



UNIVERSITI PUTRA MALAYSIA

***TERM STRUCTURE OF INTEREST RATES FOR
MALAYSIAN FIXED INCOME SECURITY***

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**TERM STRUCTURE OF INTEREST RATES FOR
MALAYSIAN FIXED INCOME SECURITY**

By

ABUELGASIM ISMAIL MOHAMED ELGAZOLI

**Thesis Submitted to the School of Graduate Studies, Universiti Putra
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Doctor of Philosophy**

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DEDICATIONS

To my late parents Ismail and Fatima

TO

My mother Nafisa

My dearest brother Dr. Halim

My brothers, sisters, nieces, nephews and in laws

My beloved Anas

My love one

My entire family

My second home Malaysia

My supervisory committee

My UPM

My Sudan

The Muslim Nations

The World

And

The Humanity

...

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in
fulfilment of the requirement for the degree of Doctor of Philosophy

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Chair: Prof. Shamsheer Mohamad Ramadili, PhD

Faculty: Economics and Management

This study investigates the term structure of interest rates for the Malaysian fixed income security. This study is relevant because Malaysia has one of the fastest growing bond markets in the region. The general objective of this research is to study the behavior of the term structure of interest rates of Malaysian fixed income security by focusing on the issues related to the predictive power of forward to the future spot rates, long rates to short rates, and forward rates to inflation. Another important objective is to explore the efficiency of Malaysian fixed income security market in terms of prices and yields and to find out to what extent they are driven by the market forces. The final objective here is to interpret the behavior of the yield curve of the term structure of interest rates of Malaysian fixed income security market and to find out which theories can explain the behavior of this market, in addition to testing the liquidity premium theory. This research differs from earlier studies in several ways. First, due to the existence of limited number of studies that focus on Malaysian bond market, this investigation addresses several

issues in corporate bond market. In addition, this study examines the behavior of the term structure of interest rates in the government bond market. Second, this work compares and scrutinizes the behavior of the yields in both government and corporate bond markets. Third, an analysis on Malaysian corporate bond market seems to be less common in this context. A number of important research questions can be raised in this regard. Are the forward rates useful in the prediction of future spot rates and inflation? Does the market reflect the true value of the security by allocating fair yields and prices to investors? Which theory of the term structure can explain the behavior of Malaysia fixed income security market? The research has responded aforementioned questions by employing CIR as one-factor model as well as the extended BDT two factor model with the use of Financial Mathematical Computational tools in MATLAB. Here, it is worth mentioning that special code has been developed to calculate the zero curves and forward rates.

The market participants in MGS and MCB based their investment decision on their own preferences according to their assets and liabilities. The interpretation of the TSOIR and yield curve shapes is influenced by the dominance of the institutional investors in the market as giant players. Interestingly, without a doubt the extended BDT two-factor model confirms the results obtained by CIR one-factor model especially in predicting the shapes of the compartmentalized market yields in both MGS and MCB which are humped curves with few exceptions.

The yield-analysis by BDT indicates that the market mis-allocated the yield as the model fair yields for the entire issues of MGS are higher than the market current yields resulting in investors not getting what they deserve to get from their investments. In addition, the yield-analysis results by BDT for MCB are found to be similar to the result obtained from MGS except for B1 as the current market

yield is higher than the model fair yield. Here, it also deserves emphasis that price-analysis of MGS reveals that model fair prices are higher than the current market prices. However, MCB exhibited different behavior for its different classes as the model fair prices are found to be higher as well as lower than the market prices for a set of bond classes. Interestingly, the yield-analysis reveals that both CIR and BDT models produce similar results. Here, it should be emphasized that although CIR model is conventionally a one-factor model, it can successfully capture the dynamics of interest rates.

The mean YTM analysis by CIR for MGS and the eight different classes of Malaysian corporate bond when comparing the different maturities within the same class of bond fail to support LPT proposition. While the mean-analysis result by BDT shows clear evidence of the liquidity premium when investors holding the MGS to the maturity date. The mean YTM reveals normal upward curve with the increase of the maturity spectrum. This probably compensates the risk-averse investors to offset the risk of uncertainty in long term investment. However, the mean-analysis results by BDT for the MCB shows mixed evidence.

The spread-analysis which compares the same maturities within MGS and different classes of the corporate bond by CIR model shows mixed results. The analysis confirms some evidence of the LPT as the investors in some classes of the corporate bond in certain maturities will be getting positive excess return in addition to the risk-free rates. In a similar vein the spread-analysis by BDT reveals that each maturity spectrum has different segmented behavior with inbuilt liquidity premium. The higher classes of MCB exhibited positive spread while medium and lower classes shows mixed spread results. The findings of the spread-analysis deserve a special emphasis in the sense that the MCB investors may formulate their

investment strategy for their portfolio by using MGS as a benchmark. Turning to the predictive power of the variables of interest following findings deserve emphasis. The long rates obtained via CIR model could be incorporated in the model to predict the short rates. While Granger non-causality test between short and long rates for MGS suggest a unidirectional causality that runs from long rates to short rates. In addition, for the predictive power of the forward rates to future spot rates by BDT model, the pooled OLS does not seem to capture the dynamics of the variables of interest. However, there is strong bi-directional causality between the variables of interest. For the predictive power of the forward rates to the future inflation, the regression leads to misleading results for the standard errors. OLS does not capture the linear relation between the forward rates and inflation. Meanwhile the Granger non-causality tests between forward and inflation rates for MGS do not provide any causal relation between the forward and inflation rates.

The bounds test results support the cointegration among the variables of short and long rates under CIR model at 10% significance level. The result for the variables of the forward and spot rates by BDT model reveals that the computed statistics are supportive for an existence of cointegration at 5% significance level. Finally the bounds test result for the variables of inflation and forward rates suggest that there is a strong cointegration. The cointegration analysis reveals significant empirical support for the validity of the expectation hypothesis in Malaysian fixed income security. Finally, the overall research outcome would be of great importance to investors and other market participants in formulating their own strategies based on the information which can reflect the true value of the securities.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

STRUKTUR TEMPOH KADAR FAEDAH UNTUK KESELAMATAN PENDAPATAN TETAP MALAYSIA

Oleh

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Kajian ini menyiasat struktur panjang kadar faedah bagi sekuriti pendapatan tetap Malaysia. Hal ini demikian kerana, Malaysia merupakan salah satu daripada pasaran bon yang paling pesat berkembang di rantau ini. Objektif umum kajian ini adalah untuk memerhatikan tingkah struktur tempoh kadar faedah untuk keselamatan pendapatan tetap Malaysia dengan memfokuskan kepada isu-isu berkaitan dengan kuasa ramalan bagi kadar spot masa depan, kadar panjang ke kadar rendah dan kadar hadapan inflasi. Satu lagi objektif yang penting adalah untuk meneroka kecekapan pasaran sekuriti pendapatan tetap Malaysia dari segi harga dan hasil dan untuk mengetahui sejauh manakah ia dipacu oleh kuasa pasaran. Objektif terakhir di sini ialah untuk mentafsirkan tingkah laku keluk hasil struktur panjang kadar faedah pasaran sekuriti pendapatan tetap Malaysia dan untuk mengetahui teori-teori yang boleh menjelaskan tingkah laku pasaran pendapatan tetap Malaysia, selain menguji teori premium kecairan. Kajian ini berbeza dengan kajian-kajian awal sebelum ini. Pertama sekali, oleh kerana kewujudan kajian yang terhad yang memberi penumpuan kepada pasaran bon di Malaysia, kajian ini

turut menyebutkan beberapa isu dalam pasaran bon korporat. Di samping itu, kajian ini turut mengkaji tingkah laku struktur tempoh kadar faedah dalam pasaran bon kerajaan. Kedua, kerja-kerja ini membandingkan dan meneliti tingkah laku hasil kedua-dua dalam kerajaan dan pasaran bon korporat. Ketiga, analisis ke atas pasaran bon korporat Malaysia seolah-olah jarang dalam konteks ini.

Beberapa persoalan penting dapat ditimbulkan dalam kajian ini seperti adakah kadar hadapan berguna dalam peramalan kadar spon hadapan dan inflasi? Adakah pasaran menunjukkan nilai sebenar keselamatan dengan memperuntukkan hasil dan harga yang adil kepada pelabur? Teori struktur panjang manakah yang boleh menjelaskan tingkah laku pasaran keselamatan pandangan tetap? Kajian ini telah memberikan respon kepada persoalan yang diajukan di atas dengan menggunakan CIR sebagai model satu faktor serta BDT yang dilanjutkan sebagai model kedua dengan menggunakan pakai alat Pengiraan Simpanan Matematikal di MATLAB. Di sini, ia adalah bernilai menyebut bahawa kod khas telah dibangunkan untuk mengira keluk sifar dan kadar hadapan. Peserta pasaran dalam MGS dan MCB mendasarkan keputusan pelaburan mereka pada pilihan mereka sendiri mengikut kepada aset dan liabiliti mereka. Tafsiran TSOIR dan bentuk keluk hasil dipengaruhi oleh dominasi pelabur institusi di pasaran sebagai pemain gergasi. Menariknya.

