Informational Content of Yield Spread: Predicting Economic Growth of Malaysia

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Abstract: The predictive ability of the yield spread and its expectations-related (ER) and term premium (TP) components for economic activity in Malaysia is examined in the presence of interest rate volatility. Yield spread is defined as the interest differential of the 10-year Malaysian Government Security and 3-month Malaysian Government Treasury Bill (MTB). Interest rate volatility is modelled as a GARCH conditional variance model of the 3-month MTB yields. The results show that the yield spread is an empirically important predictor of economic activity. While this relationship is robust and stable across different forecast horizons, its predictability power becomes significant only at longer forecast horizons, highlighting its importance after the exhaustion of short-term information contained in the other variables indicative of monetary policy stance. Of the two components, the ER term has significant informational content for explaining variations in economic activity. The TP term, however, is insignificant over all forecasting horizons. The interest rate volatility also has relevance for the yield spread's predictive ability in economic growth forecasts.

Keywords: economic growth, government bond, interest rate volatility, yield spread
JEL Classification: C26, C58, E44

1. Introduction

Short-term interest rates are instruments of monetary policy and long-term rates reflect the market's expectations of future economic conditions. Their interest rate differential holds valuable information as the yield spread contains information about the future occurrence and direction of economic growth. The monetary policy reaction may also influence the predictive power of the yield spread (Estrella *et at.* 2003).

The early empirical evidence supporting hypotheses on the relationship between the yield spread and economic activity was documented for the US. The main findings of Estrella and Hardouvelis (1991) were that the yield spread predicts both cumulative and marginal changes in future real output, and that the yield spread has extra predictive capabilities over other variables. Hu (1993) formalised the relationship between the yield curve and real economic activity through a closed form solution for the term structure of interest rates and he also found that an increase in the yield spread leads to economic growth for the industrialised nations within the G7 grouping. Other supporting evidence of the yield spread as a significant predictor of real growth for the developed markets were reported by Kozicki (1997), and Estrella *et at.* (2003).

However, the yield spread's predictive capabilities have deteriorated over time and the predictive ability of the yield spread falls with a longer forecast horizon for the developed

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countries (Haubrich and Dombrosky 1996; Bonser-Neal and Morley 1997; Dotsey 1998). The decline in the yield spread's forecasting ability can be attributed to the changing relationship between the yield curve and real activity given technological advances, changes in market organisation, improvements in production processes, and differences in the way the market reacts to information (Haubrich and Dombrosky 1996). The findings of Mody and Taylor (2003) suggested that the predictive ability of the yield spread is better for periods characterized by high inflation and volatile growth. On the contrary, they provided evidence that high-yield spread has predictive content that is robust to such economic conditions.

While the evidence on the yield spread and economic activity in developed countries is well-documented, evidence in emerging countries and particularly that of Malaysia, is limited. This is partly because the bond markets of emerging countries have deepened significantly only since the late 1990s (Mehl 2006).

The Malaysian Government Securities (MGS) were initially subscribed by the Employees Provident Fund, financial institutions and insurance companies. The 1997/1998 Asian Financial Crisis exposed the shortfalls of over relying on funding from banks, especially with currency and maturity mismatches. This was a catalyst for the growth of the Malaysian bond market. To spur bond market development, a benchmark yield curve was constructed out of sovereign-credit bond issuances by the Malaysian government (SC 2012). With strong Government commitment towards the establishment of an efficient and reliable benchmark yield curve, government bond issuances continue to be pre-announced on a quarterly basis (SC 2012). Over the past 15 years, a wider array of Malaysian government bond issues has become widely available. In addition to government and corporate entities, the issuer base in Malaysia's local currency bond markets has expanded to include foreign and supranational issuers. Issued by the Government of Malaysia, MGS are interest-bearing long-term bonds, with fixed rates and semi-annual coupon payments and a bullet repayment of principal at maturity. Meanwhile, Malaysian Treasury Bills (MTB) are short-term securities issued by the Malaysian Government for funding working capital needs.

