates by the information content of domestic macroeconomic developments. Unit root tests are employed to determine the correlation between interest rate and macroeconomic variables such as economic growth, inflation, short-term rates and debt ratio over the post-1980 sample in the countries of G7. There is a significant impact of macroeconomic factors, authorities and market participants on interest rates. For countries with high-quality bonds, increasing debt reduces rates while for countries with high debt ratios, increasing debt lead to interest rates rise. Expectations are more significant in countries with a history of volatile inflation than with a history of low and stable inflation. Long-term nominal interest rate also is clearly influenced by economic policy. Hence, economic performance is more important than economic structure to justify interest rate differentials between countries. The relationship between 12 month interest rate differentials and macroeconomic variables is evaluated by Bernhardsen (2000) for nine European countries relative to Germany. For the period 1979–1995, the correlations between interest rate differentials and explanatory variables which consist of unemployment rate, the real income growth differential, the relative labor costs, the inflation differential, the current account, and the public deficit are estimated based on panel data regressions. The results of this investigation show that the inflation differential, the real income growth differential, relative labor costs, and the current account have a significant effect on the interest rate differential. The interactions between the differentials exist which may caused by the effect of these macroeconomic variables on depreciation expectations and so the interest rate differential. Government thus can manage the monetary policy to affect the interest rate.

The Macro Factors are tested individually on the Interest Rates

The macroeconomic factors are estimated individually to identify its impact on interest rates. Mills (2008), Boileau and Normandin (2008), Nielsen (2006) and Weymark (2004), Kanczuk (2004) have considered inflation, current account and output growth as the independent variable. The relationship between interest rates, prices and inflation is studied by Mills (2008) for the case of Britain from 1750

to 2006. Mills (2008) also estimates the effect of monetary regimes on the relationship and to associated shifts in the stochastic structure of interest rates and prices. The behavior of real interest rates and expected real rate are also tested to check for robustness. Using simple graphical and regression approaches, the empirical evidence shows that there is a positive relationship between interest rates and inflation during the 1965 to 1997 period. However, there is no relationship between them during any other period. Using OLS, Boileau and Normandin (2008) perform the investigations on the relation between the current account and the interest rate differential. The interaction between the business cycle fluctuations of the current account and of the interest differential is studied for 10 developed economies over the 1975-2002. The results of this research support the idea that the current account is negatively correlated with current and future interest differentials, but positively correlated with past interest differentials. Besides that, the current account is countercyclical and the interest differential is procyclical. Nielsen (2006) traces the information content of the term structure of interest rates about future inflation in the case of UK from 1983 to 2004. The author estimates the standard Mishkin model (include time-varying expected real interest rates and inflation risk premia) by OLS and the extended Mishkin model by GMM. The most obvious finding to emerge from this study is that the term structure of interest rates encloses much information about future inflation when the time-varying expected real interest rates and inflation risk premia is taken into account in the extended Mishkin Model (especially when the long end of the term structure of interest rates is considered) while term structure of interest rates contains some degree of information about future inflation in the standard Mishkin model. Moreover, when the Bank of England started to target inflation rates, there is a structural break in the relation between the term structure of interest rates and future inflation. The term structure of interest rates has significant information for future inflation in the pre-inflation-targeting and the inflation-targeting period. Especially, the extended Mishkin model is found more significant in the pre-inflation-targeting period of 1983 to 1992. Monetary policymakers can obtain future inflation information from the term structure of interest rates if time-varying expected real interest rates, inflation risk premia and structural breaks are taken into account. Weymark (2004) investigates the impact of some key structural characteristics on the downward flexibility of interest rates at low inflation rates for a sample of six countries. In addition, this paper also determines whether monetary policy would have been controlled by the zero-interest-rate bound during 1982–1996 for the achievement of 2% inflation target. From the estimation of OLS, the theoretical results demonstrate that monetary authorities will be more constrained by the zero-interest-rate bound for any these three situation: the inflation is more responsive to the output gap, the persistence of the output gap is higher and the lower responsiveness of aggregate demand to changes in the interest rate. The results of counter-factual experiment suggest that the target inflation rate to prevent the zero-interest-rate floor from binding in all countries is not adequately high by 2%.