Hasil analisis oleh BDT menunjukkan bahawa pasaran yang salah memperuntukkan hasil sebagai model hasil yang saksama bagi keseluruhan isu MGS adalah lebih tinggi daripada pasaran hasil semasa menyebabkan pelabur tidak mendapat apa yang mereka layak dapat daripada pelaburan mereka. Di samping itu, keputusan hasil analisis oleh BDT untuk MCB didapati serupa dengan hasil yang diperolehi daripada MGS kecuali untuk B1 sebagai hasil pasaran semasa adalah lebih

tinggi daripada hasil model saksama. Di sini, ia juga layak memberi penekanan bahawa analisis harga MGS mendedahkan bahawa harga model saksama adalah lebih tinggi daripada harga pasaran semasa. Walau bagaimanapun, MCB menunjukkan tingkah laku yang berlainan bagi kelas yang berbeza sebagai model harga saksama didapati untuk menjadi lebih tinggi dan juga lebih rendah daripada harga pasaran untuk satu set kelas bon. Hasil analisis menunjukkan bahawa kedua-dua model CIR dan BDT menunjukkan keputusan yang sama. Di sini, ia perlu dititik-beratkan bahawa walaupun CIR secara konvensional model satu faktor, ia boleh menangkap dinamik kadar faedah dengan jayanya.

Analisis min YTM oleh CIR untuk MGS dan lapan kelas bon korporat Malaysia yang berbeza apabila membandingkan kematangan yang berbeza dalam kelas yang sama bon gagal untuk menyokong cadangan LPT. Sementara hasil analisis min oleh BDT menunjukkan bukti jelas premium kecairan apabila pelabur memegang MGS ke tarikh matang. YTM min mendedahkan lengkung menaik normal dengan peningkatan spektrum kematangan. Hal ini berkemungkinan mengkompensasi pelabur yang suka risiko bagi mengimbangi risiko ketidakpastian dalam pelaburan jangkamasa panjang. Walau bagaimanapun, keputusan min-analisis oleh BDT untuk MCB menunjukkan bukti bercampur.

Penyebaran analisis yang membandingkan kematangan yang sama dalam MGS dan kelas bon korporat yang berlainan oleh model CIR menunjukkan keputusan bercampur-campur. Analisis mengesahkan beberapa bukti LPT kerana pelabur dalam beberapa kelas bon korporat yang berlainan dalam kematangan tertentu akan mendapat pulangan akses positif di samping kadar bebas risiko. Dalam nada yang sama penyebaran analisis oleh BDT mendedahkan bahawa setiap spektrum matang mempunyai tingkah laku bersegi yang berbeza dengan premium ke-

cairan terbina. Kelas-kelas yang lebih tinggi daripada MCB menunjukkan penyebaran positif manakala sederhana dan rendah kelas menunjukkan keputusan merebak yang bercampur. Hasil penemuan analisis penyebaran patut menerima penekanan istimewa dalam erti kata bahawa pelabur MCB boleh merumuskan strategi pelaburan untuk portfolio mereka dengan menggunakan MGS sebagai penanda aras.

Beralih kepada kuasa ramalan pembolehubah faedah menunjukkan dapatan berikut faedah patut menerima penekanan. Kadar jangka panjang yang diperoleh melalui model CIR boleh dimasukkan dalam model untuk meramal kadar yang singkat . Sementara ujian bukan sebab-musabab Granger antara kadar pendek dan panjang bagi MGS mencadangkan sebab-musabab satu arah yang berlangsung dari kadar jangka yang panjang kepada kadar yang singkat. Walau bagaimanapun, keputusan ujian bukan sebab-musabab Granger mencadangkan bahawa kadar yang singkat seolah-olah tidak menjurus kepada kadar jangka panjang Granger. Di samping itu, bagi kuasa ramalan kadar hadapan untuk kadar spot masa hadapan mengikut model BDT, OLS terkumpul tidak kelihatan untuk menangkap dinamik pembolehubah faedah. Walau bagaimanapun, terdapat sebab-musabab kukuh dwi-arah antara pembolehubah faedah. Keputusan ujian bukan sebab-musabab Granger yang menyokong bahawa kuasa ramalan kadar spot meningkat apabila seseorang termasuk nilai lag daripada kadar hadapan serta kadar spot dalam model. Bagi kuasa ramalan kadar hadapan bagi inflasi masa hadapan , regresi membawa kepada keputusan mengelirukan bagi kesilapan standard . OLS dengan spesifikasi ini tidak menarik hubungan linear antara kadar hadapan dan inflasi. Sementara itu, ujian bukan sebab-musabab Granger antara kadar hadapan dan inflasi bagi MGS tidak memberikan apa-apa hubungan bersebab antara kadar hadapan dan inflasi. Dalam erti kata lain, keputusan ujian bukan sebab-musabab Granger membayangkan bahawa kuasa ramalan kadar hadapan kelihatan

tidak meningkat apabila nilai lag kadar hadapan serta kadar inflasi telah dimasukkan ke dalam model. Hal ini mungkin disebabkan oleh hakikat, sebagai yang ditunjukkan melalui bukti visual, bahawa siri inflasi muncul untuk mempunyai pemerhatian yang melampau. Adalah diketahui bahawa titik terpencil atau pemerhatian menyeleweng mempunyai kesan yang tidak diingini pada OLS, kebolehdajian maksimum, serta keputusan penganggaran GMM. Batas keputusan ujian menyokong integrasi bersama antara pembolehubah kadar jangka pendek dan panjang di bawah model CIR pada aras keertian 10%. Keputusan bagi pembolehubah ke hadapan dan kadar spot oleh model BDT menunjukkan bahawa statistik dikira menyokong kewujudan integrasi bersama pada aras keertian 5%. Akhirnya hasil batas ujian pembolehubah inflasi dan kadar hadapan mencadangkan bahawa terdapat integrasi bersama yang kuat. Analisis integrasi bersama menunjukkan sokongan empirikal penting bagi kesahan hipotesis jangkaan dalam keselamatan pendapatan tetap Malaysia. Akhir sekali, hasil penyelidikan keseluruhan akan menjadi kepentingan besar kepada pelabur dan peserta pasaran lain dalam merangka strategi mereka sendiri berdasarkan maklumat yang boleh mencerminkan nilai sebenar keselamatan.

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I certify that a Thesis Examination Committee has met on (**23 Nov 2012**) to conduct the final examination of Abuelgasim Ismail Mohamed Elgazoli on his thesis entitled "Term Structure of Interest Rates for Malaysia Fixed Income Security" in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the Doctor of Philosophy

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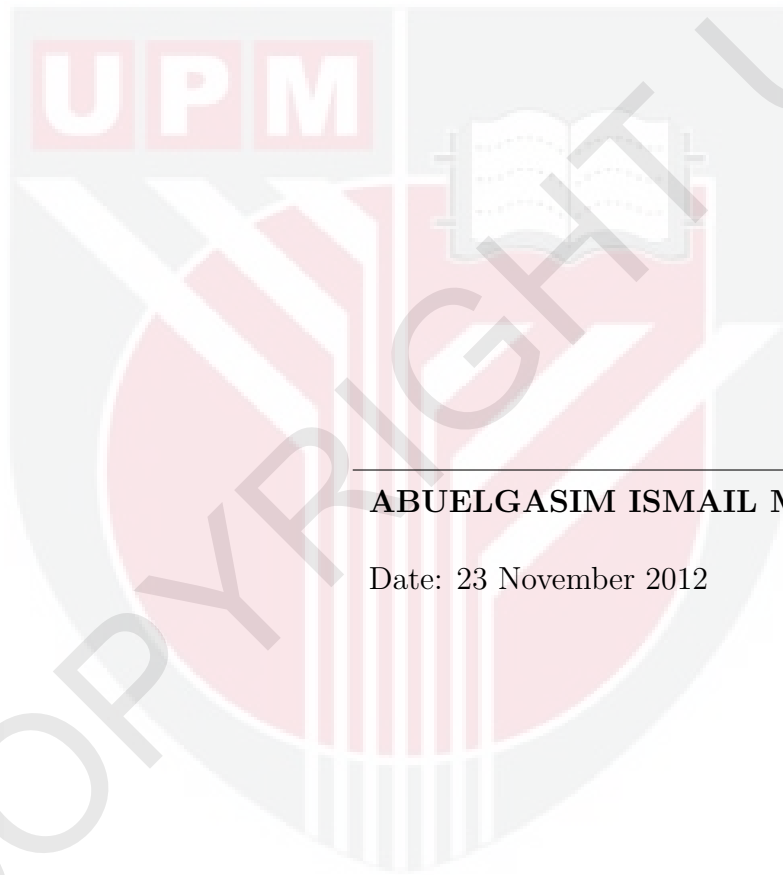
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DECLARATION

I declare that the thesis is my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously, and is not concurrently, submitted for any other degree at Universiti Putra Malaysia or at any other institution.