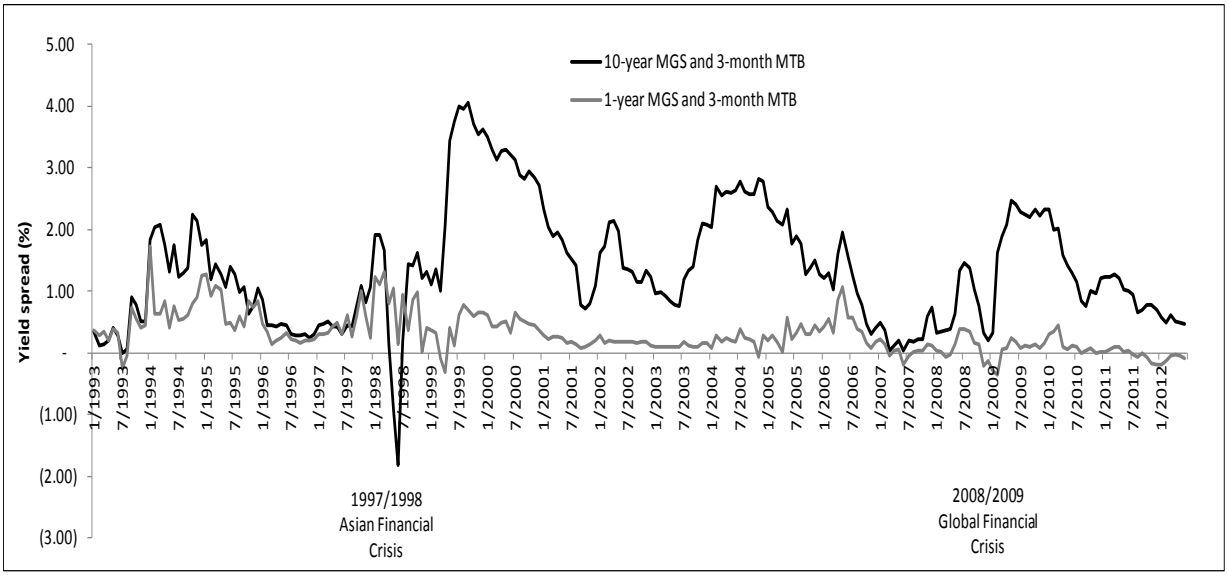

Figure 1: Malaysian Yield Spreads Over a 20-year Horizon
Data source: CEIC Data Company Ltd, accessed in October 2012.

Figure 1 plots the evolution of the Malaysian yield curve from 1993 to 2012. The slope of the yield curve is measured by the yield spreads[1] of the 10-year MGS and 3-month MTB and the interest rate differentials of the 1-year MGS and 3-month MTB. Of interest are the lower yield spreads before the recessionary periods marked by the Asian Financial Crisis (1997/1998) and Global Financial Crisis (2008/2009). A lower yield spread or flatter yield curve is typically linked to a tightening of monetary policy, when central banks increase short-term interest rates to dampen economic activity and/or contain inflation. During the Asian Financial Crisis and Global Financial Crisis, the yield spreads were volatile and in some instances had even inverted[2].

The yield spread can be decomposed into the expectations-related (ER) and term premium (TP) components (see, e.g., Hamilton and Kim 2002 and Ang *et al.* 2006). This decomposition will provide insights into the informational content for forecasting economic growth, whether the expected future path of monetary policy or the liquidity risks, that bears policy implications on bond market development. One factor that should matter for the TP term is the interest rate volatility. While this study seeks to investigate the informational content of the yield spread and its components, it also focuses on the relevance of interest rate volatility in the predictive ability of the yield spread in the case of an emerging economy.

2. Framework and Methodology

The fundamental model for assessing if the yield spread predicts future economic growth (represented by GDP growth) is as stated below:

$$y_t^k = \propto_0 + \propto_1 Spread_t + \varepsilon_t \quad (1)$$

where y_t^k represents the real GDP growth k months ahead, $Spread_t = i_t^m - i_t^n$. and i_t^m and i_t^n are the yields of the long and short-term bonds, respectively.

Although the yield spread contains information on the monetary policy stance, there are other direct indicators such as changes in short-term interest rate (Δi_t) and changes in money supply (ΔM_t). To examine the relevance of the yield spread informational content, the effects of these variables as well as inflation (π_t) and past growth (y_{t-i}) are controlled for:

$$y_t^k = \beta_0 + \beta_1 Spread_t + \beta_2 y_{t-\mathrm{i}} + \beta_3 \pi_t + \beta_4 \Delta M_t + \beta_5 \Delta i_t + \varepsilon_t \quad (2)$$

