Factors Correlated with Treasury bond Spreads in an Emerging Capital Market

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Abstract

This paper identifies macroeconomic and financial factors that are significantly correlated with Treasury bond term spreads observed over a quarter century in an emerging capital market, Malaysia. We adapted the very popular arbitrage pricing model approach widely used in share market studies and used ten macroeconomic and financial factors pre-specified to study the bond pricing behavior in this market, where industry statistics suggest that this market is the fourth largest bond market in Asia. Our findings suggest that trade balance, industrial production, GDP growth rate, money supply and the amount of funds raised are correlated with the term spreads. Trade balance is very proper to be a key variable since this emerging economy is among the top-8 trading countries with international trade constituting over 200 percent of GDP. These results, being a first using the arbitrage pricing model, help add to our understanding of bond pricing dynamics in one emerging market.

Key Words: Term structure of interest rates, Arbitrage Pricing Theory, Macroeconomic variables, Malaysia Treasury issue, Bond spreads.

JEL Classification: E43 and E44

1. Introduction

This paper reports, we believe for the first time, findings on whether key macroeconomic and financial factors already found to be price-relevant in pre-specified arbitrage pricing model applied in share market studies are correlated with the term spreads of bonds traded in a relatively efficient bond market in an emerging economy. We also include data on three special events unique to this market in one of our tests. The term spread is the difference in yields of 10-year and 1-year Treasury instruments (Malaysia Government Securities-MGS) traded over a recent 25-year period in Malaysia. Understanding the relationship between term spreads and macroeconomic factors is likely to be useful as it could provide a first set of findings about macroeconomic drivers of the term spread, which may shed useful guide to investors to make informed decisions about the likely path of the Treasury yields using available predictions of these factors.

The size of the outstanding domestic bond issues in this economy is 94 percent of the gross domestic product (GDP) a figure that matches the world average, and is at least three times higher than the average for Asian bond markets. Thus, this emerging market is ideal for studying the bond pricing behavior. More developed economies such as Japan and the US have higher bond market depth: 183 and 164 percent respectively. The role of direct financing via listed bond and share markets has increased in this economy over the last 30 years. Direct capital markets provided relatively small amounts of funds in the 1970s in this economy as were (still are) the cases in most other countries.

The banking system was the dominant provider of capital funds at that time for supporting high-growth economic activities in this economy, which grew by 8.5 percent per year over 1975-1997. Growth has slowed to about 6 percent since 1998 with the hollowing of economic activities of this and other economies by the much cheaper China as a production point. The increase in the demand for direct financing has led to the growth of publicly-traded fixed income capital markets (and of course the share market too) providing capital funds needed in this industrializing economy.

The process of direct financing by bond (and share) market is facilitating large amounts of funds to be raised as the economy diversified away from primary producing status to industrialized manufacturing status.[1]

Another reason for studying this market is the relatively more market-friendly policy environment that has led to the capital markets becoming more efficient than most of the 65-odd emerging markets in the world. Besides that, this bond market is a lot more developed than would be the case of others mainly due to de-regulations since the late 1980s that helped to improve the operations and liquidity of the market. Capacity-building measures led to improvements in the trading systems to increase liquidity, lowering transaction cost, providing technical assistance across regional developments and promoting access to financial institutions while also building the credit rating services - there are two rating agencies - accounting and credit guarantee systems. Other measures included the development of secondary, derivatives and asset-backed securities markets. New financial products, credit enhancement facilities were introduced that increased domestic and cross-border retail and wholesale investors to come to this market along with broader participation from domestic public and private sectors that include banks, mutual funds and public sector entities issuing securities of interest to investors. Many of these measures and recommendations were originated and disseminated in regional-level policy dialogue among practitioners, policy markers and academicians in conferences, talks, and meetings. The World Bank took a lead in this matter as well. For more details see Ariff, Cheng and Neo (2008).

The rest of the paper is divided into 5 sections. Section 2 explained the theories about interest rates and the macroeconomics factors. Section 3 reports a review of literatures on major theories, the local bond market research on its returns and bond spreads. Section 4 describes the methodology to calculate the yield to maturity and also the factors to be used in the test model. In Section 5 are the presentation of the results and interpretation of the findings. Section 6 concludes this paper with some suggestions for new research in this market.

