FORWARD SPREAD IN THAILAND:
ITS PREDICTIVE POWER AND KEY INFLUENCING FACTORS

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ABSTRACT

Term structure of the interest rate serves a vital role as a precise source of information on public expectation and supply and demand for loans. Expectation hypothesis (EH) should provide the best forecast of future spot interest rates. However, as prior studies in U.S.A. and Germany suggest the opposite, this paper tests the forward spread's forecasting power by using the data from Thailand. Thai term structure appears to forecast future short-term interest rate well. By employing the Generalized Autoregressive Conditionally Heteroscedastic (GARCH), an increase in forward spread explains most of the rise in yield spread. Nevertheless, the forecasts are biased with longer rates. By Ordinary Least-Squares (OLS) Regression, key factor influencing the forward spread is policy rate.

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1. INTRODUCTION

Interest rate is one of the effective monetary policy instruments employed by the central bank in achieving the ultimate targets on economic growth and stability. Through the interest rate channel, a decreasing in the policy rate lowers the opportunity cost of consumption and investment. Private domestic demand increases and results in an expansion of the economic growth and a rising in the inflationary pressures. Similarly, this decreasing in policy rate also stimulates the economy through the strengthening of businesses' balance sheet and the increasing of financial institutions' willingness to lend under the credit channel.

An importance of the interest rate is not only by being a policy tool of the central bank impacting the economy, but the monetary agent, as well, needs the continuous feedback reflecting its policy decisions and communications. Studied by Goodfriend (1998), Kim and Orphanides (2007) and Sangvinatsos (2008), the term structure of interest rates could properly serve this role as a precise source of information on understanding the market expectations and responses to the shifts in the economy. That is because, focusing on the bond market, the expectation hypothesis (EH) under the term structure of interest rates refers to the connection between interest rate and maturity of the investment where forward rates, or rates contracted today for a security issued at a future specified date, could be found from the relationship between yields of bonds with different maturities (Fisher, 1896; Benninga and Wiener, 1998).

However, a failure of the expectations hypothesis was detected by Macaulay in 1938. The short-term interest rates forecasted by the simple calculations on the data from the United States are all disputable and the expectation hypothesis has become another prominent area of study among empirical and theoretical works since then. Even so, most of the studies still argue that there is so little evidence of this forecasting power. With the forward-spot spread regression, the expectation hypothesis performs poorly and inconsistently under different forecast horizons (Fama and Bliss, 1987). Similarly, Hardouvelis (1988) and Mishkin (1988) give an extra conclusion on the variation of the forecast power across different periods. While the model could not be fully utilized under the period in prior paper, it has altered and helped predicting spot interest rate movements for several latter months in his period of study. Based his research on Fama's papers as well as Hardouvelis and Mishkin, Davis (1996) also issues an updated version of the study on the information in the term structure of interest rates. But, the term structure of interest rates still contains little information about future spot rates and the study still leads to a conclusion of weak predictive power overtime. Even the new range of tests using the term spread and VAR-based regression is developed by Campbell and Shiller later in 1991, there is still no evidence supporting the expectation hypothesis. And as mentioned that understanding the movement of interest rates would provide a precise forecast of public decisions and accurate feedback of policy decisions, there would be no reason for monetary agents to believe and employ the expectation hypothesis if the relationship are essentially unpredictable under this concept (Guidolin and Thornton, 2008).

Nevertheless, with cases of test modifications, the forecasting power improves and the expectation hypothesis becomes significant. By believing that the government bonds yields are poor measures of the interest rates, Longstaff (2000) tests the relationship on yields with extremely short maturities. As a result, the expectation hypothesis holds with daily repo rates. By accepting the empirical failure in earlier studies and believing that the arbitrage opportunities are noticeable to the public, Bulkley, Harris and Nawosah (2008) finds out that the argument against the forecasting power could become very much weaker after those profits are taken. Moreover, when the area of study is rotated away from the United States, the result conversely varies. With the group of G7 countries, evidence in all G7 except the United States supports the expectation hypothesis. While the forecasts of France and Italy are valid in the first place, the predictions of Canada, Japan, Germany and the United Kingdom correspond to the hypothesis after the use of instrumental variables (Hardouvelis, 1993). In the same way, the forward-spot spread is suggested to be a potential predictor for changes in both short and long term future interest rates in an exclusive study of German yields by Boero and Torricelli (1999).