The quantitative relationship between real interest rates and output fluctuations is analyzed by Kanczuk (2004) in the case of Brazilian economy from 1980 to 2001.

Kanczuk also pay attention to the way of interest rate affect productions in the condition of working capital restrictions in firms. Based on Stochastic Dynamic General Equilibrium Model, the relationship between real interest rate and national income is estimated using computational techniques. The findings show that output fluctuations are quite sensitive to the persistence of interest rate fluctuations. Besides that, the interest rate elasticity of output is pretty responsive to the persistence of monetary policy.

Testing the Macro Variables with Expectation Hypothesis

The other researchers try to incorporate macro variables into the model but more concentrate on the term structure theory such as Carriero, *et al.* (2006) and Kuo and Enders (2004). Carriero *et al.* (2006) published a paper in which they desired to present new evidence on the Expectations Theory (ET) of the term structure of interest rates with three dimensions and with financial and macroeconomic variables. The bivariate VAR method estimates the data set on US zero-coupon equivalent yields at 11 different maturities from 1974 to 1991. The findings show that most of the observed long-term yields are contained in the confidence interval. The deviations from the ET are very hardly ever significant and that fluctuations of risk premia are not huge. Kuo and Enders (2004) discuss the dynamic adjustment to long-run relationship between interest rates of different maturities in Japan. Unit-root tests and cointegration tests are used to estimate for period 1985-1998 in the case of Japan. The empirical results suggest that the yield spread can be constantly justified by rational prediction of future movements in short-term interest rates. The nature of the asymmetry is the same to those other studies have found for US interest rates for almost all cases studied. The error-correction process is best estimated as asymmetric in the case of the United States.

Methodology

Yields to Maturity (YTM)

The yield to maturity is the rate the bondholder would earn if the bond is purchased at the market price and held until maturity date and reinvested the interest earned. Using the bond pricing formula, YTM can be computed for either single cash flow or multiple cash flows. For the single cash flow case, the coupon interest payments are not paid to the bondholders. The discounting method is used to estimate the present value of the bond.

$$P = FV / (1 + r)^n \quad (1)$$

where, P = bond's price, FV = future value, r = YTM, n = the number of periods to maturity

There are multiple cash flows cases for the bond market in the real world. For coupon bond, the present value of the bond is calculated as the sum of the present

values of all the coupon payments plus the present value of the final payment of the face value of the bond.

$$P = C / (1 + r) + C / (1 + r)^2 + C / (1 + r)^3 + \dots + (C + FV) / (1 + r)^n \quad (2)$$

where, P = price of coupon bond, C = yearly coupon payment, FV = face value of the bond, r = YTM, n = the number of periods to maturity

Research Framework:

Longstaff and Schwartz (1992) use a two-factor general equilibrium model of the term structure to capture many observed properties of the term structure. Multifactor model of the term structure gains advantage over the single-factor models which mean that the instantaneous returns on bonds of all maturities are perfectly correlated—a property that is obviously conflicting with reality. Thus, this paper aims to extend this two-factor model into a multifactor model by including the financial and macro variables. Besides that, the empirical model in this paper is also extended by the equation of Merton (1974), Longstaff and Schwartz (1995). They focus research on the valuation for risky bonds to estimate the determinant of credit spreads. The credit spreads are driven by two factors: an asset-value and an interest rate factor. The equation given by Longstaff and Schwartz (1995) is:

$$\Delta S_t = a + b \Delta Y_t + c \Delta I_t + e_t \quad (3)$$

where, $\Delta S_t = S_t - S_{t-1}$ = the difference between a risky bond i and a riskless bond j of same maturity at a time; ΔY_t = the changes in the US exchange rate (they were studying international bonds); ΔI_t = the changes in the asset-value of the market measured by the return on a broad market index, e_t = the error term.

This paper integrates their insights within the Arbitrage Pricing Theory context by including the financial and macroeconomic factors. This paper aims at explaining the variation in the term spread of government bond by testing the macroeconomic variables involved. The maturity spread, ΔS_t between 10 year and 1 year risk-free bonds, denotes the liquidity risk between the short and long-term bonds whereas the spread in the cited study is credit risk.