2.0 Interest rates and Macroeconomics factors

The allocation of funds in an economy occurs primarily on the basis of price, expressed in terms of expected returns in an efficient market. The expected return on a financial instrument depends on the real rate of interest in the economy and on the expected inflation both forming the risk-free yield in an economy: this is the Fisher effect. The yields to maturity of these bonds are normally estimated from a sample of publicly traded government (Treasury) securities. These government issues have zero-default risk, relatively good liquidity and in some cases have tax-exempt status. The relationship among the bond yields, term to maturity and the shape of the yield curve movement over time forms the study of the theory of term structure of interest rates. The Expectation Hypothesis by Fisher (1930), which is widely believed as describing the way interest rates form in efficient markets, is based on a relationship between short-term yields and any given long-term yield. This theory suggests that the long-term yield is the geometric average of consecutive short-term yields over the horizon of the long-term instrument. The Expectations Hypothesis can be expressed as:

$$\left(1+r_{1,t}\right)^{t} = \left(1+r_{1}\right)\left(1+r_{2}\right).\ldots\ldots\left(1+r_{t}\right) \qquad (1)$$

where, r_1 , r_2 … r_t : short-term rates at period 1, 2, ……t,
$r_{1,t}$: long-term rates beginning at current time to maturity in period t,
t = n : maturity period.

The spread between long and short term yields reflects the market forecast of changes in short term rates.

Hicks and Lutz (1940) advanced the Expectation Hypothesis further to link the unobservable expectations to observable bond prices as the Liquidity Preference Theory (LPT). The LPT suggests that the returns from the investment of fixed-income securities contain the expected future rates as per the expectation of investors *and* that a liquidity premium is added to that as reward for parting with liquidity *over time*. The LPT allows for the possible existence of risk as reward for liquidity risk for any increases in term to maturity: this risk is not the default risk associated with the private-sector bonds that vary as per the ratings of the bonds by rating services. Thus, the terms spread investigated in this study is the liquidity premium in another sense, representing time risk. Credit risk has been studied widely (see Longstaff and Schwartz, 1995) but the term risk has seldom been studied in depth. Other theories in term structure of interest rates are the Market Segmentation Theory (Culbertson, 1957) and the Preferred Habitat Theory (Modigliani and Sutch, 1966).

[1] The GDP share of agriculture has shrunk to 7.2 percent in 2005 compared to its dominance in the 1950s. Also, the industrial sector accounts for 34% of the GDP compared to its much smaller share in the 1970s.

Fisher effect suggests that the nominal rate of interest fully adjusts to changes in expected inflation. That is, the relationship between changes in nominal interest rates to changes in expected inflation is one to one. Thus, any nominal interest rate is the sum of the economy's real rate (which is assumed constant) and the expected inflation: this is the basic risk-free yield used in this study as observations of Treasury yields.

The question of whether the relationship between changes in nominal interest rates and changes in expected inflation is one to one has been of continuing research interest for long. An alternative theory suggests that the expected rate of inflation raises or lowers the nominal rate of interest by less than the expected inflation rate change. The contention that the real rate of interest declines under such circumstances is that inflation reduces real money balances. In other words, money assets depreciate in real terms. As a result, real wealth declines, and this stimulates increases in savings. Finally, the decline in the real rate of interest stimulates investment since the hurdle for positive NPV projects is lowered, which would accelerate output growth.

The other arguments are the existence of tax changes, regulatory changes, technological advances, financial development, business cycle and level of economic activity contribute to not only the changes in interest rates but also the volatility of the interest rates. Therefore, macroeconomic factors like output growth, assets prices, trade, industrial production, current account and trade balance, money supply and others are related to the changes in the nominal and the real interest rates.

3.0 Evidence

3.1 Brief Review of Local Studies

There were many classic applied studies of these theories in mostly the developed capital markets. Although there are about 65 emerging markets, in most of which there is bond trading, researchers have just begun to investigate bond pricing behavior. One recent study is Andritzky, Bannister and Tamirisa (2007): it reports that macroeconomic announcements do appear to have a weak influence on the international bond pricing in several countries. To the best of our knowledge, there is no study using the term spreads because perhaps because there is no readily available database of yields by maturity and by types of bonds. The results from existing studies in support of the theories even in the developed markets are also mixed. The studies using American market data over the 1960s and 1980s did not support Expectation Hypothesis (see Shiller, Campbell and Schoenholtz, 1983). Fama (1984a; 1984b) investigated the existence of term premia in government bonds. The existence of this term premia known as the liquidity premium was hoisted as supporting the LPT by Hick and Lutz (1940). Supporting evidence for this theory were reported by Meiselman (1962), Roll (1970), and Startz (1982). Another famous group of researchers, Cox, Ingersoll and Ross (1981) showed evidence in support of the Local Expectation Hypothesis. Many researchers continue to use this CIR model.