Therefore, to be an important indicator in conducting the monetary policy, it is interesting to determine the forecasting power of the forward spread in Thailand, as well as, its supporting explanations. As the main question is whether the forward spread in Thailand follows the case of the United States or the case of Germany and other G7 countries in this case, this paper aims to observe the behavior of spread between the forward rate calculated from the expectation hypothesis on term structure of interest rates and the actual future spot rate from the market. And to understand more about the reasons behind those findings, the paper also attempts to examine the key capable factors influencing this forward spread.

In this matter, a potential analysis could come from a simple observation on an improvement of the forecasting model. Corresponding to all studies in the United States mentioned earlier, Buser, Karolyi and Sanders (1996), then, try to develop the adjusted forward rate to obtain a higher forecasting power by adding the term premiums of bond quality spread and bid-ask spread into the model. As this new adjusted forward rate becomes reliable and predictive power becomes prominent, these additional factors could possibly be observed as the potential determinants of the forward spread. Even while Fama and Bliss (1987) conduct a paper to find empirical evidence for the expectation hypothesis, their study superficially indicates that the business cycle variables might play a role in providing different forecasting results over different horizons. Considering these influencing factors in totally different perspective, Duffee and Hopkins (2009) also introduce the determinants that provide a clear sign of fluctuations in economic activity to their model. With this deeper analysis, the information that drives the dynamic of the forward spread but does not originally included in the current forecast, such as real activity and survey reports of investors' interest rate expectations, is discovered. In addition, when later studies try to focus more on these fluctuations, more obvious evidences related to the changes in forward spread spectrum are also presented. Macroeconomic and monetary surprises, together with prospects for economic growth, expectations regarding inflation and monetary policy, and compensation for risk, become another underlying factors that explain the variability of term structure under the study of Bauer (2011).

The remainder of this paper is organized as follows. Based on the prior studies, Section 2 would explain the theoretical framework of the expectation hypothesis of the term structure of interest rates. Section 3 would describe the data and the models used in the study. Section 4 would report the results of each model. Then, Sections 5 would close the paper with conclusions and further remarks.

2. THE EXPECTAION HYPOTHESIS

Relating the long-term interest rates to the actual and expected future short-term rates, the expectation hypothesis of the term structure of interest rates explains the returns on fixed-income assets by assuming that various maturities are perfect substitutes. With a simple two periods relationship, the rate of return on holding a zero-coupon bond with two years to maturity should be equal to the rate of return on holding and reinvesting a zero-coupon bond with one year to maturity (Fisher, 1896). Following this concept, even many different versions of the expectation hypothesis have been developed, this paper would focus and study only the one with discrete time model of the pure expectation hypothesis, where expected excess returns on long-term over short-term bonds are zero.

Denote the price of a zero-coupon bond with n years to maturity at time t by $P_{n,t}$ and the yield to maturity of this bond by $y_{n,t}$. By the relationship between the prices and yields of the bonds, buying one unit of the bond at time t would cost the buyer

$$P_{n,t} = \frac{1}{\left(1 + y_{n,t}\right)^{n}} \tag{1}$$

and selling this bond at time $t + s$, where $s \leq n$, would generate the holding period return of

$$R_{t \to t+s} = \frac{P_{n-s,t+s}}{P_{n,t}} = \frac{\left(1 + y_{n,t}\right)^{n}}{\left(1 + y_{n-s,t+s}\right)^{n-s}} \ . \tag{2}$$

But as $y_{n-s,t+s}$ is unknown at time t and bonds are not always sold at the maturity date or $n \neq s$, this strategy needs to be reconsidered. Instead of buying just one bond with uncertain return, investing in a combination of bonds with different maturities could guarantee the future rate of return to be made. That is, considering $1 + F_{n,t}^{n-s}$ as this guaranteed future return at time t for the bond held between the time $t + s$ to $t + n$,

$$E_t\left(1 + y_{n-s,t+s}\right) = 1 + F_{n,t}^{n-s} = \frac{1}{n-s} \frac{1}{\left(P_{n,t}/P_{s,t}\right)} = \frac{1}{n-s} \frac{\left(1 + y_{n,t}\right)^{n}}{\left(1 + y_{s,t}\right)^{s}} \tag{3}$$

or,

$$E_t(1 + y_{m,t+s}) = 1 + F_{n,t}^m = \frac{1}{m}\frac{1}{(P_{n,t}/P_{s,t})} = \frac{1}{m}\frac{(1+y_{n,t})^n}{(1+y_{s,t})^s} \ , \tag{4}$$

where $m = n - s$, holds and $F_{n,t}^m$ perfectly represents m-period forward rate mentioned in previous section.