The expectations hypothesis of the term structure (in short, the Expectations Theory) holds that the yield rate on a long-term bond will be equal to the sum of current and expected future short-term yield rates over the tenure of the bond:

$$i_t^m = \frac{1}{m} \sum_{j=0}^{m-1} E\left[i_{t+j}^n \middle| I_t \right] \quad (3)$$

where I_t is the information accessible to all agents when forming expectations at time t. According to the Liquidity Preference Theory, investors demand a positive liquidity premium as compensation for a longer holding period because short-term bonds have lower interest rate risk. This risk premium could be time-varying and not constant (Hamilton and Kim 2002). Therefore,

$$i_t^m = \frac{1}{m} \sum_{j=0}^{m-1} E\left[i_{t+j}^n \middle| I_t \right] + TP_t \quad (4)$$

where TP_t is a time-varying term premium. Drawing from these two theories, the yield spread may be decomposed into:

$$i_t^m - i_t^n = \left\{ \frac{1}{m} \sum_{j=0}^{m-1} E\left[i_{t+j}^n \middle| I_t \right] - i_t^n \right\} + \left\{ i_t^m - \frac{1}{m} \sum_{j=0}^{m-1} i_{t+j}^n \right\} + \mu_t \quad (5)$$

where the first two terms on the right are the ER and TP components, respectively. The ER component contains expectations about future short-term yields, which may reflect the expected path of monetary policy. The TP component is viewed as the sum of a liquidity and risk premium. By substituting equation (5) into (1), the following is obtained:

[1] In economic literature, the terms yield curve, term spread and yield spread are used interchangeably.

[2] The yield curve is said to have become inverted when short-term yields exceed long-term yields, causing yield spreads to be negative.

$$y_t^k = \gamma_0 + \gamma_1 \left\{ \frac{1}{m} \sum_{j=0}^{m-1} E\left[i_{t+j}^n \middle| I_t \right] - i_t^n \right\} + \gamma_2 \left\{ i_t^m - \frac{1}{m} \sum_{j=0}^{m-1} i_{t+j}^n \right\} + u_t \quad (6)$$

Equation (6) can be estimated with instrumental variable estimation using any variables dated t or earlier as instruments to deal with endogeneity. Here, possible instruments are i_t^m and i_t^n.

Hamilton and Kim (2002) developed a theoretical two factor affine model and hypothesised that cyclical variations in interest rate volatility caused by economic expansions and recessions may account for the predictive ability of the yield spread, and specifically the term premium. Hautsch and Ou (2012) found that the yield curve volatility factors are time-varying and highly persistent. Their findings suggest that risks inherent to the shape of the yield curve are relevant and effectively captured by a stochastic volatility component. Encouraged by these findings and drawing from the work of Hamilton and Kim (2002), this paper assesses the relevance of time-varying changes in the variance of interest rates for explanations of the yield spread's predictive ability. The results from Ederington and Guan (2005) suggested that amongst volatility forecasting models, the GARCH(1,1) model usually produces better forecasts compared to the historical standard deviation. The GARCH(1,1) model also performs better in out-of-sample forecasts at short horizons. We opted for a mean process that is based on an autoregressive model and derived interest rate volatility from the short-term bond represented by a GARCH(1,1) model with an autoregressive mean process as below:

$$i_t^n = c + \phi i_{t-i}^n + \varepsilon_t \quad (7)$$

$$\varepsilon_t | I_{t-i} \sim N(0, \sigma_{t|t-i}^2) \quad (7a)$$

$$\sigma_{t|t-i}^2 - \omega = \alpha\left(\varepsilon_{t-i}^2 - \omega\right) + \beta\left(\sigma_{t-i|t-i-1}^2 - \omega\right) + \gamma(i_{t-i}^n - q) \quad (7b)$$

For the estimation, the recursion for $\sigma_{t|t-i}^2$ in the GARCH(1,1) model is started by setting $\varepsilon_0^2 = \sigma_{0|-i}^2 = \omega$, where ω is the average of the volatility process[3].

Hamilton and Kim (2002) proposed that the yield spread's predictive ability for future downturns in GDP growth may be because interest rate volatility is perceived to be higher at the end of a period of economic growth and before a recession. Therefore, interest rate volatility is added to the specification of the yield spread equation as follows:

$$y_t^k = \gamma_0 + \gamma_1 \left\{ \frac{1}{m} \sum_{j=0}^{m-1} E\left[i_{t+j}^n \middle| I_t \right] - i_t^n \right\} + \gamma_2 \left\{ i_t^m - \frac{1}{m} \sum_{j=0}^{m-1} i_{t+j}^n \right\} + \gamma_3 \sigma_{t+\mathrm{i}|t}^2 + u_t \quad (8)$$

To estimate this equation, the instruments i_t^m, i_t^n and interest rate volatility $\sigma_{t+i|t}^2$ were applied.