Given the market we chose to study is an emerging bond market, we need to review prior studies in this market. Neoh (2005) reported that the behavior of the Treasury yields is weakly consistent with the Expectation Hypothesis. However the predictive power of implied forward rate is rather weak in this market. He explained this as being due to the existence of term premium, which was not taken into account in his tests. There has been no study in this market on how the yields are determined by external factors, a gap in the literature motivating this study.

4.0 Research Methodology

One of the important measures of the return in bond markets is historical measures on the yield to maturity of bonds, the YTM. The YTM depends on the length of time to maturity (term risk), the prevailing interest rates as well as their changes (and the default risk of the bonds in the case of corporate bonds). Risk in bond is mostly studied as a 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. Because we use the yields of Treasuries, default risk is not applicable in this study, only the uncertainty of changing yields, whatever causes the change, constitutes risk in this security, that is we are measuring the shifts in yields over time as the term spreads.

4.1 Yield to Maturity (YTM)

An investor can assess the value of a bond by its coupon rates and its current yield as well. However, this is not an accurate measure of the bond's actual rate of return to maturity although these are measures of current yields. The yield to maturity is commonly used to give the total return an investor will hope to receive if bondholder holds the bond until full maturity from the date of purchase either at the time of the issue or at a later date after the issue. The cash flows comprise coupon interest payments, the assumed income from reinvesting the coupon proceeds at the yield to maturity, and the maturity value, up to the period when the bond is redeemed. The yields for the bonds data are thus computed from the bond pricing formula.

Considering a case of a single cash flow to an investor in a bond, then the bond price equation is given simply as:

$$P = \frac{FV}{(1+r)^n} \quad (2)$$

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 (yield) 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 is therefore similarly discounted to obtain the present value of the bond. Extending the basic bond price Equation (1), the present value of an n-period bond is:

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

where, P_d is the "dirty price" which includes accrued interest,[2]
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.

4.2 Changes in spread

The earlier research by Merton (1974), Longstaff and Schwartz (1995) on the valuation for risky bonds is that *credit* spreads are driven by two factors: an asset-value and an interest rate factor. Our research incorporates their insights within the APT context by extending their model to include the pre-specified factors that have been found to be correlated with asset prices. The equation given by Longstaff and Schwartz (1995) is:

$$\Delta S_t = a + b \Delta Y_t + c \Delta I_t + e_t \quad (4)$$

where, ΔS_t : $S_{it} - S_{jt}$:The difference between a risky bond i and a riskless bond j of same maturity at a time,
ΔY_t : The Change in US exchange rate (they were studying international bonds),
ΔI_t : The change in the asset-value of the market measured by the return on a broad market index, and
e_t : the error term.

In the above equation, the question is whether the spread ΔS_t between 10-year and 1-year risk-free bonds as the term spread be substituted with the two classes of bonds used in credit spread. We think that the term spread represents the liquidity risk of the short 1-year and the long 10-year bond whereas the spread in the cited study is the credit risk. We then propose to add to this equation factors from the pre-specified APT model, which are the macroeconomic variables.

The selection of macroeconomic variables was done by using all the variables pre-specified in the previous two cited studies, in an earlier section. The variables were regressed individually in pairs to identify if there is indeed a plausible reason to use the variables and then we proceeded to add more variables in each subsequent regression using the Stepwise regression procedure. The results were checked for multicollinearity. Any macroeconomic variable that was correlated with another, the variable with the highest t-value was dropped. As a result, the major macro factors identified using this process were: GDP growth (representing the suggestion in economics that growth drives yields); inflation factor (representing the Fisher effect on yields); interest rate factor (representing the current level of interest as a factor driving the term spread)); money supply (representing the long-observed relationship this factor has on interest rate by virtue of monetary theory and monetary interventions); industrial production (a proxy for the demand for funds); current account; and trade balance (factors unique to economies such as Malaysia that has huge reliance on international trade).[3] Since our study is on domestic bonds in the emerging market, it is unlikely that the currency factor used in the model below to study the international bonds will affect the term spread.