The Ordinary Least Square (OLS) method will be used to estimate the effect of macroeconomic variables on the maturity spread. The other appropriate macroeconomic variables are needed to take into account to obtain the maturity spread. The GDP growth and inflation influence the bonds yields positively. The industrial production index measures the real production output so it is a proxy for the demand for funds. The money supply also has to consider in the model since this factor has a long-observed relationship on interest rate by virtue of monetary theory and monetary interventions. Since international trade brings influence to Malaysia economy, the current account and trade balance should explain the yield differentials. The stock market also plays a role in Malaysia economy because investors choose to do investments in either stock market or bond market. This leads to the consideration for variable stock indices in the estimation model.

The use of first difference in the macroeconomic variables diminishes econometric problems such as multicollinearity, serial correlation and spurious regressions. It also ensures that the data are stationary. VIF will be used to check for multicollinearity and Durbin Watson statistics for serial correlation. Thus, the regressions would be run between maturity spread and each variable individually (from model 1 to model 7) while model 8 tests the relationship with maturity spread with all the variables.

$$\Delta S_t = a_1 + a_2 \Delta Cl_t + e_t \quad (\text{Model 1}); \quad \Delta S_t = a_1 + a_2 \Delta GDP_t + e_t \quad (\text{Model 2})$$

$$\Delta S_t = a_1 + a_2 \Delta IPI_t + e_t \quad (\text{Model 3}); \quad \Delta S_t = a_1 + a_2 \Delta INF_t + e_t \quad (\text{Model 4})$$

$$\Delta S_t = a_1 + a_2 \Delta TB_t + e_t \quad (\text{Model 5}); \quad \Delta S_t = a_1 + a_2 \Delta CA_t + e_t \quad (\text{Model 6})$$

$$\Delta S_t = a_1 + a_2 \Delta M1_t + e_t \quad (\text{Model 7})$$

$$\Delta S_t = a_1 + a_2 \Delta Cl_t + a_3 \Delta GDP_t + a_4 \Delta IPI_t + a_5 \Delta INF_t + a_6 \Delta TB_t + a_7 \Delta CA_t + a_5 \Delta M1_t + e_t \quad (\text{Model 8})$$

where, $\Delta S_t = S_t - S_{t-1}$ = the changes of the spread between 1 year and 10 years MGS, ΔCl_t = the changes in the returns on the Kuala Lumpur Stock Exchange Composite Index, ΔGDP_t = the changes in the GDP growth rate, ΔIPI_t = the changes in the industrial production index, ΔINF_t = the changes in the inflation rate, ΔTB_t = the changes in the trade balance, ΔCA_t = the changes in the current account, $\Delta M1_t$ = the changes in the money supply (M1), e_t = the error term.

Hypothesis

The hypothesis hold in this model is that a strong relationship exists between Treasury maturity spreads, as the dependent variable, and the independent variables comprise of GDP growth rate, industrial production index, inflation rate, money supply, current account, trade balance and composite index. The key hypothesis is:

Changes in financial and macroeconomic variables are correlated to the maturity spreads in the bond market. If there is no statistical evidence to show the relationship between the maturity spreads and the macroeconomic variables, the null hypothesis is accepted. The simple and multiple regressions are estimated through OLS method. The model fit will be tested by the t-statistics, R-squared value, adjusted R-squared value and the F-ratio. The t-test will be run for each individual variable to test each variable's hypothesis and its significance. Diagnostic checks of the model ensure that there are no econometric problems exist.

Data

The data used in this study consist of the yield on 1 year and 10 year Malaysian Government Securities, GDP growth rate, industrial production index, inflation rate, money supply, current account, trade balance and KLSE Composite Index (KLCI). The data are obtained from Datastream and Central Bank of Malaysia (Bank Negara Malaysia) covering the time period 1997Q1 to 2009Q2 in the case of Malaysia.

Results

Table 1 shows the descriptive statistics for each of the variables namely maturity spreads, GDP, industrial production index, inflation rate, money supply, trade balance, current account and stock market return. Data set is arranged in quarterly series and derived from 50 observations from 1997Q1 to 2009Q2.