Therefore, according to

$$(1 + y_{n,t})^n = E_t(1 + R_{t\to t+n}) \ , \tag{5}$$

the expectation hypothesis, explaining the connection between the return of one (long-term) zero-coupon bond with n-period to maturity and h (short-term) zero-coupon bonds with h maturities, could be expressed as

$$(1 + y_{n,t})^n = (1 + y_{s,t})^s E_t \prod_{i=1}^{h} \left[(1 + y_{j_i,t+s+j_{i-1}})^{j_i} \right] \tag{6}$$

where ith short-term bond comes with j_i-year to maturity, $j_{i-1} = 0$ and $\sum_{i=1}^{h} j_i = n - s = m$. That is, with the forward interest rate, the expectation hypothesis could also be written as

$$(1 + y_{n,t})^n = (1 + y_{s,t})^s \prod_{i=1}^{h} \left(1 + F_{n,t}^{j_i}\right)^{j_i} . \tag{7}$$

The investment return on a long-term bond is equal to the geometric mean of investment returns on a series of short-term bonds.

3. DATA

With the study period between 2002-2012, this paper mainly focuses on two groups of data. Based on equation (7), the first group covers all yields of bonds with 1 to 6-year to maturities used in the main analysis. Quantitatively, it further specifies the study horizon. Even yields from Thai Bond Market Association (ThaiBMA) is available under daily basis, best horizon of monthly basis is selected due to stationary problem. And while this group consists only the returns on Thai bond market, the other becomes the group with both the monetary figures and key macroeconomics indicators in Thailand including announced policy rates, monthly export values, values of capital inflow and nominal effective exchange rates (NEER) from Bank of Thailand (BOT), manufacturing production indices (MPI) from Office of Industrial Economics (OIE), numbers of working hours from National Statistics Office (NSO) and inflation rates from Bureau of Trade and Economic Indices, Ministry of Commerce. This case, the announced policy rates would represent the monetary policy, the monthly export values and the manufacturing product indices stand for the country's productions and the numbers of working hours are used as the substitutes of the employment rates.

4. METHODOLOGY

As well as various forms of the expectation hypothesis, the prior tests appear in many different versions. Mentioned that the focus area of examination deals only with discrete time model of the pure expectation hypothesis, the paper follows the forecasting power tests of Fama and Bliss (1987) and employs three steps with two models analysis. By firstly calculating the forward interest rates or the expected future interest rates from the return on the combination of investments under the expectation hypothesis, the paper sets up two models in latter two steps to answer two main study questions. However, due to the availability of the yields data and the simplicity of the model, the paper would assume only two short-term bonds, where one is the 1-year to maturity bond purchased today and the other is the 1-year, 3-year or 5-year to maturity bond purchased a year later, in this case.

1. The forward interest rates

According to equation (7), as the expectation hypothesis equates the return of n-year to maturity (long-term) bond to the geometric mean of the returns between 1-year and $n-1$-year to maturity (shorter-term) bonds, the following relationship holds:

$$\left(1+y_{n+1,t}\right)^{n+1} = \left(1+y_{1,t}\right)\left(1+F^{n}_{n+1,t}\right)^{n}, \tag{8}$$

The n-year forward rate for bond at time t could be found from the equation of

$$F^{n}_{n+1,t} = \left(\frac{\left(1+y_{n+1,t}\right)^{n+1}}{\left(1+y_{1,t}\right)}\right)^{\frac{1}{n}} - 1. \tag{9}$$

That is, 1-year, 3-year and 5-year forward rate would be

$F^{1}_{2,t} = \left(\frac{\left(1+y_{2,t}\right)^{2}}{\left(1+y_{1,t}\right)}\right) - 1$, $F^{3}_{4,t} = \left(\frac{\left(1+y_{4,t}\right)^{4}}{\left(1+y_{1,t}\right)}\right)^{\frac{1}{3}} - 1$ and $F^{5}_{6,t} = \left(\frac{\left(1+y_{6,t}\right)^{6}}{\left(1+y_{1,t}\right)}\right)^{\frac{1}{5}} - 1$, respectively.