[2] When a bond is bought or sold in between the coupon period, a certain amount of coupon interest will have accrued. The accrued interest, $a_i = t_0 C$ where to is the proportion of a period passed since the last coupon payment was made. Bonds are normally quoted on a clean basis but settled on a dirty basis.

[3] The macroeconomic variables could be reduced by using factor analysis, but the authors prefer to keep the originality of the data, as factor analysis will lose the identity of the macroeconomic and financial variables and make interpretation within the pre-specified APT that much more non-transparent.

Thus, an APT framework is developed dropping the exchange rate and including other factors:

$$\Delta S_t = a_1 + a_2 \Delta I_t + a_n \sum \Delta F_t + e_t \quad (5)$$

$\Delta S_t : S_t - S_{t-1}$ the changes of the spread between a 1-year and a 10-year Treasury issues (MGS),
ΔI_t : the change in the asset-value of broad market index, i.e. KLCI,
$\sum \Delta F_t$: other macroeconomic variables: GDP growth, inflation factor, interest factors, money supply, industrial production, current account, and trade balances, and
e_t : the error term.

All the macroeconomics variables are first differenced. Table 1 shows the details of the dependent, and the 10 independent variables.

Insert table (1) about here

The issue to be estimated here is that the spreads of Treasury issues (Malaysia Government Securities-MGS) over the years have varied, so the question is "How are these spreads correlated with APT-like factors?". This spread measure indicates two components. The first is the prediction of future spot rate, and forward rates. The second is the liquidity premium for an investor holding a security of different terms to maturity. This liquidity premium measures the risk to asset values of investors holding Treasuries, the opportunity cost of liquidity and the state of the economy.

The term spread is affected by the sovereign and economic status of the country. Malaysia has experienced many economic cycles, and thus has sovereign risk. In another sense, therefore, the issue of concern in this paper is to investigate whether the sovereign and economic conditions are related to the changes in the spreads. The use of first difference in the macroeconomic variables and the natural logarithm of some variables mitigate econometric problems such as multicollineraity, serial correlation and heteroscadesticity. It also ensures that the data are stationary. Variance Inflation Ratio will be used to check for multicollinerity; and Durbin-Watson statistics for serial correlation. Heteroscasdesticity will be checked by using the test in the standard statistical software package.

The Equation (5) uses the annual variables at each year end: some of the time series are only available on an annual basis, hence this interval is preferred also as having less intervalling effect. All variables are computed as at year end. Therefore, this raises another question whether the present known macroeconomic variables are affecting the next year's spread? To check this hypothesis, the regressions are performed with lagged macroeconomic variables to find out whether the spreads are related to the previous year's lagged variables? The equation (5) becomes:

$$\Delta S_t = a_1 + a_2 \Delta I_t + a_n \sum \Delta F_t + a_{n+k} \Delta I_{t-1} + + a_{n+k+1} \sum \Delta F_{t-1} + e_t \quad (6)$$

where, k denotes the lagged variables.

The additional parameters will enable us to answer whether the past information have any information content beyond the present information.

Further to the general model for study of bond spreads as in Equation 6, we needed to incorporate controls for special events in this market. During 1990 to 1997, before the Asian financial crisis of 1997-8, more funds were raised by the private sector than the public sector. This was due to the downsizing of government in economic activities via the privatization of traditional government agencies and major infrastructure projects. During this period, funds raised by private sector through the stock markets and the issuance private bonds contributed to more than 90 percent of the total funds raised. Therefore, we think the funds raised or volume of MGS issues affected the spread of the bonds. A new variable that measured the changes in the MGS issue is introduced to the regression after identifying the significant macroeconomic factors. The first special new variable is the change in the value of Treasury issues deflated by GDP.

The regulators in consultation with the industry and the World Bank embarked on series of reforms from 1998 after the Asian financial crisis to improve the liquidity and the amount of funds raised using fixed-income securities. Therefore, this research proposes a dummy variable (D_1) to be added for period after the deregulation and another dummy (D_2) for the 1997/98 Asian financial crisis.

Equation thus 6 becomes:

$$\Delta S_t = a_1 + a_2 \Delta I_t + a_3 \Delta MGSI_{t-1} + a_4 D_1 + a_5 D_2 + a_n \sum \Delta F_t + a_{n+k} \Delta I_{t-1} + a_{n+k+1} \Delta MGSI_{t-1} + a_{n+k+2} \sum \Delta F_{t-1} + e_{t-1} \quad (7)$$

where, $\Delta MGSI_{t-1}$: the changes in Treasury/GDP issues, (Fund raised/GDP)
D_1 : dummy variable for deregulation, 1 from 1998 to 2006, 0 otherwise, and
D_2 : dummy variable for Asian financial crisis, 1 for 1997 and 1998, 0 otherwise.