This research investigates the predictive ability of the yield spread for economic growth using monthly observations between January 1997 to June 2012. All data are obtained from CEIC Data Company Ltd. Spread is defined as the difference between the 10-year Malaysian Government Securities (MGS) and 3-month Malaysian Treasury Bills (MTB), or $Spread_t = i_t^{120} - i_t^3$. Economic activity is defined using seasonally adjusted real gross domestic product (GDP), expressed in 2005 prices. Data on Malaysia's real GDP is available only on a quarterly basis. To convert quarterly to monthly observations, we use an interpolation method which fits a local quadratic polynomial for each monthly observation to the quarterly real GDP series. The other explanatory variables involved are interest rate, money supply and inflation represented by the Kuala Lumpur Interbank Offer Rate (KLIBOR), M2 monetary aggregate, and changes in consumer price index (CPI with base year 2005), respectively. Interest rate volatility was derived from the 3-month MTB yields. The instruments that were applied are i_t^{120}, i_t^3 and interest rate volatility $\sigma_{t+3|t}^2$.

[3]We follow Hamilton and Kim (2002) in using the subtraction of ω and q in the equation for a normalization of the constant terms. This approach is for the convenience of setting initial values in the estimation process.

3. Results

Equation (2) was estimated to examine the predictability of GDP growth using yield spread. This specification was chosen to ascertain if yield spread contains information beyond the monetary policy stance. It is particularly important that the model controls for inflation, as BNM's primary goal in monetary policy is to maintain price stability (Singh 2011).

In the presence of inflation, the spread loses some of its near term predictive power (see Table 1). While still predicting cumulative real GDP growth, it does so only at longer forecast horizons of between 5 quarters to 4 years. The KLIBOR emerges as a stable and more consistent predictor of economic activity, while the monetary aggregate does not turn out to be significant. The coefficient of KLIBOR is consistently negative and coherent with the economic intuition that higher interest rates raise borrowing costs and dampen economic growth.

Kozicki (1997) offered an explanation for this. Compared to the yield spread, the KLIBOR has strong predictive ability for economic growth because it offers a cleaner measure of the monetary policy stance. In addition, the yield spread also holds information on credit market conditions. The yield spread may also lose some significance when concurrently considered with inflation and the monetary policy stance, due to the high correlation between inflation and future monetary policy expectations (Favero *et al.* 2005).

Many authors attributed the yield spread's ability to forecast real economic activity to its role as a signal of expected future short-term rates (the ER component) and as an indicator of the stance of monetary policy. The term spread also contains a liquidity premium or term premium (TP) component which may reflect the risk of alternative investments (Hamilton and Kim 2002). Equation (6) was estimated to examine the relationship between future economic activity, future short-term interest rate expectations and the premium required by investors for holding long-term bonds.

The results in Table 2 are striking. The decomposed yield spread explains significantly more variations in economic activity. Only the ER term is significant in explaining variations in economic activity. These results suggest that expectations of future changes in short-term MTB yields contain important information about economic activity in Malaysia. Expanding on the positive yield spread coefficients obtained in Table 1, we infer that the most important reason for a positive relationship between the yield spread and future real GDP growth is because a higher spread implies expectations of rising future short-term rates. Investments will therefore be expedited to avoid expected rising borrowing costs in the future, and current spending will result in future expansion.

The TP term is insignificant over all forecasting horizons. Ang *et al.* (2006) obtained similar results and suggest that to predict GDP growth, the TP component should be subtracted from the spread. Failing to do so would result in the information content of the yield spread being contaminated by the TP component, and the GDP forecasts would be less accurate.

Equation (8) was estimated to assess the relevance of interest rate volatility to the predictive capability of the yield spread for economic growth (see Table 3).[4] Again, we find that the ER term is solely significant in explaining variations in economic activity and the coefficient on the TP component remains always insignificant. An expected increase in future

[4] The volatility model is as follows:

$$i_t^3 = 0.3402 + 0.8881 i_{t-3}^3$$

$$\sigma_{t|t-1}^2 = 0.0126 + 1.0684(\varepsilon_{t-3}^2 - 0.0126) + 0.4526\left(\sigma_{t-3|t-4}^2 - 0.0126\right) - 0.0003(i_{t-3}^3 - 2)$$

short-term interest rates signals an uptick in economic activity at all forecasting horizons. The forecasting power of the ER component continues to decline with a lengthening of the forecast horizon. The maximal contribution of the ER component is at a horizon 1-quarter ahead, where a 100 basis point increase in expected short-term rates is expected to cause a 2.13% increase in cumulative real GDP growth**.**

Table 1: Predicting Cumulative GDP Growth Using the Yield Spread, Inflation and Monetary Variables

$$y_t^k = \beta_0 + \beta_1 Spread_t + \beta_2 y_{t-3}^3 + \beta_3 \pi_t + \beta_4 \Delta M2 + \beta_5 \Delta KLIBOR_t + \varepsilon_t$$