2. Predictive power of the forward spread

After knowing the expected return on bonds purchased in future date or the forward interest rate, the paper econometrically tests it predictive power. Based the study on the forward-spot yield spread approach of Fama and Bliss (1987), spreads are computed by comparing the rates calculated from equation (9) and the latter real market spot rates with the current rates of the same maturity. The corresponding simple regression model takes the form

$$y_{n,t+1} - y_{n,t} = \alpha + \beta\left(F^{n}_{n+1,t} - y_{n,t}\right) + \varepsilon_{t+1} \tag{10}$$

where $y_{n,t+1} - y_{n,t}$ is the actual yield spread of the bond with n-year to maturity,
$F^{n}_{n+1,t} - y_{n,t}$ is the n-year forward spread
and ε_{t+1} is the expectation error orthogonal to the information at time t.

With this form, the paper starts its analysis with the simplest model of the Ordinary Least Squares (OLS) then moves to the Feasible Generalized Least Squares (FGLS), the Autoregressive Conditionally Heteroscedastic (ARCH) and the Generalized Autoregressive Conditionally Heteroscedastic (GARCH) and selects the best results as appropriate. In this matter, it also adds the exogenous variables to improve the model and alleviate the biases on the coefficient estimates. As a result, the multiple regression form is

$$y_{n,t+1} - y_{n,t} = \alpha + \beta\left(F_{n+1,t}^{n} - y_{n,t}\right) + \sum_{i=1}^{u} \eta_i z_{i,t} + \varepsilon_{t+1} \tag{11}$$

where $z_{i,t}$ is ith monetary and economics exogenous variables including the policy rates, the inflations and the exports values.

This case, according to prior studies of Fama and Bliss, (1987), Hardouvelis (1988), Mishkin (1988), David (1996) and Boero and Torricelli (1999), the forward spread would have a powerful predictive power if and only if the value of β from the regression line is unity or the estimated interval covers a value of 1. All changes in the forward spread fully explain changes in the yield spread and the forward rate is believed to be an unbiased predictor of the future spot rates. That is, the expectation hypothesis of term structure of the interest rates holds according to equation (7).

3. Key factors influencing the forward spread

Assuming there is a powerful predictive power and the model in previous step is valid, one more question on the reasons behind that power is still left to be answered. As well as the test on the forecasts, the paper starts finding the influencing factors through the Ordinary Least Squares (OLS). Nevertheless, as the yield spread moves dynamically (Duffee and Hopkins, 2009), the Vector Error Correction Model (VECM) is also introduced to cover all possible responses. The model targeting the potential factors is

$$F_{n+1,t}^{n} - y_{n,t} = \gamma + \sum_{i=1}^{u} \delta_i x_{i,t} + \varepsilon_{t+n-1} \tag{12}$$

where $x_{i,t}$ is ith possible factor including (a) inflation rates, (b) monetary policy factor of announced policy rates and (c) business cycle variables of export values, capital inflow, exchange rates, manufacturing production indices and numbers of working hours.

Changes in the factor affect changes in the forward spread only when its coefficient estimate is statistically significant or $\delta_i \neq 0$ in this case.

5. RESULTS

In this section, the paper reports the results following two main models developed in the previous part. To determine if there is any forecasting power under the term structure of interest rate in Thailand, the paper follows equation (10) and equation (11) and to figure out what is the key potential factors influencing the forward spread in Thailand, the paper tests on the equation (12). By running the regressions with various types of statistical and econometrical techniques, the interpretations of coefficient estimates show as follows.

4.1. Forecasting power of the forwards spread in Thailand

Examining the model of equation (10) and equation (11), figure 1 reports the simplest connections of the forward interest rates and the latter real spot interest rates. While blue dots are the plots between yield spreads and forwards spread of the bonds at each time period, the lines represent their linear relationships and the slope of these lines refers to the amount of changes in the yield spreads that is explained by the forward spreads or the coefficient estimate, β. And as the perfect case, the slope of the green line is set to one. Therefore, considering all red lines as the best linear fit line of all data scattered, the closer of these slope to the slopes of green lines means better predictive power of the forward spreads. However, from the figure, the only spread with the predictive power is the 1-year forward spread shown in the top graph. The slope of its red line from the regression model is very closed to the perfect case of the green line while the slopes for 3-year and 5-year forward spreads worsen the forecasting power by showing the negative relationships even though their plots scatter less.