4.3 Hypothesis

The major hypothesis in this study is that a strong relationship exists between Treasury term spreads, and the right-hand side variables pre-specified as pricing factors (GDP growth rate, inflation rates, broad market index returns, interest rates, industrial output, money supply, the trade balance, changes in funds raised, de-regulation and financial crisis). The strategic hypothesis is:

> Changes in macroeconomic, financial and regulatory factors are correlated with the term spreads in the bond market over the 25-year period.

The null will be accepted if there is no significant relation between the spreads and the factors. The model fit will be judged by the t-statistics, adjusted R-squared value and the F-ratio. The individual factors will be tested for significance using the t-tests: For each factor, there is a hypothesis to be tested using the t-values.

4.4 Data

The data set was mainly accessed from the yearly Treasury issues over 1982 to 2006 (25 years). The macroeconomic variables, GDP growth, inflation factor, interest factor, money supply as M1, industry production, current account and trade balance, and Kaula Lumpur Composite Index are obtained from various Asian Development Bank databases and the financial data in the Bursa Malaysia stock exchange. Data relating to YTM are estimated from various MGS issues for the 25-year period 1982 to 2006: this is taken from a larger database set up by a team of scholars including the authors of this paper for the study of Asian bond markets.

5.0 Results

5.1 Descriptive statistics

The spread between 10-year and 1-year bonds are show in the Table 2, column 2.

Insert table (2) about here

The spreads have a minimum of 0.014 percent to a maximum of 2.48 percent. Overall the average spread for the twenty-five years is 1.07 percent. There is no negative spread, meaning that the yield curves are all upward sloping. In term of GDP growth rates, this economy scored a maximum of 10.76 percents and a minimum of -10.60 percent in the last 25 years of history. The average growth for the last 25 years is 5.93 percent. The inflation rates represented by the changes in Consumer Price Index (CPI) vary from 0.39 percent to 5.59 percent. The average change in CPI is 1.4 percent. The interest rates represented by 12-month saving rates vary from 3.70 percent to 10.42 percent. The average 12 month saving rate is 6.22 percent. The trade balance/GDP ratios have varied from -4.78 percent to 24.3 percent in the last 25 years. The average trade balance is 9.04 percent of GDP. The industry Production/GDP ratios vary from 25.2 to 44.6 percent, with an average of 34.0 percent. The M1/GDP ratios vary from 16.8 percent to 25.3 percent with an average of 21.6 percents. The Current account/GDP ratios vary from -16.65 percent to 2.35 percent with an average of -4.4 percent. The Reserve/GDP ratios vary from 4.78 to 16.56 percent with an average of 9.5 percent. The KLCI: ranged between -74 and 68 percent. The average return is 4 percent per annum over the last 25 years. The last column of Table 1 shows the MGS issue against GDP. The ratios vary from 0.91 percent to 10.73 percent, with an average of 5.2 percent.

5.2 Results from Simple Regressions

Table 3 provides a summary of findings using two-variable regressions as a start before using multiple regressions mainly as a screening process for likely relationships. There were 20 simple regressions performed. Table 3 reports only five (5) significant factors.[4] The five significant factors are the changes in GDP growth, money supply, lagged changes in GDP growth, lagged changes in trade balance and lagged changes in the industry production factors are significant. GDP growth rates and the Money supply (M1/GDP) ratios have significant effect on the spreads. In Model 1, the GDP growth rate, which is the percentage change in GDP, has a coefficient of 0.058, a t-statistic of 2.650 with p-value of 0.014 significant at 0.05 probability level. This shows that GDP growth affects the bond spreads positively. The higher the changes in the GDP growth rates the greater is the spread. This is consistent with the observed regularity in the economy of interest rates going up during the uptrend part of the business cycles. The R-square value is 23.4 percent, which is considerably a high value for this kind of test.

Insert table (3) about here

[4] Only 5 out of 20 regression results are shown in Table 2, the other 15 regression results can be provided upon request. The full results are available with the authors, and can be provided on request.