Months ahead, k	$\hat{\beta}_0$	$\hat{\beta}_1$	$\hat{\beta}_2$	$\hat{\beta}_3$	$\hat{\beta}_4$	$\hat{\beta}_5$	R^2
3 months	**5.3169*** **	**0.5461**	**0.1506***	**-120.424*** **	**34.1612**	**-16.937**	**0.1473**
Std error	*1.7070*	*0.5827*	*0.0773*	*38.7501*	*44.5415*	*10.332*	
p-value	*0.0021*	*0.3500*	*0.0532*	*0.0022*	*0.4441*	*0.1029*	
6 months	**6.2007*** **	**0.2603**	**0.0542**	**-113.54*** **	**-1.2135**	**-31.111*** **	**0.1692**
Std error	*1.3586*	*0.4650*	*0.0613*	*30.657*	*35.3205*	*8.1706*	
p-value	*0.0000*	*0.5763*	*0.3781*	*0.0003*	*0.9726*	*0.0002*	
9 months	**5.4882*** **	**0.3464**	**-0.0098**	**-68.854** **	**-36.4967**	**-33.501*** **	**0.1540**
Std error	*1.1753*	*0.4035*	*0.0533*	*26.555*	*30.8679*	*7.0637*	
p-value	*0.0000*	*0.3917*	*0.8530*	*0.0103*	*0.2387*	*0.0000*	
12 months	**4.0199*** **	**0.5637**	**-0.0100**	**-19.966**	**-44.9038**	**-25.571*** **	**0.1218**
Std error	*1.0331*	*0.3550*	*0.0467*	*23.295*	*27.2740*	*6.1933*	
p-value	*0.0001*	*0.1142*	*0.8292*	*0.3926*	*0.1016*	*0.0001*	
15 months	**3.6270*** **	**0.6995** **	**-0.0654**	**-7.8571**	**-20.9012**	**-20.686*** **	**0.1296**
Std error	*0.8934*	*0.3069*	*0.0404*	*20.145*	*23.6122*	*5.3733*	
p-value	*0.0001*	*0.0240*	*0.1076*	*0.6970*	*0.3773*	*0.0002*	
18 months	**3.6332*** **	**0.6205** **	**-0.0651***	**-0.2634**	**-15.1810**	**-15.489*** **	**0.1220**
Std error	*0.7604*	*0.2613*	*0.0347*	*17.184*	*20.2627*	*4.5747*	
p-value	*0.0000*	*0.0187*	*0.0627*	*0.9878*	*0.4548*	*0.0009*	
21 months	**3.8687*** **	**0.5284** **	**-0.0668** **	**2.0879**	**-17.3131**	**-10.584*** **	**0.1205**
Std error	*0.6323*	*0.2173*	*0.0289*	*14.243*	*16.8002*	*3.7910*	
p-value	*0.0000*	*0.0162*	*0.0221*	*0.8836*	*0.3043*	*0.0059*	
24 months	**4.3192*** **	**0.4318** **	**-0.0702*** **	**-5.3736**	**-18.4547**	**-8.3180*** **	**0.1425**
Std error	*0.5188*	*0.1760*	*0.0235*	*11.561*	*13.5500*	*3.0693*	
p-value	*0.0000*	*0.0153*	*0.0033*	*0.6427*	*0.1752*	*0.0075*	
36 months	**5.0882*** **	**0.2597*** **	**-0.04828*** **	**-27.745*** **	**-6.6589**	**-6.2968*** **	**0.2553**
Std error	*0.2987*	*0.0954*	*0.0128*	*6.8849*	*7.3917*	*1.6884*	
p-value	*0.0000*	*0.0073*	*0.0002*	*0.0001*	*0.3692*	*0.0003*	
48 months	***5.0382**** **	***0.2207****	***-0.0280****	***-25.197**** **	***-15.5267****	***-6.6877**** **	***0.2305***
Std error	*0.3146*	*0.0916*	*0.0129*	*8.2158*	*7.1667*	*1.8043*	
p-value	*0.0000*	*0.0173*	*0.0318*	*0.0026*	*0.0321*	*0.0003*	
60 months	***4.9459**** **	***0.0749***	***-0.0125***	***-9.0031***	***-15.9492****	***-5.5488**** **	***0.1448***
Std error	*0.2979*	*0.0862*	*0.0116*	*7.7916*	*6.5401*	*1.5941*	
p-value	*0.0000*	*0.3868*	*0.2800*	*0.2502*	*0.0162*	*0.0007*	

*Note: ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels in two-tailed tests respectively.*