The results reveal that the average rate of the maturity spread is 1.5%. This means that the yield differential between 1 year and 10 year bond are quite small by 1.5%. The maturity spread varied highly about 81.2% so the yield differential was always changing.

Table 1 Descriptive Statistics

Variables	Mean	Standard Deviation
Maturity Spreads	0.015	0.812
Stock Market Return	0.024	0.160
Growth Domestic Product	0.025	0.042
Industrial Production Index	0.016	0.035
Inflation Rate	0.007	0.007
Trade Balance	-0.181	1.740
Current Account	0.074	0.557
Money supply	0.027	0.050

Malaysia stock market return is rising on average of 2.35%. Its standard deviation of 16% is higher than other variables since the stock market in Malaysia has attacked heavily by Asian financial crisis 1997-1998 and global financial crisis 2008-2009.

This is dissatisfied economic performance since gross domestic product is growing on average by 2.5% only. Its standard deviation is 4.2%, somewhat small as compared to other macro variables. A narrower measure of output production, industrial production index is growing on average by 1.6%. Standard deviation (3.5%) shows that industrial production is quite stable to the mean of 1.6% from time to time. Inflation rate is varying on average by 0.7% over time. The condition of inflation is quite stable in Malaysia since the standard deviation of 0.7% shows that inflation rate has little deviation only from mean. Trade balance is declining on average by 18.1% while current account is growing on average by 7.4%. Malaysia economy is active in importing oil so the fluctuation of oil price exerts a large variability on import values, trade balance and current account. Therefore, a large spread out of standard deviation from the mean by 174% (trade balance) and 55.7% (current account) exists in Malaysia. Malaysian government tries to stabilize money supply which can be shown by its mean of 2.7% and standard deviation of 5%. The monetary policies have been conducted prudentially so the changes in money supply (M1) are small.

Model Fit of Simple Regressions

The seven independent variables, namely stock market return, gross domestic product, industrial production index, inflation rate, trade balance, current account and money supply are tested individually with maturity spread. The regression results from model 1 to model 7 are shown in Table 2. The finding of the study

document that changes in current account has a negative impact on maturity spread. The needs to meet capital and operating expenditures by Malaysian government will decrease for increasing current account surpluses. Therefore, the supply of bonds reduces and also leads to the downward movement of interest rate. Thus, current account is found to be significant with p-value of 0.003 and t-statistic of -3.153 at significance level of 5%. Thus, the null hypothesis that the partial slope (β coefficient) of current account is equal to 0 cannot be rejected. The strong negative relationship between current account and maturity spread is similar to the results reported in the study of Bernhardsen (2000). Nonetheless, Boileau and Normandin (2008) had suggested different findings. They suggested that current account is negatively correlated with current and future interest differentials but positively correlated with past interest differentials. Model 7 explains the relationship between maturity spread and money supply. At 5% significance level, the coefficient of money supply is found to be positively related with maturity spread at p-value of 0.023 and t-statistic of 2.353. The null hypothesis that the partial slope (β coefficient) for money supply is equal to 0 cannot be rejected. Thus, this regression indicates that change in money supply has strong relationship with maturity spread. The result is consistent with several documented studies by Cherif and Kamoun (2007), Diebold *et al.* (2006) and Hordahl *et al.* (2006). More specifically, Hordahl *et al.* (2006) documented that monetary policy shocks have stronger impact on short-term maturities of bond yield while Diebold *et al.* (2006) suggested that money supply affect the future movements in yield curve. Other five factors do not have relationship with maturity spread since the coefficients are insignificant at 5%. Thus, this suggests that the changes in stock market return, gross domestic product, industrial production index, inflation rate and trade balance do not lead to the changes in maturity spread. The findings are not consistent with the results from Ang and Piazzesi (2003), Mills (2008), etc. They suggested that these variables can affect the bond yield differential.

