STOCK MARKET BUBBLES, INVESTMENT RISK AND THE ROLE OF MONETARY POLICY IN THAILAND

Surakiat Kahaboonsirihansa

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Surakiat Kahaboonsirihansa

School of Development Economics

Associate Professor..Major Advisor

(Komain Jiranyakul, Ph.D.)

Assistant Professor..Co-Advisor

(Wisit Chaisrisawatsuk, Ph.D.)

Assistant Professor..Co-Advisor

(Yuthana Sethapramote, Ph.D.)

The Examining Committee Approved This Dissertation Submitted in Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy (Economics).

Lecturer..Committee Chairperson

(Komen Niyomvanich, D.B.A.)

Associate Professor..Committee

(Komain Jiranyakul, Ph.D.)

Assistant Professor..Committee

(Wisit Chaisrisawatsuk, Ph.D.)

Assistant Professor..Committee

(Yuthana Sethapramote, Ph.D.)

Assistant Professor..Dean

(Nada Chunsom, D.B.A.)

July, 2013

ABSTRACT

Title of Dissertation Stock Market Bubble, Investment Risk and the Role of Monetary Policy in Thailand

Author Mr. Surakiat Kahaboonsirihansa

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The dividend discounted models with rational expectation under a perfect expectation model; CAPM, ICAPM and APT are used for the study. The results show that there are no bubbles in Thailand under Engle and Granger co-integration test and ARDL Bound test during 2002-2012. For the monetary policy effects on asset prices, there are monetary policy transmissions from policy rate on the real money supply, deposit rates and lending rates under the Granger causality test. There are the monetary effects from policy rates, deposit rates and lending rates on the bond market, but there is no liquidity effect of the real money supply on bond market rates. The results show significant long term effects of monetary policy on asset prices. The negative effects of monetary policy interest rates on asset prices are conformed for all three models including CAPM, ICAPM and APT. For CAPM, the explanation would be that beta is less than one, so the effect of interest rates will be negative on asset price valuation. For the magnitude of sensitivity effect, RP rates have a higher impact on asset price valuation than deposit rates and lending rates because of the direct effect of monetary policy through all monetary transmission mechanisms.

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ABBREVIATIONS AND SYMBOLS

Abbreviations	**Equivalence**
CAPM	Capital Asset Pricing Model
ICAPM	Intertemporal Capital Asset Pricing Model
APT	Arbitrage Pricing Theory
BOT	Bank of Thailand
RP	Repurchase Rate
IMF	International Monetary Fund
FX	Foreign Exchange
GARCH	Generalized Autoregressive Conditional Heteroskedasticity
BGG	Bernanke-Gertler-Gilchrist Model
ARDL	Autoregressive Distributed Lag Model
EG Cointegration	Engle-Granger Cointegration
ADF	Augmented Dickey-Fuller Unit Root Test
VAR Model	Vector Autoregressive model
ECM	Error Correction Model
MLR	Minimum Lending Rate
OMOs	Open Market Operations
BRP	Bilateral Repurchase Operations
VIX	Chicago Board Option Exchange Market Volatility Index
OECD	Organization for Economic Co-operation and Development
SET	Stock Exchange of Thailand Index

DJIA	Dow Jones Industrial Average Index
DJCA	Dow Jones Composite Average Index

Symbol	**Equivalence**
P_t	Price of assets or index
R_t	Discount rate or Expected return of asset
D_t	Dividend
P_t^*	Expost ration price
ε_t	Error term
$\sigma^2(P_t)$	Variance of asset price
φ_t	Consumer's set of information
θ	Coefficient under AR(1)
P_t^f	Fundamental price of asset
B_t	Bubble component
p_t	Log of asset price
d_t	Log of dividend
$\bar{d}$	Trend of growth of dividend
ν_t	Error term
r_{t+1}	Log of total expected return
F_t	Fundamental value of asset price
$R_{f,t}$,	Risk free rate
$R_{p,t}$	Risk premium
E_t	Earnings
e_t	Log of earnings
O_t	Dividend payout ratio
o_t	Log of dividend payout ratio
ROE_t	Return on equity
G_t	Long run Sustainable Earnings Growth

	Rate
R_m	Market return
μ_i	Expected excess return of risky asset i
μ_m	Expected excess return of market Portfolio
f_t	Factor effect
λ_t	Risk premium factor
AP_t	Aggregate price level
M_t^d	Money demand
M_t^s	Money supply
Y_t	Real national income
i_t	Nominal interest rate
ap_t	Log of aggregate price level
m	Log of nominal quantity of money
y_t	Log of real national income
i_t	Nominal interest rate
$Inf_{i,t}$	Inflation rate
$R_{i,t}$	Rate of return on asset i
$\sigma_{R,t}^2$	Conditional variance of equity return
$\sigma_{inf,t}^2$	Conditional variance of inflation rate
$m_{a,t}$	Log of money supply
$m_{sa,t}$	Seasonal log of money supply
$m_{r,t}$	Log of real money supply
CPI_t	Log of seasonal consumer price index
$p_t - d_t$	Log Price-to-Dividend
G_t	Sustainable Growth Rate
$R_{f,t}$	10year treasury yield
RP_t	RP Rate
DR_t	Deposit Rate
MLR_t	Minimum Lending Rate
$R_{3m,t}$	3month treasury yield