ABUELGASIM ISMAIL MOHAMED ELGAZOLI

Date: 23 November 2012

TABLE OF CONTENTS

	Page
DEDICATIONS	i
ABSTRACT	ii
ABSTRAK	vi
ACKNOWLEDGEMENTS	xi
DECLARATION	xv
LIST OF TABLES	xx
LIST OF FIGURES	xxvii
LIST OF ABBREVIATIONS	xxxiii
CHAPTER	
1 OVERVIEW OF THE STUDY	1
1.1 Introduction	1
1.2 The Term Structure of Interest Rates (TSOIR)	2
1.3 Theories in Term Structure of Interest Rates	3
1.4 Empirical Evidence on the Term Structure of Interest Rates	4
1.5 Supporting Evidences on the Term Structure of Interest Rates	5
1.6 Test of the CIR Model	6
1.7 Black Derman and Toy Model (BDT)	6
1.8 Government Security Market (GSM)	7
1.8.1 The Importance of Efficient Government Security Market	8
1.8.2 The Importance of the Yield Curve for Government Securities	9
1.9 The Problem Statement	11
1.10 General Objective of the Study	14
1.10.1 Specific Objectives	14
1.11 Significance and Contribution of the Study	15
1.12 Outline of the Thesis	17
2 BACKGROUND OF THE STUDY	19
2.1 Introduction	19
2.2 Bond Market Developments	20
2.3 Overview of Malaysian Bond Market	25
2.4 Malaysia and Selected Local World Bond Markets	26
2.5 Malaysian Government Security Market	29
2.6 Introduction to Corporate Bond Market	31
2.7 Development of Malaysian Corporate Bond	32
2.8 The Size of Malaysian Corporate Bond	35
2.9 Rating Agencies	37

3	LITERATURE REVIEW	39
3.1	Introduction	39
3.2	The Predictive Power of the Term Structure of Interest Rates on the Short-term Changes of Interest Rates	39
3.3	Evidence of the Term Structure of Interest Rates from Asian Region	55
3.4	Evidence of the Term Structure of Interest Rates from Malaysia	57
3.5	Liquidity Premium Theory and the Term Structure of Interest Rates	62
3.6	Measures and Various Aspects of Market Liquidity	68
4	THEORETICAL FRAMEWORK	79
4.1	Introduction	79
4.2	Theories of the Term Structure of Interest Rates	79
4.2.1	Market Segmentation Theory (MST)	79
4.2.2	Expectations Hypothesis	82
4.2.3	Biased Expectations Theory	90
4.2.4	Preferred Habitat Theory	91
4.2.5	Liquidity Premium Theory	92
5	RESEARCH METHODOLOGY	95
5.1	Introduction	95
5.2	Research Methods	95
5.3	The Wiener Process	96
5.3.1	Generalized Wiener Process	97
5.4	Ito's Process	98
5.4.1	Estimation of μ and σ	100
5.5	Cox, Ingersoll and Ross (CIR) Model	101
5.6	An Extension of Ito's lemma	102
5.7	Black, Derman and Toy (BDT) Model	103
5.7.1	BDT Two-Factor Model	104
5.7.2	The Advantages of Extended BDT Two-Factor over One-Factor Model	105
5.8	MATLAB Process	105
5.9	Data Specification	106
5.10	Diagnostic Testing	107
5.11	Hypotheses Test	108
5.12	Conclusion	110
6	RESULTS AND DISCUSSION	112
6.1	Introduction	112
6.2	CIR Analysis	113
6.2.1	CIR Simulation Result for MGS	114
6.2.2	CIR Simulation Results for Malaysian Corporate Bond-MCB	115
6.2.3	Comparison of the Mean YTM within the Same Securities by CIR	126
6.2.4	Comparison of the Mean YTM for MGS by CIR	126

6.2.5	Comparison of the Mean YTM for Malaysian Corporate Bond Different Maturities within the Same Class by CIR	128
6.2.6	Comparison of the Mean YTM for Same Maturities within Different Securities by CIR	138
6.3	Analysis Results of the Two Factor Model Black, Derman and Toy-BDT	141
6.3.1	BDT MATLAB PROCESS	141
6.3.2	Comparison of Model Fair Yield with Current Market Yield for MGS 2011 by BDT	142
6.3.3	Comparison of Model Fair Yields with Current Market Yields for MGS 2011 and 2010 by BDT	148
6.3.4	Comparison of Model Fair Prices with Current Market Prices MGS 2011	151
6.3.5	Comparison of Model Fair Yields and Prices with Current Market Yields and Prices for Malaysian Corporate Bond 2011 by BDT	157
6.3.6	Comparison of Mean Model Fair YTM for MGS and MCB Within Similar Maturities by BDT	176
6.3.7	Comparison of the Mean Model Fair YTM within the Same Securities by BDT	183
6.4	Predictive Power of the Term Structure of Interest Rates	201
6.4.1	Predictive Power of Long Rates to Short Rates	201
6.4.2	Causality Test Results for Short and Long Rates	203
6.4.3	Predictive Power of Forward to Spot Rates	204
6.4.4	Causality Test for Forward and Spot Rates	207
6.4.5	Predictive Power of Forward Rates to Future Inflation	209
6.4.6	Causality Test for Forward and Inflation Rates	210
6.4.7	Cointegration Test Results	212
7	CONCLUSION	216
7.1	Introduction	216
7.2	Summary of the Results for Malaysian Fixed Income Security	219
7.2.1	Result for Malaysian Government Security - CIR Model	220
7.2.2	Result for the Malaysian Corporate Bond - CIR Model	222
7.2.3	Results for the Malaysian Government Security - BDT Model	225
7.2.4	Results for the Malaysian Corporate Bond - BDT Model	227
7.3	Summary for Predictive Power of the Forward rates	230
7.3.1	Result for Predictive Power of Long Rates to Short Rates	230
7.3.2	Result for Predictive Power of Forward to Spot Rates	231
7.3.3	Result for Predictive Power of Forward to Inflation Rates	233
7.3.4	Result for Cointegration Test	234
7.4	Contribution of the Study	235
7.5	Limitation of the Study	238
7.6	Suggestion for Future Researches	239

REFERENCES	240
APPENDICES	255
B.2 Syntax for CIR	259
B.3 Syntax BDT Tree	259
B.3.1 Example for BDT Tree	260
B.4 Syntax BDT Price	260
B.5 Syntax BDT Yield	260
B.6 Syntax for Spot rates by BDT	261
B.7 Syntax for Forwards by BDT	263
B.8 Syntax for Spot and Forward Rates by BDT	263
B.9 Data Sample for Malaysia Fixed Income Security	265
B.10 Simulation of MGS Yield Curves for different Maturities	269
B.11 Mean YTM For Malaysian Corporate Bond- Tables and Curves	278
B.12 Model Prices and Yields for Malaysian Government Bond 2010	280
C.2 Simulation for the Forward Rates	282
C.3 Simulation for the Spot Rates	302
C.4 Simulation for Selected Forward Rates, Spot Rates and Yields Curves By BDT Model	322
BIODATA OF STUDENT	328
LIST OF PUBLICATIONS	330

LIST OF TABLES

Table	Page
2.1 Comparison of Major World Local Bond Markets	27
6.1 MGS Long and Short Interest Rates by CIR Model	114
6.2 MCB Credit Class Rated AAA Long and Short Interest Rates Simulation by CIR	116
6.3 Credit Class Rated AA1 Long and Short Interest Rates Simulation by CIR Model	117
6.4 MCB credit class rated AA3 Long and Short Interest Rates Simulation by CIR Model	119
6.5 MCB Credit Class Rated A1 Long and Short Interest Rates Simulation by CIR Model	119
6.6 MCB Credit Class Rated A2 Long and Short Interest Rates Simulation by CIR Model	120
6.7 MCB credit class rated A3 Long and Short Interest Rates Simulation by CIR Model	121
6.8 MCB Credit Class Rated B1 Long and Short Interest Rates Simulation by CIR Model	122
6.9 MCB credit class rated NR (LT) Long and Short Interest Rates Simulation by CIR Model	123
6.10 MGS Mean of Long and Short Interest Rates Simulation by CIR Model	128
6.11 The Mean YTM for MCB rated AAA by CIR Model	128
6.12 MGS Free-Risk Rates and MCB Different Risk-Classes Rates 2011	139
6.13 Model Fair Yield and Market Yield for Malaysian Government Bond 2011	143
6.14 Current, Model Fair and Mean Yield for Malaysian Government Bond 2010 and 2011	148