Model Fit of Multiple Regressions

In the last model, all the factors will be gathering together to test their impact on maturity spread. The factors included in the multiple regression model are stock market return, gross domestic product, industrial production index, inflation rate, trade balance, current account and money supply. The findings are highlighted in the Table 2. For model 8, the relationship between changes in maturity spread and all the independent variables are statistically significant ($F = 2.644$, p-value = 0.023). The relationship is characterized as strong since p-value is 0.023 at 5% significance level. The null hypothesis that "all of the partial slopes (b coefficients) = 0" is failed to reject. There are only two factors, current account and money supply, significant in this model. The result is also consistent with both variables are tested individually with maturity spread. F statistics is more significant for model 8 than model 7. Besides that, money supply and current account in Model 8 are also more significant than in Model 6 and Model 7 respectively. The findings indicate that money supply and current account appear to be the major factor affecting the bond yield differential. Nonetheless, stock market return, gross domestic product, industrial production index, inflation rate and trade balance are not found to be

have any significant effect on the movement between the yield of short and long term bond. Thus, it can be concluded that money supply and current account are considered as the common factors for bond maturity spread.

Explanatory Power of the regression analysis

Table 3 shows the explanatory power of all the simple and multiple regressions by using R-Squares and adjusted R-Squares. All R-Squares in the simple regression are between 0.2% and 11% only but R^2 has increased to 30.6% when all the financial and macro variables are included in the multiple regressions. Although 30.6% of the variability in Y is explained by the model, there may be other factors attribute to the 69.4% of variations in Y.

Table 3 Summary Results on R^2 , Adjusted R^2 , Durbin-Watson and Variation Inflation Factor

Independent Variable	R^2	Adj. R^2	Durbin-Watson	Variation Inflation Factor
Model				
1	0.027	0.007	1.735	1.000
2	0.005	0	2.073	1.000
3	0.006	0	2.097	1.000
4	0.005	0	1.993	1.000
5	0.002	0	2.037	1.000
6	0.110	0.091	1.734	1.000
7	0.094	0.075	2.264	1.000
8	0.306	0.190	1.931	1.212-4.885

Table 2 Regression Results For Relationship between Maturity Spread and Financial and Macroeconomic Variables from 1997Q1 to 2009Q2

Regression Model: $\Delta S_t = a_1 + a_2 \Delta CI_t + a_3 \Delta GDP_t + a_4 \Delta IPI_t + a_5 \Delta INF_t + a_6 \Delta TB_t + a_7 \Delta CA_t + a_8 \Delta M1_t + e_t$

Independent Variable	Constant	CI	GDP	IPI	INF	TB	CA	M1	F-Stat
	a								
Model									
1	0.035 (0.300) (0.765)	-0.836 (-1.157) (0.253)							1.339 (0.253)
2	-0.021 (-0.155) (0.878)		1.439 (0.513) (0.610)						0.263 (0.610)
3	-0.012 (-0.095) (0.925)			1.746 (0.524) (0.603)					0.275 (0.603)
4	-0.038 (-0.234) (0.816)				7.596 (0.471) (0.640)				0.222 (0.640)
5	0.011 (0.098) (0.922)					-0.020 (-0.299) (0.766)			0.089 (0.766)
6	0.051 (0.460) (0.648)						-0.483 (-2.434) (0.019)*		5.926 (0.019) *
7	-0.118 (-0.940) (0.352)							5.017 (2.228) (0.031)*	4.963 (0.031) *

8	-0.208	-0.791	0.307	2.242	11.535	-0.063	-0.655	5.893	2.644
	(-1.126)	(-1-101)	(0.063)	(0.341)	(0.695)	(-0.944)	(-3.153)	(2.353)	(0.023)
	(0.267)	(0.277)	(0.950)	(0.735)	(0.491)	(0.351)	(0.003)*	(0.023)*	*

Note: The figures above parentheses denote coefficient estimates. The figures in parentheses (...) are referred to t-statistics and p-value which is significant at () 0.05 and (**) 0.01 level.*

Adjusted R^2 is used to correct the tendency for R^2 to approach one as independent variables are added to the model. This is a better statistic or explanatory power of this model since there are 8 models compared with different numbers of coefficients in this paper. The adjusted R^2 from the model 1 to 7 are noticeably low with the range of 0 and 9.1%. However, adjusted R-square is higher in Model 8 with 19%. Both current account and money supply have contributed to the increase in adjusted R-square in Model 8.