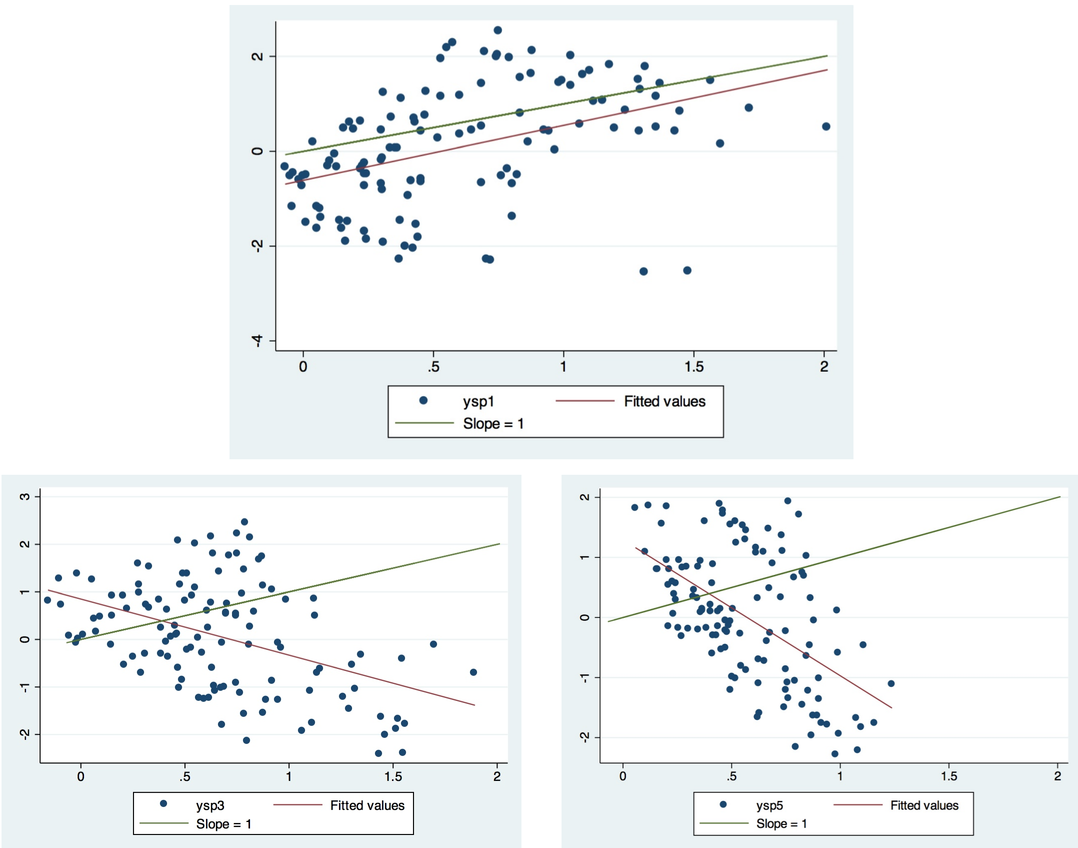

Figure 1 The scatter plot between yield spreads and forward spreads

Table 1 Tests of the expectation hypothesis with forward-spot spread approach.

$$y_{n,t+1} - y_{n,t} = \alpha + \beta\left(F_{n+1,t}^{n} - y_{n,t}\right) + \sum_{i=1}^{u} \eta_i z_{i,t} + \varepsilon_{t+1}$$