Table 2: Predicting Cumulative GDP Growth Using the Yield Spread Components

$$y_t^k = \gamma_0 + \gamma_1\left(\frac{1}{120}\sum_{j=0}^{119} i_{t+j}^3 - i_t^3\right) + \gamma_2\left(i_t^{120} - \frac{1}{120}\sum_{j=0}^{119} i_{t+j}^3\right) + u_t$$

Months ahead, k	$\hat{\gamma}_0$	$\hat{\gamma}_1$	$\hat{\gamma}_2$	R^2	$H_0: \gamma_1 = \gamma_2 = 0$
3 months	**4.923831*** **	**2.130855*** **	**0.142662**	**0.108115**	**21.81979*** **
Standard error	*1.221128*	*0.588748*	*0.637775*		
p-value	*0.0001*	*0.0004*	*0.8233*		*0.0000*
6 months	**5.298349*** **	**1.663076*** **	**-0.174553**	**0.128867**	**26.18365*** **
Standard error	*0.986429*	*0.467539*	*0.511143*		
p-value	*0.0000*	*0.0005*	*0.7331*		*0.0000*
9 months	**5.341920*** **	**1.336600*** **	**-0.288792**	**0.131893**	**26.43618*** **
Standard error	*0.857659*	*0.400639*	*0.441092*		
p-value	*0.0000*	*0.0010*	*0.5135*		*0.0000*
12 months	**5.103905*** **	**1.181256*** **	**-0.223405**	**0.136706**	**27.07843*** **
Standard error	*0.748601*	*0.344515*	*0.382089*		
p-value	*0.0000*	*0.0008*	*0.5595*		*0.0000*
15 months	**4.746543*** **	**1.053025*** **	**-0.029557**	**0.120447**	**23.00622*** **
Standard error	*0.663139*	*0.301961*	*0.336247*		
p-value	*0.0000*	*0.0006*	*0.9301*		*0.0000*
18 months	**4.624764*** **	**0.823770*** **	**0.030334**	**0.096471**	**17.61736*** **
Standard error	*0.574554*	*0.259286*	*0.289552*		
p-value	*0.0000*	*0.0018*	*0.9167*		*0.0001*
21 months	**4.539383*** **	**0.617992*** **	**0.077741**	**0.072545**	**12.67160*** **
Standard error	*0.488184*	*0.217580*	*0.244234*		
p-value	*0.0000*	*0.0051*	*0.7507*		*0.0018*
24 months	**4.486408*** **	**0.504358*** **	**0.116198**	**0.065645**	**11.17095*** **
Standard error	*0.406918*	*0.178504*	*0.201903*		
p-value	*0.0000*	*0.0053*	*0.5658*		*0.0038*
36 months	**4.603939*** **	**0.468079*** **	**0.119188**	**0.167598**	**29.59743*** **
Standard error	*0.225882*	*0.099494*	*0.110676*		
p-value	*0.0000*	*0.0000*	*0.2833*		*0.0000*
48 months	**4.532815*** **	**0.415994*** **	**0.125502**	**0.157898**	**25.31315*** **
Standard error	*0.220451*	*0.093540*	*0.105341*		
p-value	*0.0000*	*0.0000*	*0.2356*		*0.0000*
60 months	**5.004521*** **	**0.174961** **	**-0.084304**	**0.106529**	**14.66541*** **
Standard error	*0.214129*	*0.082980*	*0.098569*		
p-value	*0.0000*	*0.0370*	*0.3941*		*0.0007*

*Note: ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels in two-tailed tests respectively.*

Table 3: Predicting Cumulative GDP Growth with Interest Rate Volatility

$$y_t^k = \gamma_0 + \gamma_1\left(\frac{1}{120}\sum_{j=0}^{119} i_{t+j}^3 - i_t^3\right) + \gamma_2\left(i_t^{120} - \frac{1}{120}\sum_{j=0}^{119} i_{t+j}^3\right) + \gamma_3\sigma_{t+3|t}^2 + u_t$$