Diagnostic Tests of Simple and Multiple Regressions

Table 3 also shows the econometric problems, especially autocorrelation and multicollinearity, whether exist via diagnostic checks. Regression analysis assumes that the errors (residuals) are independent and there is no serial correlation. No serial correlation implies that the size of the residual for one case has no impact on the size of the residual for the next case. As a general rule of thumb, the residuals are not correlated if the Durbin-Watson statistic is approximately 2 and an acceptable range is 1.50 - 2.50. The Durbin-Watson statistic for all simple regression models are between 1.73 and 2.26 while for the multiple regressions model is 1.93 which falls within the acceptable range. Hence, the assumptions of regression analysis are satisfied and thus autocorrelation is not present in all models.

Since all variables have been calculated for the percentage change before running regression analysis, the influence of multicollinearity has been reduced. From multiple regressions analysis, VIF is from 1.21 to 4.89 which is smaller than 10 for each of the independent variables. Hence, multicollinearity is not a problem in this paper. There is no econometric problem so results may provide robust estimates of the parameters.

Summary of Findings

In this paper, time series model is used to analyze whether changes in spread correlate with macroeconomic variables in Malaysia. The economic performance needs to be determined for the extent to affect the differentials in interest rate. If this is the case, Malaysian government has some scope for influencing the interest rate by conducting proper macroeconomic policy. The investors also could utilize the past data to make investment decisions wisely. Nevertheless, researches on this topic over a long time period have produced conflicting results. Dewachter *et al.* (2006), Hordahl *et al.* (2006), Ang and Piazzesi (2003), Carriero *et al.* (2006) and Caporale and Williams (2002) argue that macroeconomic variables can affect the term structure of interest rates but the degree of significance shows a discrepancy for different maturities. This study has examined the relationship between bond markets and macroeconomic developments in Malaysia. This has been analyzed by employing an econometric approach which takes into account the descriptive statistics, significance and diagnostic checks of the variables of interest. When applied to interest rates differentials in Malaysia, the techniques are used to deliver well specified relationships that have a clear economic interpretation. However, the estimated equations only support to the idea that spreads are significantly affected by macroeconomic factors with moderate weak evidence. Money supply and current account are the factors that have strong relationship with maturity spread. Money supply influence bond yield differentials positively while current account

influence it negatively. The other five variables, namely stock market return, gross domestic product, industrial production index, inflation rate and trade balance do not have impact on the maturity spread. This means that portfolio managers and investors may use the money supply data and current account data in determining the investment decision. Besides that, the authorities also can accomplish a proper monetary policy and control the government expenditure to influence the bond yield differentials.

The Limitations of the Study

The special event of Asian financial crisis in 1997-1998 and global financial crisis in 2008-2009 leads to the distortion in prices and the improper estimation model. The authorities seek advice from the industry and the World Bank to carry out the series of economic reforms since 1998. The reforms are aim at improving the liquidity and the amount of funds raised using fixed-income securities after the Asian financial crisis. Therefore, the future study suggests the dummy variables to be included for the financial crisis and for period after the deregulation. Do the present known macroeconomic variables are affecting the next year's spread? With this question, the lagged term will be added to find out the correlation between spreads and previous year's lagged variables. Data limitations restrict to the choice of macroeconomic factors since several factors for example gross domestic product and current account are not available on the monthly frequency. Thus, the research design of this study is only able to include the quarterly data. The significance of the findings can be increased through enlarging the size of sample data. The number of observation does change the evidence of estimated model.

Suggestions for Future Research

Further research should aim at resolving the fact and predictions. The extension model should consider the effects of the maturity spreads on macroeconomic variables. Besides that, the relation between maturity spread and different macroeconomic variables has to be focused in terms of different maturities. For example, Dewachter *et al.* (2006) and Ang and Piazzesi (2003) find evidence that the macro variables do not have an effect on the interest rate in long term, and Carriero *et al.* (2006) and Caporale and Williams (2002) find evidence in the opposite side. Also, Hordahl *et al.* (2006) show the monetary policies shocks impact the interest rate differentials in short term while inflation impacts it in the long term.

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