6.15	Current Market Prices, Model Fair Prices and Model Mean for MGS 2011	152
6.16	The Current Market, Model Fair YTM and Prices for MCB 2011 rated guaranteed AAA	157
6.17	The Current Market, Model Fair YTM and Prices for MCB 2011 rated guaranteed AA1	161
6.18	Current and Model Yields and Prices for Malaysian Corporate Bond 2011 Rated Guaranteed AA3	163
6.19	Current and Model Yields and Prices for Malaysian Corporate 2011 Bond Rated Guaranteed A1	165
6.20	Current and Model Yields and Prices for Malaysian Corporate 2011 Bond Rated Guaranteed A2	167
6.21	Current and Model Yields and Prices for Malaysian Corporate Bond 2011 Rated Guaranteed A3	170
6.22	Current and Model Yields and Prices for Malaysian Corporate Bond 2011 Rated Guaranteed B1	172
6.23	Percentage of Higher, Lower Yields and Prices for MGS and MCB 2011	174
6.24	MGS Free-Risk Rates and MCB Different Risk-Classs Rates 2011	177
6.25	Spread for MCB Different Classes Rated 2011	178
6.26	The Spread for Five-Year Bond within Different Rated Classes of MCB	180
6.27	The Spread for Seven-Year Bond within Different Rated Classes of MCB	181
6.28	The Spread for 10-Year Bond within Different Classes Rated of MCB	182
6.29	Mean Model Fair YTM for Malaysian Government Security	184
6.30	Mean Model Fair YTM and Access Return for MGS Two-Year, Three-Year, and 10-Year Bond	185

6.31 Mean Model Fair YTM and Access Return for MGS Three-Year, Seven-Year and 20-Year Bond	186
6.32 Mean Model Fair YTM and Access Return for MGS Five-Year, 10-Year, 15-Year and 20-Year Bond	188
6.33 Mean Model Fair YTM for MCB Rated Class AAA	189
6.34 Mean Model Fair YTM for MCB Rated Class AA1	191
6.35 Mean Model Fair YTM and Access Return for MCB Class Rated AA1, Eight-Year, Nine-Year and 10-Year Bond	192
6.36 Mean Model Fair YTM and Access Return for MCB Class Rated AA3, 10-Year, 15-Year and 50-Year Bond	193
6.37 Mean Model Fair YTM and Access Return for MCB Class Rated A1, Five-Year, Nine-Year and 10-Year Bond	194
6.38 Mean Model Fair YTM and Access Return for MCB Class Rated A2, Five-Year, Six-Year and Seven-Year Bond	195
6.39 Mean Model Fair YTM and Access Return for MCB Class Rated A3 Five-Year and 10-Year Bond	197
6.40 Mean Model Fair YTM and Access Return for MCB Class Rated B1	199
6.41 OLS Estimation Results	202
6.42 Causality Test Results for Short and Long Rates	204
6.43 Pooled OLS Estimation Results	205
6.44 Fixed Effects Estimation Results	206
6.45 Causality Test Results for Forward and Spot Rates	207
6.46 OLS Estimation Results	210
6.47 Causality Test Results for Forward and Inflation Rates	211
6.48 Bounds Testing Results For Short and Long Rates	212
6.49 Bounds Testing Results for Inflation and Forward Rates	213
6.50 Pedroni's Panel Cointegration Result for Spot and Forward Rates	214

A.1	Size and Composition of Selected Local Bond Markets	255
A.2	Size and Composition of Selected Local Bond Markets	256
A.3	Comparison of Emerging East Asia Local Bond Markets as Percentage of GDP	257
A.4	Malaysian Local Bond Market Ratio to GDP	258
B.1	Sample of Row Data for Malaysia Government Security 15-Year Bond Maturity	265
B.2	Sample of Row Data for Malaysia Corporate Bond AAA Eight-Year Bond Maturity	266
B.3	Sample of Arranged Data for Malaysia Government Security	267
B.4	Sample of Arranged Data for Malaysia Corporate Bond Rated AA1	268
B.5	The Mean YTM for MCB rated AA1 by CIR Model	278
B.6	The Mean YTM for MCB rated AA3 by CIR Model	278
B.7	The Mean YTM for MCB rated A1 by CIR Model	278
B.8	The Mean YTM for MCB rated A2 by CIR Model	279
B.9	The Mean YTM for MCB rated A3 by CIR Model	279
B.10	The Mean YTM for MCB rated B1 by CIR Model	279
B.11	The Mean YTM for MCB rated NR(LT) by CIR Model	279
B.12	Current, Model Fair and Mean Prices for Malaysian Government Bond 2010	280
B.13	Current, Model Fair and Mean Yields for Malaysian Government Bond 2010	281
C.1	Simulation for Forward Rates Base on the Settlement Date at The End of Each Month for Year 2000	282
C.2	Simulation for Forward Rates Base on the Settlement Date at The End of Each Month for Year 2000	283

C.3	Simulation for Forward Rates Base on the Settlement Date at The End of Each Month for Year 2001	284
C.4	Simulation for Forward Rates Base on the Settlement Date at The End of Each Month for Year 2001	285
C.5	Simulation for Forward Rates Base on the Settlement Date at The End of Each Month for Year 2002	286
C.6	Simulation for Forward Rates Base on the Settlement Date at The End of Each Month for Year 2002	287
C.7	Simulation for Forward Rates Base on the Settlement Date at The End of Each Month for Year 2003	288
C.8	Simulation for Forward Rates Base on the Settlement Date at The End of Each Month for Year 2003	289
C.9	Simulation for Forward Rates Base on the Settlement Date at The End of Each Month for Year 2004	290
C.10	Simulation for Forward Rates Base on the Settlement Date at The End of Each Month for Year 2004	291
C.11	Simulation for Forward Rates Base on the Settlement Date at The End of Each Month for Year 2005	292
C.12	Simulation for Forward Rates Base on the Settlement Date at The End of Each Month for Year 2005	293
C.13	Simulation for Forward Rates Base on the Settlement Date at The End of Each Month for Year 2006	294
C.14	Simulation for Forward Rates Base on the Settlement Date at The End of Each Month for Year 2006	295
C.15	Simulation for Forward Rates Base on the Settlement Date at The End of Each Month for Year 2007	296
C.16	Simulation for Forward Rates Base on the Settlement Date at The End of Each Month for Year 2007	297
C.17	Simulation for Forward Rates Base on the Settlement Date at The End of Each Month for Year 2008	298

C.18 Simulation for Forward Rates Base on the Settlement Date at The End of Each Month for Year 2008	299
C.19 Simulation for Forward Rates Base on the Settlement Date at The End of Each Month for Year 2009	300
C.20 Simulation for Forward Rtes Base on the Settlement Date at the End of Each Month for Year 2009-2010	301
C.21 Simulation for Spot Rates Base on the Settlement Date at the End of Each Month for Year 2000	302
C.22 Simulation for Spot Rates Base on the Settlement Date at the End of Each Month for Year 2000	303
C.23 Simulation for Spot Rates Base on the Settlement Date at the End of Each Month for Year 2001	304
C.24 Simulation for Spot Rates Base on the Settlement Date at the End of Each Month for Year 2001	305
C.25 Simulation for Spot Rates Base on the Settlement Date at the End of Each Month for Year 2002	306
C.26 Simulation for Spot Rates Base on the Settlement Date at the End of Each Month for Year 2002	307
C.27 Simulation for Spot Rates Base on the Settlement Date at the End of Each Month for Year 2003	308
C.28 Simulation for Spot Rates Base on the Settlement Date at the End of Each Month for Year 2003	309
C.29 Simulation for Spot Rates Base on the Settlement Date at the End of Each Month for Year 2004	310
C.30 Simulation for Spot Rates Base on the Settlement Date at the End of Each Month for Year 2004	311
C.31 Simulation for Spot Rates Base on the Settlement Date at the End of Each Month for Year 2005	312
C.32 Simulation for Spot Rates Base on the Settlement Date at the End of Each Month for Year 2005	313