The statistics under Model 2 show that the coefficient for money supply measured as M1/GDP ratio is 0.12 with a t-statistics of 1.85 and a p-value of 0.078, which is significant at 0.10 probability level. This finding suggests that the money supply affects the spreads directly. The positive sign indicates a positive relationship between the MGS spread and the money supply suggesting that interest spread goes up as a result of changes to the interest rates brought about by the monetary policy. The R-square value is a low 12.9 percent, which means that money supply explained 12.9 percent in the variation in the spreads.

On the simple regression with the lagged variables, the lagged GDP growth rates affect the spreads significantly. In Model 3, the lagged GDP growth rate, which is the lagged percentage change in GDP, has a coefficient of -0.054, a t-statistic of -2.390 with p-value of 0.026, which is significant at 0.05 probability level. This shows that lag GDP growth affects the bond spreads negatively. The higher the lag changes in the GDP growth rates the lower is the spread. The R-square value is 20.6 percent, which is considerably a high value for this kind of test. The money supply and industry production variables are positively related to spreads. Industry production contributed to GDP growth. Therefore, one should expect the two variables to move in the same direction with spreads.

Statistics in Table 3, Model 4, show that the coefficient for lagged Trade balance/GDP ratio is 0.077 with a t-statistics 4.55 and a p-value of 0.02 or better, which is significant at usual acceptance level. This finding suggests that the lagged Trade balances affect the term spreads positively. The positive sign indicates a positive effect of the lagged Trade balance as a factor in this economy which has a high level of international trade. The R-square is 48.5 percent, which mean that lag trade balance explained almost half of the variation of the Treasury spreads, which is a very large percentage.

Also in Table 3, Model 5, the statistics show that the coefficient for lagged Industry production/GDP ratio is -0.034 with a t-statistics of -3.88 and a p-value of 0.001 significant at 1 percent level. This finding suggests that the lagged Industry production/GDP ratios affect the spreads. The negative sign indicates a negative relationship between the spread and the lagged Industrial production/GDP ratio: this appears to suggest that the greater the industrial output, the narrower is the spread, perhaps due to the effect of monetary policy targeting easier interest rates when industrial production is increasing. The monetary authorities are known to do this in this economy to spur production by easing monetary policy. The R-square is 40.65 percent, which mean that lag Industrial production/GDP ratio explained 40.65 percent in the variation of the spreads, which is another very large value. From the results in Table 3, it appears that the following variables may be chosen for further inquiry: GDP growth rates, inflation, money supply and industry production for multiple regression. The results and discussion are in the next section.

From Table 3, in columns 8, 9 and 10, the statistics show the respective econometric measurements on serial correlation by Durbin-Watson statistics and heteroscadestocity statistics. Generally there is no econometric problem and the residuals do not display serial correlation and heteroscadesticity.

5.3 Stepwise Multiple Regression Results

The next Table 4 shows the multiple regression results between the changes in spreads and the pre-specified factors and their lags that are found significant in the earlier simple regressions. These results are obtained using the Stepwise Regression procedure, which selects the variables using Akaike Selection Criterion to include variables so that the included variables are contributing to the explanatory power of regression. The insignificant variables are removed first before adding a new variable in this procedure. The statistics in Table 4 show the significant factors are: the GDP growth, Money Supply, Trade/GDP ratio and Industrial production/GDP ratios. The stepwise regression removed the lag on Money supply, and the lag on GDP growth. Table 4 shows the results after the above variables have been removed.[5]

Insert table (4) about here

In terms of the model (Equation 6), the F-ratios indicate highly significant model fit at 0.000 or better probability with just the four variables. The explanatory power of the model as indicated by the adjusted r-squared values is very high with that value exceeding 57.5 percent. Hence, given that these parameters are estimated with no serial correlations, no multicollinearity and heteroskedasticity problems, one could suggest that these regressions provided are robust estimates of the parameters. The results for Model 1 show that the macroeconomics variables are the current and the lagged Trade balance, Industry production, lagged Money supply. These together explained 63.2 percent of the variation in spreads. The significant coefficients are the current and the lagged Industry production and the lagged Trade balance.

[5] The results from Model 1 to 4 are shown here only, earlier stepwise results can be provided upon request.

Finally, by removing the insignificant variables stepwise, Model 4 shows that the lagged Trade balance and the Industry production explain 57.5 percents of the variation in spreads. From the above stepwise multiple regressions, the evidence is strong that previous year's Trade balance and the Industrial production are the most significant macroeconomics variables affecting the spreads. Money supply and GDP growth follows next as important determinants of the spreads. Other macroeconomics variables namely inflation, interest rates, assets prices, current account and reserves have either no effect on the spreads or if these had any effect, these have been controlled in the final regression.