Model	(1.1)	(1.2)	(1.3)	(1.4)	(1.5)	(1.6)	(1.7)	(1.8)	(1.9)	(1.10)	(1.11)
Technique	**OLS**	**OLS**	**FGLS**	**ARCH(1)**	**GARCH(2,1)**	**OLS**	**FGLS**	**ARCH(1)**	**OLS**	**FGLS**	**ARCH(1)**
	ysp1	ysp1	ysp1	ysp1	ysp1	ysp3	ysp3	ysp3	ysp5	ysp5	ysp5
fsp1	1.159***	1.174***	1.174***	1.034***	0.748***						
	(0.223)	(0.231)	(0.222)	(0.094)	(0.037)						
fsp3						-1.135***	-1.135***	-1.251***			
						(0.257)	(0.205)	(0.141)			
fsp5									-2.741***	-2.741***	-3.001***
									(0.340)	(0.321)	(0.169)
dpolrate		0.942	0.942	-0.385	-0.497**	1.101*	1.101**	-0.147	0.616	0.616	-0.027
		(0.697)	(0.625)	(0.271)	(0.238)	(0.625)	(0.525)	(0.304)	(0.528)	(0.429)	(0.253)
infla		-0.170***	-0.170**	0.045*	0.004	-0.0613	-0.0613	-	0.005	0.005	-0.035
		(0.054)	(0.074)	(0.026)	(0.013)	(0.0546)	(0.0468)	(0.0355)	(0.044)	(0.035)	(0.025)
export		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Constant	-	0.348	0.348	-	-0.427***	1.575***	1.575***	0.012	3.185***	3.185***	1.598***
	(0.170)	(0.414)	(0.433)	(0.207)	(0.121)	(0.394)	(0.432)	(0.256)	(0.426)	(0.412)	(0.246)
Observations	120	119	119	119	119	119	119	119	119	119	119
Adjusted R^2	0.180	0.262	0.262	.	.	0.216	0.216	.	0.410	0.410	.
Fwdsp = 1	0.477	0.452	0.434	0.720	0	0	0	0	0	0	0
CI(lower b)	0.718	0.717	0.734	0.849	0.676	-1.644	-1.541	-1.528	-3.413	-3.376	-3.333
CI(upper b)	1.600	1.632	1.614	1.219	0.819	-0.625	-0.729	-0.974	-2.068	-2.106	-2.669
BIC	377.4	373.6	373.6	307.1	306.7	360.3	360.3	302.4	315.3	315.3	251.8

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

And by running the regressions, table 1 numerically reports the coefficient and standard error estimates. As mentioned that many appropriate models are used to figure out the best results, the number on the top of each row shows the rank of the model and the letters on the row below shows the regression technique used in the analysis. The dependent variables which are the yield spread with 1, 3 and 5-year to maturity (ysp1, ysp3 and ysp5) are in the third row of the table and the independent variables including the 1, 3 and 5-year forward spread (fsp1, fsp3 and fsp5), growth rate or difference of the policy rates (dpolrate), inflation rate (infla) and export values (export) are in the first column of the table.

Comparing this table with the scatter plots, model (1.1) is equivalent to the top graph with 1-year forward spread of the previous figure as it purely follows equation (10), having no exogenous variable. That is, the sample estimate coefficient from table 1 is 1.159 and the red line from figure 1 is a bit steeper than the green line. Nevertheless, with the test setting the null-hypothesis of the unity coefficient estimate or $H_0\colon \beta = 1$, there is no enough evidence to reject this null-hypothesis. The population coefficient still represents 1 and the expectation hypothesis still holds.

Then, considering the model of 1-year forward spread with the exogenous variables, the OLS simple regression is run again in model (1.2). The better result with the higher adjusted R-squared is reported, even the coefficient of only one exogenous is significant. Although the estimated coefficient increases, still, the validity of the expectation hypothesis could not be rejected. The p-value from the table is 0.452, which is a lot more than 0.05, and the confidence interval, lying between 0.717 and 1.632, still covers the value of 1. Moving forward to model (1.3) of the FGLS regression due to the problem of heteroskedasticity and the better model (1.4) of the ARCH(1,1) according to the problem on the error terms, the results still hold with the smaller coefficient estimates and the narrower confident intervals. And as the forecasting power is weakening over the improvement of the model in this case, model (1.5) of GARCH(2,1) finally reports the problem on the expectation hypothesis. Even almost 80% of the movements in the yield spread could still be explained by the changes in the forward spread, the null-hypothesis is now rejected.

Even it is mentioned by the paper that, between figure 1 and table 1, there is no equivalent models with 3 and 5-year forward spread, the result reported in the table still matches with the relationship in the figure. That is, all the coefficient estimates are statistically significantly negative and become larger negative over the horizons of the bonds. Also, been similar to the model (1.2), (1.3), (1.4) and (1.5), an improvement of the model (1.6) to (1.7) and (1.8), and the model (1.9) to (1.10) and (1.11) drops the ability to forecast of the forward spread.