C.33 Simulation for Spot Rates Base on the Settlement Date at the End of Each Month for Year 2006	314
C.34 Simulation for Spot Rates Base on the Settlement Date at the End of Each Month for Year 2006	315
C.35 Simulation for Spot Rates Base on the Settlement Date at the End of Each Month for Year 2007	316
C.36 Simulation for Spot Rates Base on the Settlement Date at the End of Each Month for Year 2007	317
C.37 Simulation for Spot Rates Base on the Settlement Date at the End of Each Month for Year 2008	318
C.38 Simulation for Spot Rates Base on the Settlement Date at the End of Each Month for Year 2008	319
C.39 Simulation for Spot Rates Base on the Settlement Date at the End of Each Month for Year 2009	320
C.40 Simulation for Spot Rates Base on the Settlement Date at the End of Each Month for Year 2009-2010	321

LIST OF FIGURES

Figure	Page
4.1 Theories of the Term Structure of Interest Rates	80
4.2 Yield Curve in Market Segmentation Theory	82
4.3 The Shapes of the Yield Curves	87
6.1 Term Structure of Interest Rates for MGS from CIR Model	113
6.2 The Yield Curve of the Credit Class Rated AAA from CIR Model Simulation	116
6.3 The Yield Curve of the Credit Class Rated AA1 from CIR Model Simulation	118
6.4 The Yield Curve of the Credit Class Rated AA3 from CIR Model Simulation	118
6.5 The Yield Curve of the Credit Class Rated A1 from CIR Model Simulation	120
6.6 The Yield Curve of the Credit Class Rated A2 from CIR Model Simulation	121
6.7 The Yield Curve of the Credit Class Rated A3 from CIR Model Simulation	122
6.8 The Yield Curve of the Credit Class Rated B1 from CIR Model Simulation	124
6.9 The Yield Curve of the Credit Class Rated NR (LT) from CIR Model Simulation	124
6.10 Simulation of 20-Year MGS Yield Curve Maturing on 15 Sep 2026	125
6.11 The Mean Yield Curve of MGS by CIR Model	127
6.12 The Mean Yield Curve of MGS Five, Ten- and 15-Year by CIR Model	127
6.13 The Mean YTM for MCB rated AAA by CIR Model	129

6.14	The Mean YTM for MCB rated AAA Five, 10 and 12-Year by CIR Model	129
6.15	The Mean YTM for MCB rated AA1 by CIR Model	130
6.16	The Mean YTM for MCB rated AA1 Five, 10 and 15-Year by CIR Model	131
6.17	The Mean YTM for MCB rated AA3 by CIR Model	131
6.18	The Mean YTM for MCB rated AA3 Five, 10 and 15-Year by CIR Model	132
6.19	The Mean YTM for MCB rated A1 by CIR Model	133
6.20	The Mean YTM for MCB rated A2 by CIR Model	134
6.21	The Mean YTM for MCB rated A3 by CIR Model	134
6.22	The Mean YTM for MCB rated A3 Five, 10 and 15-Year by CIR Model	135
6.23	The Mean YTM for MCB rated B1 by CIR Model	135
6.24	The Mean YTM for MCB rated B1 Eight, 10-Year and 14-Year by CIR Model	136
6.25	The Mean YTM for MCB rated NR(LT) by CIR Model	137
6.26	The Mean YTM for MCB rated NR(LT) Two, Five and 10-Year by CIR Model	137
6.27	The Structure of Interest Rates for Malaysian Government Bond 2011 by BDT	144
6.28	The Model Term Structure of the Interest Rates with the Current YTM 2011 for MGS	145
6.29	The Model Term Structure of the Interest Rates, Average Model and the Current 2011 for MGS	146
6.30	The Average Model YTM and the Coupon Rates 2011 for MGS	146
6.31	The Model Term Structure of the Interest Rates, Average Model, Current 2011 YTM and Coupon Interest Rates	147

6.32	The Current Market Yield for MGS 2010 and 2011	149
6.33	The Term Structure of Interest Rates for Malaysian Government Bond 2011 and 2010	150
6.34	The Current Market Yield, Model Fair YTM, Model Mean YTM and the Coupon Interest Rates for MGS 2011 and 2010	151
6.35	The Model Mean Prices For MGS 2011	153
6.36	The Model Prices and Current Market Prices for MGS in Year 2011	153
6.37	The Current Market Prices, Model Prices and Model Mean Prices for MGS 2011	155
6.38	The Yield Curve for Malaysian Corporate Bond 2011 Rated Guaranteed AAA	159
6.39	The Current and model fair prices for Malaysian Corporate Bond 2011 Rated Guaranteed AAA	159
6.40	The Yields Curve for Malaysian Corporate Bond 2011 Rated Guaranteed AA1	162
6.41	The Current and model fair prices for Malaysian Corporate Bond 2011 Rated Guaranteed AA1	162
6.42	Yields Curve for Malaysian Corporate Bond 2011 Rated Guaranteed AA3	164
6.43	Current and Model Prices for Malaysian Corporate Bond 2011 Rated Guaranteed AA3	164
6.44	Yields Curve for Malaysian Corporate Bond 2011 Rated Guaranteed A1	166
6.45	Current and Model Prices for Malaysian Corporate Bond 2011 Rated Guaranteed A1	167
6.46	Yields Curve for Malaysian Corporate Bond 2011 Rated Guaranteed A2	168
6.47	Current and Model Prices for Malaysian Corporate Bond 2011 Rated Guaranteed A2	169

6.48	Yields Curve for Malaysian Corporate Bond 2011 Rated Guaranteed A3	170
6.49	Current and Model Prices for Malaysian Corporate Bond 2011 Rated Guaranteed A3	171
6.50	Yields Curve for Malaysian Corporate Bond 2011 Rated Guaranteed B1	173
6.51	Current and Model Prices for Malaysian Corporate Bond 2011 Rated Guaranteed B1	173
6.52	The Mean Model Term Structure of Interest Rate for MGS	184
6.53	The Mean Model Fair YTM for MGS Two-Year, Three-Year, and 10-Year Bond	186
6.54	The Mean Model Fair YTM for MGS Three-Year, Seven-Year and 20-Year Bond	187
6.55	The Mean Model Fair YTM for MGS Five-Year, 10-Year, 15-Year and 20-Year Bond	188
6.56	The Mean Model Yield Curve for MCB class Rated AAA	190
6.57	The Mean Model Yield Curve for MCB Class Rated AA1	191
6.58	The Mean Model YTM for MCB Credit Class Rated AA1, Eight-Year, Nine-Year and 10-Year bond	192
6.59	The Mean Model Yield Curve for MCB Credit Class Rated AA3	194
6.60	The Mean Model Yield Curve for Five-Year MCB Credit Class Rated A1	195
6.61	The Mean Model Yield Curve for Five-Year MCB Credit Class Rated A2	196
6.62	The Mean Model Yield Curve for Five-Year MCB Credit Class Rated A3	198
6.63	The Mean Model Yield Curve for Five-Year MCB Credit Class Rated A3	199
6.64	The Mean Model Yield Curve for MCB Credit Class Rated B1	200

B.1	Example for BDT Tree 15-Year MGS 30 Jul 2004-30 to Jul 2019	260
B.2	Simulation of 20-Year MGS Yield Curve Maturing on 15 Jul 2025	269
B.3	Simulation of 20-Year MGS Yield Curve Maturing on 31 May 2027	269
B.4	Simulation of 20-Year MGS Yield Curve Maturing on 15 Sep 2028	270
B.5	Simulation of 20-Year MGS Yield Curve Maturing on 15 Apr 2030	270
B.6	Simulation of 15-Year MGS Yield Curve Maturing on 29 Jan 2018	271
B.7	Simulation of 15-Year MGS Yield Curve Maturing on 7th Feb 2018	271
B.8	Simulation of 15-Year MGS Yield Curve Maturing on 30 Jul 2019	272
B.9	Simulation of 10-Year MGS Yield Curve Maturing on 28 Sep 2011	272
B.10	Simulation of 10-Year MGS Yield Curve Maturing on 4th Dec 2012	273
B.11	Simulation of 10-Year MGS Yield Curve Maturing on 25 Feb 2013	273
B.12	Simulation of 10-Year MGS Yield Curve Maturing on 30 Apr 2014	274
B.13	Simulation of Seven-Year MGS Yield Curve Maturing on 15 Mar 2017	274
B.14	Simulation of Five-Year MGS Yield Curve Maturing on 27 Aug 2014	275
B.15	Simulation of Five-Year MGS Yield Curve Maturing on 12 Feb 2015	275
B.16	Simulation of Three-Year MGS Yield Curve Maturing on 27 Feb 2012	276
B.17	Simulation of Three-Year MGS Yield Curve Maturing on 27 Nov 2012	276
B.18	Simulation of Two-Year MGS Yield Curve Maturing on 14 Aug 2011	277
C.1	Simulation of Forward Rates Base on the Settlement Date on 31 Dec 2000	322
C.2	Simulation of Spot Rates Base on the Settlement Date on 31 Dec 2000	322