5.4 Effects of Liquidity, Deregulation and Financial Crisis

Table 5 provides a summary of results from the regression including the three special factors in this market. The special factors are the fund depth (funds raised/GDP), deregulation and financial crisis. The factors suggested in the previous set of results were included: these are lagged trade balance and industrial production.

Insert table (5) about here

From the above set of results from regression, the lagged changes in Trade and Industry production remain as significant as before. The parameters of these two factors are statistically significant as can be seen in the table with 0.05 or better acceptance levels. The coefficient for the changes in funds raised/GDP is not significant however. The previous year's changes in funds raised/GDP as a factor is significant at 0.01 acceptance level with a t-value of 2.874 for its coefficient of 0.102. Thus, there is a relationship between size of funds raised in previous years and the spread in current year. The two dummy variables D_1 and D_2 are not significant: the signs on deregulation suggest that deregulation reduced the spread (which is expected) and that the financial crisis increased the spread, a fact observed during the first couple of years when the crisis hit in 1997. Therefore, we can conclude that the deregulation had a positive effect of reducing the spread, a sign f efficiency improvement and the financial crisis had increased the spread, though both these factors are only direction-wise meaningful with no significant t-statistics to support this interpretation. The adjusted R-squared value is 67.1 percent, a slightly higher compared to the value reported for Model 4 in Table 4 (i.e. an adjusted R-squared value of 57.5%). But the amount of Treasury issues in the previous years tended to increase the term spread suggesting that either the monetary policy is lagging behind or that the market takes a year to learn of the demand for money to translate it to relevant policy.

6.0 Conclusion

This study is motivated to find explanations for yield spreads between 10-year and 1-year Treasury issues of different maturity – we call this term spread – as to whether this variable is systematically related to a set of factors suggested by finance and economic theories as well as the special circumstances in an emerging bond market. The term spreads vary from 0.14 percent to 2.48 percent over a test period of recent 25 years. What drives bond market yields or term premium (liquidity premium) is largely unknown in any emerging market although this variable has been described in theories as the time risk as liquidity premium, sovereign risk, shifts in term structure, etc. This exercise is expected to provide a framework for similar studies in more emerging markets as well as providing for the first time a set of results in an arbitrage pricing modeling framework applied to bond market studies. It is notable that most studies of bond market variables are conducted with data from few large and visible developed economies. Despite the fact that there are about 65 emerging economies most of which have some bond trading, there is as yet significant research of bond market pricing dynamics.

The results of this study suggest that six variables are potential factors that determine the term spreads over the 25-year test period. Trade balance, Industrial production, Money supply, GDP growth rate, Funds raised and some lagged variables of some of these are the statistically significant factors driving term spreads in this one emerging market. As a highly trade-dependent economy, our findings - trade balance and industrial output and the amount of funds raised – appear to be believable. Also, the finding that money supply and trade balance are significant drivers in this relationship is not surprising as these are theory-suggested variables that should be relevant in a private-sector-led economy such as the one we studied. What is surprising is a set of results that are not significant. Inflation was not found to be significant: perhaps this is apt since the inflation history over the 25-year period in the economy is so low that market participants may have ignored to factor this in the pricing process. The stock market factor appears to be irrelevant, which is likely to be the case since term spread may have very tenuous effect, if any, with bond market: there is no literature that we could find that indicates a likely relationship, and our initial screening removed this factor from the tests. Finally, the most talked-about, also written-about factors, the financial crisis and deregulation appear to have had no significant impact on the term spread in a long-period test in this study. Perhaps these factors affect spreads in short term. We believe our findings appear to make economic sense, and will add significantly to studies on bond market dynamics.