Therefore, the predictive power of the forward spread in Thailand varies across different maturities. While the change in the forward spreads explains most of the fluctuation in the future interest rates for yields of 1-year to maturity bonds with weak forecasting power, the movement direction of long-term bonds are predicted incorrectly. The forecasts for yields with 3-year and 5-year time to maturity are distinctly biased. The expectation hypothesis, then, fails to demonstrate Thai term structure of the interest rates and the paper corresponds with results of prior studies in the United States.

4.2. Influencing factors of Thai forward spread

Despite the results found in the previous analysis of the predictive power, this part of determining the key factors is still in the interests of this paper due to these following reasons. Given that the movement in 1-year forward spread is able to capture most of the actions in the yield spread, it is still worth to know what are the key elements moving this forward spread. Furthermore, even 3-year forward spreads and 5-year forward spreads provide the low predictive powers, the coefficient estimates of these two groups of returns are still statistically significant. As underlying reasons are still needed, knowing the determinants of the forward spread might help explain the results in previous part.

Based the study on the earlier literatures and the equation (12), the paper separates all the possible factors into three groups due to their directions of impacts on the term structure of interest rates. Mentioned in the data section, the groups are the monetary policy, the business cycle variables and the inflation. Although there are a few more groups of important affecting factors according to the prior studies, such as the bid-ask spreads and the expectation indicators, they are not included in this case owing to the availability.

Table 2 Tests on the determinants of the forward spread.

$$F^{n}_{n+1,t} - y_{n,t} = \gamma + \sum_{i=1}^{u} \delta_i x_{i,t} + \varepsilon_{t+n-1}$$

Model	(2.1) fsp1	(2.2) fsp1	(2.3) fsp1	(2.4) fsp1	(2.5) fsp1	(2.6) fsp1	(2.7) fsp3	(2.8) fsp5
1. Monetary Policy								
dpolrate	1.047***	0.882***	0.865***	0.756***	0.764***	0.742***	0.671***	0.398***
	(0.230)	(0.243)	(0.258)	(0.283)	(0.283)	(0.281)	(0.250)	(0.151)
2. Business Cycle								
ympi		0.768**	0.716*	0.765*	0.882*	0.864*	-0.288	0.221
		(0.346)	(0.428)	(0.430)	(0.448)	(0.444)	(0.396)	(0.239)
yexport			0.0950	0.0464	-0.0764	-0.188	0.579	0.194
			(0.460)	(0.461)	(0.479)	(0.480)	(0.427)	(0.258)
ykinflow				0.0510	0.0445	0.0402	0.0355	0.0100
				(0.0374)	(0.0381)	(0.0378)	(0.0337)	(0.0204)
ywhour				-0.591	-0.382	-0.662	1.537	1.125
				(2.791)	(2.801)	(2.784)	(2.480)	(1.499)
yneer					-1.070	-0.998	3.784***	0.923
					(1.124)	(1.116)	(0.994)	(0.601)
3. Inflation								
dinfla						0.0896	-0.0208	0.000447
						(0.0551)	(0.0491)	(0.0296)
Constant	0.600***	0.570***	0.563***	0.543***	0.564***	0.577***	0.577***	0.496***
	(0.0397)	(0.0465)	(0.0575)	(0.0594)	(0.0631)	(0.0631)	(0.0562)	(0.0340)
Adjusted R-squared	0.144	0.171	0.163	0.164	0.163	0.176	0.211	0.146

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 2 reports the results from the OLS simple regression on the models following the equation (12). Again, the dependent variables which are the yield spread with 1, 3 and 5-year to maturity (ysp1, ysp3 and ysp5) are in the top of the table and the independent variables including the growth rate or difference of the policy rates (dpolrate), the year on year growth rate of manufacturing production indices (ympi), the year on year growth rate of export values (yexport), the year on year growth rate of capital inflows (ykinflow), the year on year growth rate of number of working hours (ywhour), the year on year growth rate of the nominal effective exchange rate (yneer) and the growth rate or difference of the inflation rates (dinfla) are in the first column of the table.