C.3 Simulation of Yield Rates Base on the Settlement Date on 31 Dec 2000	323
C.4 Simulation of Forward Rates Base on the Settlement Date on 30 Jun 2005	323
C.5 Simulation of Spot Rates Base on the Settlement Date on 30 Jun 2005	324
C.6 Simulation of Yield Rates Base on the Settlement Date on 30 Jun 2005	324
C.7 Simulation of Forward Rates Base on the Settlement Date on 31 Jan 2010	325
C.8 Simulation of Spot Rates Base on the Settlement Date on 31 Jan 2010	325
C.9 Simulation of Yield Rates Base on the Settlement Date on 31 Jan 2010	326
C.10 Simulation of Forward Rates From Jan 2000 to Jan 2010	326
C.11 Simulation of Spot Rates From Jan 2000 to Jan 2010	327

LIST OF ABBREVIATIONS

ATSMs	Affine Term Structure Models
BNM	Bank Negara Malaysia
BDT	Black, Derman and Toy
BK	Black-Karasinski
BIDS	Bond Information Dissemination System
CMP	Capital Market Master Plan
CLOs	Collateralized Loan Obligations
CIR	Cox, Ingersoll and Ross
EPF	Employee Provident Fund
EH	Expectations Hypothesis
FAST	Fully Automated System for Issuing Tendering
GII	Government Investment Issues
GSM	Government Security Market
HJM	Heath-Jarrow-Morton
HW	Hull-White
ISCAP	Institutional Securities Custodian Program
IDBS	Interdealer Brokers System
KLSECI	Kuala Lumpur Stock Exchange Composite Index Futures
IOFC	Labuan International Offshore Financial Center
LPT	Liquidity Preference Theory
MCB	Malaysia Corporate Bond
MGS	Malaysia Government Security
MITB	Malaysian Islamic Treasury Bills
MARC	Malaysian Rating Corporation Berhad

MTB	Malaysian Treasury Bill
MST	Market Segmentation Theory
MTM	Mark-to-Market
MVPEH	Modified Version of the Pure Expectations Hypothesis
NASD	National Association of Securities Dealers
NBMC	National Bond Market Committee
NPL	Non-Performing Loan
PHT	Preferred Habitat Theory
PDS	Private Debt Securities
PEH	Pure Expectations Hypothesis
RAM	Rating Agency Malaysia Berhad
RENTAS	Real Time Electronic Transfer of Funds and Securities
REPO	Repurchase Agreements
SBL	Securities Borrowing and Lending
TSOIR	Term Structure of Interest Rates
TRACE	Trade Reporting and Compliance Engine

CHAPTER 1

OVERVIEW OF THE STUDY

1.1 Introduction

Financial system plays an important role in promoting economic growth by offering to the saver varied of choices to place their funds in most profitable projects, giving the borrower ways to issue securities and gathering funds from people and businesses that have more than they need. Therefore, the function of the financial system is to facilitate the flow of funds to the borrowers from lenders. The larger the flow of funds and the more efficient it's allocation are, a market expects to face the greater economic growth and welfare. Thus saving, lending, borrowing and investment are closely linked with each other through financial markets and the factor behind all of them is the rates of the interest.

The interest rate is an important concept in finance. It defines the way a fee is paid on borrowed capital or assets. Then, these assets can be lent in the form of direct money, shares, consumer goods, heavy machinery and finance lease agreements. It may also be referred to as an opportunity cost of money, a premium to enjoy access for money and the price of credit which is commonly known as the price of money.

Interest rates have an influence on the national economy through lending, borrowing, saving, and investment in both micro as well as the macro level. In addition to that, the effect can spread to other countries via the inter-country barring or what is commonly known as contagion effect. There are several determinants of interest rates in the economy such as inflation, supply and demand for loanable fund, types of loan or debts and duration of the loan. The relation between the loan duration and the yield to maturity is referred as the term structure of interest

rates (TSOIR). TSOIR linking the securities similar in all provisions (tax, default or credit risk, convertibility, call, floating rates or other special provision) except for the term to maturity. TSOIR is also known as the yield curve which considers one of the commonly used bond valuation method. The TSOIR represent the plot of the yield to maturities (YTM) with its respective maturities spectrum of benchmark fixed-income securities. The TSOIR is used as measurement for the market expectations about the future course of interest rates. This expectation will take into account the condition of the current market. The government securities are considered risk-free. The YTM in the government bond used as the benchmarks for fixed-income securities (for example corporate bond and Sukuk) with the similar maturities. The TSOIR plots with zero-coupon bond which would mature on the coupon payment date. The TSOIR may exhibit different shapes, normal, inverted, flat or humped. The change in the shape is a sign for the investors to change their expectations about the future short interest rates and economy as the whole.

1.2 The Term Structure of Interest Rates (TSOIR)

This study concerns about the behavior of the TSOIR of the fixed income security market in Malaysian Government Security (MGS) as well as Malaysian Corporate Bond (MCB). It is of great importance to study the TSOIR as it contains useful information about the intertemporal choices made by economic agents and shed light on the efficiency of the financial market in utilizing the information to form expectations. The TSOIR represents a channel of monetary transmission. The monetary authority has a direct influence on short-term interest rates, while long term rates evolve on the basis of investors' expectations about the future path of the economic variables including short term interest rates and economic uncertainty. Thus, the TSOIR helps to transmit monetary policy effect to the real

sectors of the economy as investment and production are affected by the expectations of future real interest rates. Globally, the TSOIR affects the international capital flow. The yield on the TSOIR for government bond is considered as an important category of interest rates in the economy which gains its importance for being a benchmark for other securities in the market like corporate bond and sukuk. The TSOIR can be interpreted by the theory of Expectation Hypothesis (EH), Liquidity Premium Theory (LPT), Preferred Habitat Theory (PHT) and Market Segmentation Theory (MST).

1.3 Theories in Term Structure of Interest Rates

The TSOIR has been a vibrant topic for research in Economics and Finance in developed countries since the beginning of the last century. In 1930, Fisher developed the EH theory which explains the relation between short-term and long-term interest rates under the conditions of efficient bond pricing environment and perfect foresight. In this context, all relevant information is incorporated into market participants' expectation concerning the future course of interest rates. If forward rates and expected future spot rates differ, then market participants would exploit the opportunity until it is eliminated. As a result, forward rates which are implied in the term structure of interest rates would be unbiased estimates of expected future spot rates. The shape of the TSOIR can be upward, flat or even downward sloping curve.

Here, it is worth mentioning that several theories on TSOIR have empirical support in the literature. However, these studies are on the behavior of the bond market in the developed countries. For example, Hicks & Lutz (1940) developed the LPT which assumes that the investors are risk averse and the term premium will cause forward rates to be higher than the expected spot rates. Investors, therefore, re-

quire a higher premium to invest in long term bond rather than the short one. The longer the term to maturity, the higher would be the term premium. This term premium causes the TSOIR to be upward sloping curve.

Culbertson (1957) developed The Market Segmentation Theory (MST). He assumes that the investors remain in a preferred habitat dictated by the nature of their assets and liabilities. The author proposed that the securities of different maturities should be traded in a different markets. The shape of TSOIR in this type would not be upward sloping. Rather, it would be humped as the result of the segmented behavior of the TSOIR.

Modigliani & Sutch (1966) came out with the Preferred Habitat Theory (PHT) which argues that the TSOIR reflects the expectation of the future interest rates and the risk or term premium which increase with the long term to maturity. This PHT is an extension of the MST as it includes the term premium to the expectation of all future interest rates. Unlike the PHT, EH accepts only the expectation of all future interest rates. While PHT differs from the MST as it allows the investors to shift from their preferred habitats to other habitats if offered better return. The risk premium in PHT increases uniformly with the increase of maturity if the investors are in a need to liquidate their bond at shorter possible time while borrowers like to invest in long maturity, the MST does not accept this notation. The shape of the TSOIR in PHT may experience all different shapes either upward, downward sloping, flat or humped curve.

1.4 Empirical Evidence on the Term Structure of Interest Rates

Since the development of the EH by Fisher (1930), many researchers and academicians used US data to test the theory. Their results failed to support this theory.

These include Macaulay (1938), Bekaert, Hodrick & Marshall (1995), Fama (1984a, b), Fama & Bliss (1987), Mankiw (1986), Mankiw & Summers (1984), Mankiw & Miron (1986), Shiller (1979), Shiller, Campbell & Schoenholtz (1983), Hardouvelis (1994), among others.