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Table 1: Selected Macroeconomics and Financial Variables

No	Description of Variables	Measures	Form
1	MGS Spread	YTM of 10yr MGS-2yr MGS	First Difference
2	Gross Domestic Product	GDP Growth rates	First Difference
3	Inflation	Consumer Price Index Growth rates	First Difference
4	Interest rates	12 month Interest rates	First Difference
5	Interest spread	12 month rates and saving rates	First Difference
6	Trade balance	Trade balance/GDP	First Difference
7	Industry production	Industry production/GDP	First Difference
8	Money supply	M1/GDP	First Difference
9	Current account	Surplus or deficit/GDP	First Difference
10	Reserve	Reserve/GDP	First Difference
11	Assets Pricing	KLCI index returns	First Difference of Ln

Table 2: The Descriptive Statistics of The Major Variables in the Model, 1982-2006 (In percentage)

	Mean	Standard Deviation	Minimum	Maximum
YTM Spread	1.07	0.72	0.14	2.48
GDP growth	5.93	5.67	-10.60	10.76
Inflation	2.83	1.40	0.39	5.59
Interest rates	6.22	2.21	3.70	-4.78
Trade/GDP	9.04	8.96	-4.78	24.30
Industry/GDP	34.0	2.40	25.2	44.6
M1/GDP	21.6	0.48	16.8	25.3
CA/GDP	-4.4	0.93	-16.65	2.35
Reserve/GDP	9.5	0.58	4.78	16.56
KLCI Returns	4.0	29.0	-74.0	68.0
MGSI/GDP	5.2	0.57	0.91	10.73

Table 3: Statistics from Simple Regressions of Spreads and Macroeconomic Factors

		Constant	**Coeff**	**Lag Coeff**	**R^2**	**F-stat**	**DW**	**Heteros**
1	GDP Growth	-0.070 (-0.612) (0.546)	0.058 (2.650) (0.014*)		0.234	7.007 (0.014*)	1.630	(0.899)
2	Money Supply	-0.083 (-0.676) (0.506)	0.120 (1.850) (0.078*)		0.129	3.411 (0.078)	1.850	(0.132)
3	Lag GDP	-0.048 (-0.390) (0.701)		-0.054 (-2.390) (0.026*)	0.206	5.706 (0.026*)	1.870	(0.261)
4	Lag Trade Balance	-0.118 (-1.190) (0.247)		0.077 (4.550) (0.000***)	0.485	20.700 (0.000***)	1.740	(0.849)
5	Lag Industry Production	0.275 (2.020) (0.055)		-0.034 (-3.880) (0.001**)	0.406	15.060 (0.001**)	1.680	(0.355)

Note: * significant at 0.05 level, ** significant at 0.01 level, *** significant at 0.001 level.

Table 4: Statistics from Multiple Regression using Stepwise Method

		Coeff.	t	Sig	F-statis	Adj R^2	DW	VIF
1	(Constant)	-0.089	-0.624	0.540				
	Trade	0.024	1.451	0.164	8.905	0.632	1.939	1.430
	Industry	0.023	2.396	0.028*				2.104
	Lag Trade	0.035	1.906	0.073*				1.673
	Lag Industry	-0.023	-3.051	.007**				1.287
	Lag Money supply	-0.079	-1.443	0.166				1.684
2	(Constant)	-0.050	-0.348	0.732				
	Trade	0.027	1.574	0.132	10.039	0.611	2.411	1.413
	Industry	0.016	1.873	0.077*				1.520
	Lag Trade	0.043	2.439	0.025*				1.498
	Lag Industry	-0.023	-2.860	0.010*				1.278
3	(Constant)	0.033	0.237	0.815				
	Industry	0.009	1.181	0.251	11.697	0.683	1.891	1.091
	Lag Trade	0.051	2.898	0.009**				1.379
	Lag Industry	-0.022	-2.713	0.013				1.277
4	(Constant)	0.109	0.879	0.389				
	Lag Trade	0.057	3.331	0.003**	26.537	0.575	1.680	1.271
	Lag Industry	-0.021	-2.619	0.016*				1.271

Note: * significant at 0.05 level, ** significant at 0.01 level, *** significant at 0.001 level.

Table 5: Special Factor Effects and Identified Normal Factors

	Coeff	**t**	**Sig**	**F-stat**	**Adj-R^2**	**DW**	**VIF**
(Constant)	0.185	1.544	0.141	8.830	0.671	1.73	
Lag Trade	0.036	2.096	0.051*	(0.000***)			1.699
Lag Industry	-0.026	-3.290	0.004**				1.558
Funds Raised/GDP	0.051	1.457	0.163				1.240
Lagged funds raised/GDP	0.102	2.874	0.011**				1.334
Deregulation D_1	-0.051	-0.289	0.776				1.233
Crisis, D_2	0.299	1.023	0.321				1.110

a Dependent Variable: Bond spread. Note: * significant at 0.05 level, ** significant at 0.01 level, *** significant at 0.001 level.