Considering all the OLS models at the same time, the only factor from table 2 that is statistically significant for all conditions and model modifications is the policy rate. With an additional percentage increase in the policy rate, the 1-year forward spread rises by 0.742 percent in model (2.6), 3-year forward spread rises by 0.671 percent in model (2.7) and 5-year forward spread rises by 0.398 percent in model (2.8). There are the positive relationships between the policy rate and the forward spread and the impacts of the percentage changes in the policy rates on the forward spread reduce over the horizons of the spread. Moreover, while some factors of the business cycle variables, such as the year on year growth rate of manufacturing production indices and the year on year growth rate of the nominal effective exchange rate, affect the forward spread at some horizons, the inflation rate has no impact on the forward spread.

Constructed in the same way as table 2, table 3 in the appendix reports the results from the VECM. Even the paper aims to use VECM in covering all possible dynamic movement of the forward spreads, the very short-term feedbacks vary a lot. As a result, no further information could be concluded in this case.

Therefore, based on the OLS models' result, the monetary policy becomes the only key determinant of the forward spread in Thailand. Its changes move the forward spread into the same direction and its impact is stronger in spreads with shorter time to maturities. Comparing the analysis with the basic understanding of the bond yields, the results found in this case is reasonable. As the rate of returns gained from the bond market is, at all time, compensating with the rate of returns on the other investments, when the central bank announces an increase in the policy rate, rate of returns on all the investment including this fixed income asset should increase. Furthermore, as a non-parallel shift of the yield curve happens frequently in the real world (Goodfriend, 1998), it is also a possible case for Thailand that the effectiveness of a policy tightening diminishes over the longer end.

6. CONCLUSION

Studying the term structure of interest rates in Thailand, this paper analyzes the expectation hypothesis by testing the predictive power of the forward spread under Thai bond market then determining the key potential factors underlying the movement of this forecasting spread. It applies the econometrical models include OLS, FGLS, ARCH, GARCH and VECM in its analysis and provides the conclusion of evidences against the expectation hypothesis. Corresponding with the cases studied in the United States (Fama and Bliss, 1987; Hardouvelis, 1988; Mishkin, 1988 and David, 1996), the forecasting power of the forward spread in Thailand gently exists in the bond with short-term maturity. It, however, dilutes in the long end, as the slope of the term structure of interest rates cannot predict the direction of changes in the long-term yields correctly. Given that the expectation hypothesis fails more dramatically for longer-term bonds, further understanding about the components of the forward spread is still necessary. While the business cycle variables and the inflation rate have no impact on the movements of the forward spread in this case, the percentage change in the policy rates, as a representative of the monetary policy, explains most of the unidirectional fluctuations in the forward spreads. And as well as the previous test, the effectiveness of the monetary policy also declines over the horizons of the bonds.

Consequently, the expectation hypothesis under the term structure of interest rates is still essentially important in conducting the monetary policy. With the lessen magnitude of impacts over the horizon of the bonds, the monetary agents would be able to understand their policy feedbacks more and, therefore, more beneficial policies could be conducted.

Also, as this paper deals with the simplest version of expectation hypothesis, further study with additional assumptions, such as the shorter-maturity or the existence of the term premium (Longstaff, 2000 and Buser, Karolyi and Sanders, 1996), might be needed. Moreover, as the transmission mechanism also plays a key role during the procedure (Goodfriend, 1998), further understanding of its connection with the term structure might be helpful in explaining the results of this paper as well.

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APPENDIX

Table 3 Tests on the determinants of the forward spread using VECM

	(3.1) fsp1	(3.2) fsp3	(3.3) fsp5
1. Monetary Poicy			
dpolrate	12.247***	35.592***	-1.679
	(4.284)	(11.464)	(1.477)
2. Business Cycle			
ympi	7.741	-4.189	2.426
	(7.169)	(19.109)	(2.353)
yexport	2.133	32.247	0.152
	(7.408)	(19.861)	(2.506)
ykinflow	-0.884*	-3.320**	0.379*
	(0.514)	(1.365)	(0.198)
ywhour	499.924***	-1233.362***	141.304***
	(54.819)	(142.741)	(14.523)
yneer	6.926	27.521	-8.034
	(14.640)	(38.928)	(5.840)
3. Inflation			
dinfla	-1.843*	-3.873	-2.560***
	(0.998)	(2.711)	(0.288)
Constant	0.440	0.054	0.171

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1