Campbell and Shiller's (1991) finding also failed to support the EH theory. They argue that the term premium is believed to be the cause of the rejection of the theory in the US. The argument that the term premium which caused the long interest rates either overreacts to the expectations of the future short rates or to underreacts to the current short rates.

1.5 Supporting Evidences on the Term Structure of Interest Rates

While the above studies fail to support the theory, on the other hand there are many studies that support the TSOIR theory by using data for other developed countries rather than US. In one of the students (Hardouvelis, 1994) finds evidence supporting the theory by testing the TSOIR in Canada, France, Germany, Italy, Japan and U.K. This study for G7 supports the theory except for US. Other researchers as well found strong support to the theory Mankiw (1986), using Canadian, German and U.K. data, Mills (1991) using U.K data, Tease (1986), using Australian data, Bekaert, Hodrick & Marshall (1995), using U.K data, Cuthbertson & Nitzsche (2000), using German data, Dahlquist & Jonsson (1995), using Swedish data & Margaritis (1994), using New Zealand data. Generally, all of them found support for the EH theory in their respective studies unlike the previous studies using US data. Following the developed TSOIR theory, many researchers attempt to modeling the TSOIR, one of the innovation in modeling the TSOIR emerged in (1981) Cox, Ingersoll & Ross (CIR) enriched the theory by developing the famous CIR model. Black, Derman & Toy(1990) as well developed BDT model for

the interest rates. Both CIR and BDT models are proven to be testable for the Expectation Hypothesis.

1.6 Test of the CIR Model

The TSOIR in the CIR model it have been determined within a dynamic general equilibrium framework and it contains the elements of the traditional hypotheses, it takes into consideration the relation between interest rates and the state of the economy. The TSOIR is linked directly to specification of preferences, technologies and the distributions of the underlying sources of uncertainties. The CIR model has empirical implications for the price of different types of securities like default free, option bonds, callable bonds and valuation of contingent claims.

Some of the researchers who used the CIR model in their analysis for TSOIR are Brown & Dybvig (1986), used U.S monthly treasury data from December 1952 to December 1983. From their data, 373 cross sections of default-free coupon bond prices were obtained, each of which was used to estimate the parameters of the CIR model. The same approach was used by Brown & Schaefer (1988) and Barone, Cuoco & Zautzik (1991). CIR specification of the Expectation Hypothesis theory was supported in all those studies.

1.7 Black Derman and Toy Model (BDT)

Black, Derman & Toy (1990) came out with their BDT model, which is a one factor interest rates model and have been extended to two factor model by Turan, G. B., (2001:2003). The BDT two factor model is represented by the short-term interest rate and the instantaneous variance (or standard deviation) of changes in the short rate. It is known that the current level and volatility of interest rate

changes are two of the most important factors in explaining movements in the term structure of interest rates. Turan, G. B., (2001) presents the pricing implications for discount bonds. Monte Carlo simulation results for the implied yields of three and six month zero coupon bonds imply that incorporating the so-called level and GARCH effects in volatility improves the pricing performance of the interest rate models. This BDT two factor model is proven to generate better results, and useful in the pricing of fixed income bonds as well as the floating rates bonds.

1.8 Government Security Market (GSM)

The bond market usually brings together issuers having long-term needs for finance with investors willing to invest their fund in long-term interest-bearing securities, by doing so bond market do the matching process between both groups. A mature domestic bond market usually offers wide range of alternatives and opportunities for funding the government and private sector as well. The government bond market considered as a channel of financial intermediation for its purpose of mobilizing savings and investment that promotes development and economic growth . Bonds are very important for the resources allocation, as they are the main vehicles by which funds are raised for long-term investment projects, moreover the government uses its bond market as a vehicle and means to finance its budget deficits.

The development of the GSM heavily based on the development and efficiency of the financial system of each country. Some governments rely on its funding mechanism to a few domestic banks, which makes competition scarce and transaction costs high. In addition, absence of a sound market infrastructure may make specific actions to develop GSM insufficient. Scarcity of institutional investors, low domestic saving rates, and low interest and encouragement from international investors can result in inefficient bond market, therefore, weaken investors' confidence and

increase the risk associated with GSM. GSM in developed and developing countries plays as the backbone of fixed income securities. GSM provides benchmark yield curve for the market and helps in establishing the over all credit curve for corporate and other securities in the market.

1.8.1 The Importance of Efficient Government Security Market

The efficient GSM provides an important benefit to the country's economy at both macro and micro level. At the macroeconomic government's policy level, the bond market provides a platform to fund the budget deficits in a addition to the funding provided by the central bank. Thereby, can reduce the need for direct monetary financing of government deficits in both domestic and foreign markets and avoid increase of foreign debt. GSM may also strengthen the implementation of the monetary policy. If coupled with sound debt management, GSM can help government to reduce its exposure to interest rates. Finally, the shift toward market oriented funding of government budget deficits will reduce debt costs in the medium and long term through the development of a deep and efficient government security market. The efficient government security market is a vital element in developing efficient and liquid corporate market, as the government yield being benchmark for the corporate bond.

On the other hand at the microeconomic level, development of a security market can help change the financial system from a primarily bank-oriented one to a multi-layered system, where capital markets can complement the bank financing. As the GSM developes, it would force the commercial banks to develop new products in a competitive way. The development of the GSM helps to increase the financial stability in general by enhancing the competition, which may result in improving the financial intermediation and promoting the development of related financial

infrastructure, products and services. The development of security markets enables the introduction of new financial products and services, including structured finance, money market instruments and repurchase agreements (repos), which can improve the risk management and overall financial stability. In addition, the development of securities markets requires the creation of extensive informational, legal, and institutional infrastructures that can benefit the entire financial system and foster the liquidity in the market.

Finally, most of the countries in this financial liberalization era are moving from the use of direct monetary policy tools, such as interest rates controls and credit ceilings, to the use of indirect monetary policy instruments such as open market operations. The use of indirect monetary instruments has the advantage of improving the efficiency of the monetary policy by allocating the financial resources on a market basis. In addition to the above, increasing integration in the financial markets make the use of direct monetary controls ineffective. Therefore, the government security is particularly an important instrument to implement indirect monetary policy operation.

1.8.2 The Importance of the Yield Curve for Government Securities

The GSM gains its importance from its yield curve, which is a line that plots the interest rates, at a set point in time, of securities differing only on maturity dates. Usually the yield curve uses as a common benchmark for other debt in the financial market, such as mortgage rates, bank lending rates, corporate bond, sukuk and other products in the financial market. The curve helps to give an idea of future interest rates changes and also used to predict changes in economic activities. The development of benchmark in GSM is an essential element of a well-functioning government security. By concentrating on new issues of government securities in

a relatively limited number of popular standard maturities, government can assist the development of the liquidity in those securities and thereby lower the issuance' costs. Thus, markets can use these liquid issues as benchmarks for pricing of a range of other riskier financial instruments. In addition, spreading relatively few benchmark issues across wide range of maturities and building benchmark yield curve would enhance the accuracy of the price for the financial instruments across similar maturity spectrum. The yield curve helps both lenders and borrowers in making the decision on their investment portfolios. The lenders face the reinvestment risk when the long term bond matures and also risk of uncertainty in the bond value if decided to redeem it before maturity date. Where as the borrowers face the risk of higher interest rate of refinancing when borrowing in short term or face the risk of locking their business in a higher cost of borrowing when borrowing on long term.

Different government security has typically different characteristics in terms of maturity, coupon rates, method of interest setting and use of embedded options. The dominant type is the nominal fixed-interest, whose coupon rates are close to market rates at the time of issue. Typical benchmark maturities are 2-3, 5 and 10 years. Some countries issue different maturities like, 15, 20 30-year fixed-interest securities. Treasury bills dominate the short end of the GSM, with maturities normally less than one year. The yield curve in a liquid GSM carries important information for both investors and policy makers of the monetary policy.

The slope of the TSOIR has been used as one of the vital predictor of expected returns in U.S financial markets and in other international markets, (Fama and French 1989) and (Harvey 1991; 1993)respectively. Other researchers summarized the crucial role of the slope of TSOIR as a useful predictor of the growth in output

and it contains information about real growth and monetary variable. They also stated that the foreign TSOIR has predictive power for domestic real economic growth Plosser and Rouwenhorst (1994).

1.9 The Problem Statement

The lack of well developed and efficient local government bond markets in most of the Asian countries prior to Asian financial crisis in 1997 forced the governments and individuals to borrow in foreign currencies. This makes their economies more vulnerable to a speculative currency attack.