Months ahead, k	$\hat{\gamma}_0$	$\hat{\gamma}_1$	$\hat{\gamma}_2$	$\hat{\gamma}_3$	R^2
3 months	**4.747372*** **	**1.572242** **	**0.329309**	**-0.485353** **	**0.125371**
Standard error	*1.241132*	*0.639428*	*0.648554*	*0.240001*	
p-value	*0.0002*	*0.0149*	*0.6123*	*0.0446*	
6 months	**5.158957*** **	**1.534005*** **	**-0.087697**	**-0.080329**	**0.117712**
Standard error	*1.011010*	*0.514487*	*0.525469*	*0.192744*	
p-value	*0.0000*	*0.0033*	*0.8676*	*0.6774*	
9 months	**5.501808*** **	**1.788368*** **	**-0.440524**	**0.466018*** **	**0.156622**
Standard error	*0.860697*	*0.431674*	*0.444018*	*0.161430*	
p-value	*0.0000*	*0.0001*	*0.3225*	*0.0044*	
12 months	**5.391953*** **	**1.852034*** **	**-0.471395**	**0.665108*** **	**0.233969**
Standard error	*0.717776*	*0.354653*	*0.367499*	*0.132371*	
p-value	*0.0000*	*0.0000*	*0.2013*	*0.0000*	
15 months	**4.987272*** **	**1.636956*** **	**-0.242149**	**0.578465*** **	**0.221813**
Standard error	*0.634813*	*0.310392*	*0.322909*	*0.115790*	
p-value	*0.0000*	*0.0000*	*0.4544*	*0.0000*	
18 months	**4.825778*** **	**1.336552*** **	**-0.153065**	**0.508016*** **	**0.210018**
Standard error	*0.546722*	*0.264961*	*0.276420*	*0.098833*	
p-value	*0.0000*	*0.0000*	*0.5805*	*0.0000*	
21 months	**4.726538*** **	**1.085576*** **	**-0.091622**	**0.459928*** **	**0.216596**
Standard error	*0.456538*	*0.218524*	*0.229158*	*0.081468*	
p-value	*0.0000*	*0.0000*	*0.6898*	*0.0000*	
24 months	**4.643929*** **	**0.890998*** **	**-0.025073**	**0.379262*** **	**0.217529**
Standard error	*0.378857*	*0.178455*	*0.188618*	*0.066461*	
p-value	*0.0000*	*0.0000*	*0.8944*	*0.0000*	
36 months	**4.677067*** **	**0.623732*** **	**0.063476**	**0.149382*** **	**0.235664**
Standard error	*0.220503*	*0.104451*	*0.108271*	*0.038146*	
p-value	*0.0000*	*0.0000*	*0.5586*	*0.0001*	
48 months	**4.612249*** **	**0.552181*** **	**0.073283**	**0.129698*** **	**0.221864**
Standard error	*0.216540*	*0.098636*	*0.103658*	*0.035738*	
p-value	*0.0000*	*0.0000*	*0.4808*	*0.0004*	
60 months	**5.055856*** **	**0.296321*** **	**-0.122790**	**0.111815*** **	**0.181675**
Standard error	*0.208494*	*0.086929*	*0.096177*	*0.030530*	
p-value	*0.0000*	*0.0009*	*0.2041*	*0.0004*	

*Note: ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels in two-tailed tests respectively.*

Elsewhere, the coefficient for the GARCH(1,1) measure of interest rate volatility makes a statistically significant contribution in cumulative real GDP growth predictions for all forecast horizons. At near-term forecast horizons of 1 and 2 quarters ahead, the impact of interest rate volatility on economic activity is consistent with economic intuition. The coefficient signs for interest rate volatility at these forecast horizons are negative, indicating a countercyclical relationship between economic activity and interest rate volatility. Higher volatility precedes slower GDP growth; uncertainty becomes higher when the economy is expected to become weaker.

We develop a plausible reason for the joint significance of the coefficients of the interest rate volatility and ER terms at the 1 and 2 quarter forecast horizon. Over shorter-term horizons, interest rate volatility contains information on economic agents' perceived uncertainties and these uncertainties affect their expectations of future short-term interest rates. This reasoning does not apply to forecast horizons beyond 2 quarters as the signs of the coefficients for interest rate volatility are positive.

This paper subscribes to the theoretical view that the predictive ability of the yield spread mainly stems from its ability to signal the stance of monetary policy in Malaysia. The significance of the ER term shows that the yield spread holds information about future economic activity because it reflects economic agents' expectations of the future direction of short-term interest rates. The expectations of these agents are, in turn, formulated based on their expectations on the future stance of monetary policy.

A possible explanation for the insignificance of the TP component lies in the relatively nascent stage of the Malaysian bond market, compared to the bond markets of developed nations. In Malaysia, the bond market is currently dominated by institutional investors but in developed nations such as the United States, retail participation by the man-on-the street exists (Hunt 2009; MIBB 2012). Retail participation has the benefit of widening the pool of investors in the bond market, adding to demand for bonds and injecting further breadth and depth to the capital market (MIBB 2012). Moreover, because the risk appetites and investment strategies of retail investors differ significantly from institutional investors, retail participation may add dimension to the TP component of yield spreads. Another plausible reason for the irrelevance of the TP component in this study is our sample selection of government bonds. The TP component can be viewed as the summation of a liquidity and risk premium which in part, reflects credit risk. Credit risk - which can be generally defined as the risk of a borrower defaulting on its debt obligations - is missing from this study because government bonds are generally and traditionally perceived to be credit risk free.

4. Conclusion

This paper examines the predictive ability of the yield spread and its ER and TP components for economic activity in Malaysia. Secondly, we assess the explanatory power of the yield spread for economic activity in the presence of interest rate volatility.

We provide empirical evidence for a significantly positive relationship between the yield spread and economic activity. All else equal, an increase in the yield spread precedes an uptick in future economic growth. The yield spread contains information about future economic growth beyond that contained in monetary policy, values of past growth and inflation. However, the predictability power of yield spread becomes significant only at longer forecast horizons, highlighting its importance after the exhaustion of short-term information contained in the other variables.

In all decompositions of the yield spread, only the ER term is significant in explaining variations in economic activity. This suggests that the 3-month MTB yields contain important information on economic activity in Malaysia, and the most important reason why a higher yield spread may predict an uptick in economic activity is because a higher spread implies rising future short-term interest rates, which are in turn influenced by monetary policy. Our results support the results of a study by Jallah (2004), who finds that monetary policy operates through short-term interest rates to achieve the objective of price stability in Malaysia.

Our findings indicate that uncertainty over future economic growth affects economic agents' expectations of future economic growth prospects. Over forecast horizons of 1 and 2 quarters, interest rate volatility contains information on economic agents' perceived uncertainties and these uncertainties affect their expectations of future short-term interest

rates. Higher interest rate volatility also precedes slower GDP growth because uncertainty becomes higher when the economy is expected to become weaker.

5. Policy Implications

Assessing the link between yield spreads and economic activity has policy significance because monetary policy actions have direct impacts on the yield spread's ability to predict economic activity. For instance, more accommodative monetary policy and the consequent higher yield spreads are typically associated with economic expansions. The yield spread predictions should be interpreted in the context of the monetary policy regime. For example, the yield spread forecasts may be less accurate if the monetary authority has an exclusive focus on controlling inflation (Wheelock and Wohar 2009).

The rationalisations of the forecasting ability of the term spread in this paper focus on explaining the movement of the spread in relation to the expected future path of short-term interest rates. The findings of this paper support the theoretical view that the forecasting power of the yield spread stems mainly from its signal of the stance of monetary policy, through movements in short-term yields. The transmission of monetary policy has been traditionally viewed as unidirectional, from short-term interest rates managed by central banks to long term interest rates which influence aggregate demand (Goodfriend 1998). The relevance and importance of the yield spread for making short-term and long-term forecasts of economic growth as documented in this paper implies that the yield spread is a measure that can be useful in guiding Malaysian monetary policy.

Our results emphasize the importance of agent expectations in the formulation of monetary policy in Malaysia. The expectations of agents are an important driving force behind short-term interest rate movements and economic growth, and policymakers should take these expectations into account when formulating monetary policy. Further, interest rate volatility has been shown to be a forward looking measure for uncertainties and risks perceived by economic agents about future economic activity. Announcements on interest rates influence the expectations of economic agents and their responses determine future economic growth. Therefore, prudence in the release of such announcements must be practiced. These implications hold true, even during periods of uncertainty.

Our findings for the insignificance of the TP component draw attention to the need to develop a more diversified investor base in the Malaysian bond market, which is currently dominated by institutional investors. Encouraging retail participation in the bond market, for example, has multi-pronged benefits for issuers, investors and regulators. Issuers gain access to a wider investor base while investors gain access to risk-free investments which add diversity to their investment portfolios and offer the added prospect of capital gains. From the regulatory perspective, a predominantly institutional bond market may be unfavourable as it renders the bond market vulnerable to capital flight and swings caused by changes in market sentiment. Retail participation provides some stability to the bond market and helps dampen the effect of the institutional flow of funds (Khan 2013). In this light, the Securities Commission's initiative to promote retail participation in the Malaysian bond market bodes well for an improvement in the latter's depth and breadth, and may have a bearing on the significance of the TP component in future studies.

While we find evidence that the yield spread is a simple measure that can be useful in guiding Malaysian monetary policy, a compelling case still cannot be made for giving the yield spread a formal role in monetary policy because the stability of the relationships have yet to be fully empirically determined. Moreover, the relationship between interest rates and monetary policy is complex and varies over time (Kozicki and Sellon 2005). In this regard, we hope that the findings of this research paper will be groundwork to spur further research on bond yields, economic activity and interest rate volatility.

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