In the era of the crisis, most of the ASIAN countries including Malaysia, have experienced huge capital outflow thus leading to dual mismatch problems due to the absence of well developed domestic bond markets as an alternative source of finance. This is situation where governments, banks and other corporate dominated loans in foreign currency used to finance their investment projects in local currencies which experienced depreciation as the result of the crisis and made the re-payment of the debts very costly and created currency mismatch problems.

At least a decade before the Asian crisis, the region has been shaped by development episode. At that time, the nature of the available funds was the portfolio Foreign Direct Investment (FDI) which was short term in nature. It is not in line with the pre-requisite of the expansion of the economic development which is long term in nature. As noticed, the governments and corporate borrowed foreign currency to finance their local projects in their local currencies. Thus, when the crisis hit the region and with the depreciation of the currency and the need to roll the loan to be in line with the long term nature of the project, the situation resulted in maturity mismatch problem. The dual mismatch triggers the needs for further de-

velopment in the region's domestic bond markets including Malaysia. As a matter of fact, the bond market is as important as equity market and other financial intermediation for the efficient allocation of any nation's financial resources. In highly developed countries, it is common for bond markets to be substantially larger than equity markets. For example, for the case of US, Goyenko *et al.* (2011) argue that the average daily trading volume in Treasury markets is about USD 500 billion compared to only about USD 100 billion in the New York Stock Exchange. Furthermore, the authors argue that Treasury markets are crucial for asset allocation purposes as well as in the setting of benchmark risk-less rates used by corporations in capital budgeting.

Many economists, financial analysts and policy makers extensively study the Asian financial crisis in terms of its causes, drawbacks and what lessons to be learned. Shamsher *et al.* (2000) argue that one of the key lessons coming from the crisis was the need for additional forms of capital formation and financial intermediation away from the dependence on banks intermediation.

Prior to the Asian financial crisis, foreign capital flooded in, typically as short-term loans to banks. By 1996, capital inflows had grown to USD 93 billion and this inflow became over USD 12 billion of outflows in 1997. Radelet & Sachs (1998), Jonathan *et al.* (2006), and Yellen (2007) described the Asian financial crisis as the liquidity crisis. While in the post crisis, steps have been taken to ensure basic bond market infrastructure which has been put in place, still there is an absence of efficient pricing mechanism in some markets in the region, which remains as one of the barriers for market development.

Corporate bond market is as important as the government bond market. It provides the economy with an important backup form of intermediation. Gyntelberg *et al.*, (2006) stated that the development in Asian bond markets became as high priority for policymakers after the 1997 crisis. It can be seen as one of the measures to avoid the crisis by developing local bond market which may help reduce possible currency and maturity mismatches in the financial system. The authors further state that while the Asian governments succeeded in developing active government bond market, they recognized that the robust financial system requires multi-financing channel. This turned their attention to develop corporate bond market to make fair financing competition for the fixed income markets and other financial intermediation to compete for borrowers.

The Asian governments' fixed income security markets have experienced significant growth in the years following the Asian financial crisis in 1997. The authorities in Asian emerging markets have recognized the importance and the needs for deep and efficient bond markets in the region. Market for fixed income security plays vital role in providing a basis for a robust efficient financial system.

Therefore, this research aims to contribute to the development of Malaysian emerging security market by combining both government security and corporate bond while questioning whether the forward rates can predict the future spot rates? To what extent is the predictivity power of the forward rates to the future spot rates? Whether the yields and prices have reflected the true value of the bonds in this market? Which theory of the TSOIR can explain the behavior of Malaysian fixed income security market? This study attempts to find answer to these research questions.

It is not surprising that the attention of academics and policy makers has focused on identifying and then overcoming those obstacles to build viable domestic Malaysian bond market. Although financial reforms have been taken to ensure that the basic infrastructure in Malaysian bond market has been put in place, still more additional investigation for untouched issues on the TSOIR behavior for Malaysian fixed income security should be carried out. This is to observe the results of the reforms in this particular market.

On the other hand, as stated by (Mohamad *et al.*, (2007), there are numerous research issues that could be explored in the corporate bond market which is almost absent in the literature of Malaysian fixed income security market. As an example, one may consider the relationship between government bond yields and corporate yields. Intensive analysis for the prices, yields fair values and the shapes of the credit curves of different bonds. Thus, this research attempts to explore some of these issues in order to help investors to better understand what they deserve to formulate good strategies for their investment portfolios.

1.10 General Objective of the Study

The general objective of this research is to study the behavior of the TSOIR of Malaysian fixed income security and focus on the issues related to the accuracy of the predictive power of forward to the future spot interest rates in Malaysia. This general objective of the study would be achieved by focusing on the different specific objectives

1.10.1 Specific Objectives

For better coverage of the scope of this research and in order to reach some useful conclusion, the above general objective should be broken down to the following

specific objectives which are:

1. To investigate the predictive power of the forward interest rates as predictor of the future spot interest rates and inflation.
2. To examine the predictive power of the yield curve to forecast the future spot interest rates in Malaysian fixed income security market.
3. To explore the efficiency of Malaysian fixed income security market in terms of prices and yields.
4. To interpret the behavior of the yield curve of the TSOIR of Malaysian fixed income security market and to find out which theories hold.
5. To examine the validity of the liquidity premium theory in Malaysian fixed income security.
6. To provide policy options and recommendations to the relevant authorities of Malaysian fixed income security in order to create an environment which best facilitates the pricing in secondary market and, hence, to achieve sustainable economic growth for future market development .

1.11 Significance and Contribution of the Study

The present study would extend the finance literature by making several important contributions. The study would contribute to the body of knowledge of the TSOIR by addressing some of the gaps in recent literature in particular, the lack of extensive research in Malaysian fixed income market, especially the corporate market. This study is going to use the PEH as the a solid layer for the research to further confirm the accuracy of the predictive power of forward to the future spot interest rates in this important emerging market.

Firstly, there are several theories of TSOIR which explain the links between short term and long term interest rates: the EH which assumes that market participants are risk-neutral and the TSOIR are solely determined by expectation of the future interest rates, the LPT assumes that the investors are risk-averse and the TSOIR is determined by the expectation of the future interest rates and the term premium, the MST which assumes that market participants are risk-averse and the TSOIR is determined purely by investors and borrowers preferences, the PHT which proposes that the TSOIR includes the term premium to the expectation of all future interest rates. Therefore, it would be interesting to know which theory holds for this particular Malaysian government bond market. The outcome of the research would place the market participants with better information to manage their investment portfolios. This accordingly can contribute to further development of Malaysian fixed income security market.

Secondly, there is not much extensive literature and empirical studies on the behavior of Malaysian fixed income market except some of respected researches, among which are (Khan *et al.* 2002), (Ghazali & Low, 2002), (Ghazali, 1993), (Neoh, 2005), (Mohamad *et al.* 2007), (Ariff *et al.* 2009), (Adesina, 2011) and Fah & Ariff, 2011), in addition to some other respected studies out of the author reach. Those previous studies have set a good foundation and motivation for this research to come out especially to investigate the issues related to Malaysian fixed income market with regards to both government and corporate bonds.

Thirdly, the empirically highlight of the issues relating to the behavior of the TSOIR and the pricing of the fixed income security would help in further developing Malaysian fixed income market. Efficient Malaysian government and corporate bond market would be starting points for the robustness and efficiency of

the Malaysian financial system as a whole. Hence, the study aims to look at the behaviorally aspects of the TSOIR for more efficient pricing and valuation for the Malaysian fixed income security market.

Finally, the concluding remarks of this study are hoped to provide policy options and recommendation to both government and central bank of Malaysia in developing suitable policy according to the market characteristics and gaining competitive advantages in these dynamic environment and challenging global markets.

1.12 Outline of the Thesis

This thesis is divided into seven chapters where chapter one is an overview of the study which includes, summary introduction for the term structure of interest rates, statement of problem as well as the objectives and significance of the study. Chapter two is general background about Malaysian bond market with short summary and explanation of the development through the years for Malaysian fixed income security with its both wings government and corporate as one, in addition to some highlights on the importance of this market. Chapter three is exploring the literature review for the term structure of interest rates and highlighting the empirical researches in context to the developed countries as well as the Asian region with special attention to the previous work done in Malaysian bond market. Chapter four is the theoretical frame work containing the discussion on the theories of the term structure of interest rates, which is the expectation hypothesis in different forms and market segmentation theory as the theoretical base for this research, in addition to the predictive power of the forward rates. Chapter five describes the data used in the research besides the methodology adopted to achieve the objectives of this study. Chapter six focuses on results and discussion which presents different analysis applied with discussion on the obtained results. Finally

chapter seven which is the conclusion part of the thesis, presents the concluding remarks beside summary for the obtained result, contribution of the study as well as the limitation and finally the direction for the future researches.



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