$R_{1y,t}$	1year treasury yield
IP_t	Industrial production index
ip_t	Log of Industrial production index
$R_{m,t}$	World Market Rate of Return
VIX_t	VIX Index
$SPREAD_t$	JP Morgan Emerging Market Spread

CHAPTER 1

INTRODUCTION

Asset price bubbles are the processes that occur when asset prices are traded at valuation levels that deviate from intrinsic values. The first bubbles originated in the Tulip mania in 1636-37, followed by the Mississippi bubble in 1719-20 and South Sea prices bubbles in 1720. Stock market bubbles play an important role on many occasions during economic cycles and economic crises. The bubbles in asset prices also play an important role on the business cycle and economic crises in Thailand. The crisis in 1997 also came after the collapse of the real estate and stock market bubbles. It is important to identify and measure the bubbles in asset prices. Therefore, The first part of this study is to find whether there are stock market bubbles in Thailand during 2002-2012 to ensure whether the rising stock market prices during this period are going to be bubbles or not.

The second part of this study is to find the long term and short term relationship between asset price valuations and risk factors, including the volatilities in Thailand's own stock market, the global stock market and macroeconomic data as well as the emerging market credit risk. The risks from volatilities in the stock market and macroeconomic data have the important effects on the equity returns. Most of the asset pricing models concern the risk premium on excess returns. The capital asset pricing model (CAPM) developed by Sharpe (1964: 425-442) indicates that the risk premium comes from the systematic risk of the market. The intertemporal capital asset pricing model (ICAPM) developed by Merton (1973: 867-887) indicates that the risk premium come from the market portfolio and state variables and Merton (1980: 323-361) shows that the expected excess return can be represented by the market portfolio volatility. The Arbitrage Pricing Theory (APT) by Ross (1976: 341-360) can be used for measuring the risk factors from macroeconomic variables and volatilities from macroeconomic factors. It would be helpful to find the effects of the risk factors on the equity prices to quantify the relationship between volatilities and equity returns.

For the role of monetary policy in asset prices, declining interest rates could stimulate the economy and reduce the cost of investment. However, the monetary tightening also affects negatively on asset prices. Monetary policy effect study is to find the long term and short term relationship between asset prices and monetary policy. The low interest environment after the subprime crises in 2008 caused rising equity markets, including Thailand during 2002-2012. It would be helpful to find the effect of monetary policy on the equity prices and to find whether monetary policy plays an important role on the movement of asset prices or not. This paper is to find the effect of monetary policy on the stock valuation because stock market prices can play a major role on the outlook of the economy.

For Chapter 2, I start reviewing the background of asset price bubbles. Under rational expectations, asset prices should not differentiate from their fundamental value; however, history has shown many asset price bubbles. Asset price bubbles started in 1636 with Tulip mania, followed by the Mississippi bubbles in 1719-20 and South Sea bubbles in 1720 also involving the speculative bubbles from monetary easing and credit expansion. The Poseidon bubbles in Australia in 1969-1970 and Dot-com bubbles in 1997-2000 came from the over expectation of future business performance. For the Asia region, Japanese bubbles occurred in 1986-1990 after economic boom and rising expectation of investment. The Asian financial crises in 1997 came from asset price bubbles because of the cheap foreign funding costs and capital inflows. The recent bubbles in the Chinese stock market in 2005-2007 also came from the strong economic growth and earnings expansion.

For monetary policy in Thailand, I review the development of monetary policy in Thailand from the fixed exchange rate regime at the beginning of the Bank of Thailand’s (BOT) policy to follow monetary targeting, during International Monetary Fund (IMF) program period, and currently, to the inflation targeting regime to support price stability. I review the development of policy rates under inflation from 14 days repurchase rate (RP) to one-day repurchase rate and currently one-day bilateral repurchase rate. For monetary policy instrument, BOT uses a range of monetary policy instruments, including reserve requirement, open market operation from bilateral repurchase operation, issuance of BOT bills/bonds, FX-swap and outright purchase/sales of securities, and standing facilities.

For asset bubbles studies, I reviewed many methodologies to detect asset prices bubbles. There are four major approaches. First, the variance bound test is introduced by Shiller (1981: 421-436) and another approach is West (1987:553-580)'s two-step test. The most popular and superior methodology is the cointegration test and the last is the intrinsic bubble test by Froot and Obstfeld (1991: 1189-1214). For the effect of investment risks on asset prices, I reviewed many methodologies on risk factors studies, especially volatilities and the asset prices. Most of the studies found the relationship between excess returns and risk factors. Generalized Autoregressive Conditional Heteroskedasticity (GARCH) model is used for the volatilities estimation. Finally, for monetary policy effects on asset prices, I reviewed many methodologies to find the effect of monetary policy on asset prices. There are many studies including Bordo and Lane (2012) and Patelis (1997: 1951-1972) who used Vector Autoregressive Model (VAR) for the study. Many studies followed Bernanke and Gertler (1999: 17-51) who used the New Keynesian Model initially developed from the Bernanke-Gertler-Gilchrist (BGG) model for the study. Eichengreen and Tong (2003) used regression to find the effect of monetary policy on stock return volatility that was estimated from the GARCH model. Thorbecke (1997: 635-654) studied the monetary policy from Fed fund rates on asset price returns by using changes in Fed Fund rates and the innovation of Fed fund rates. Baillie and DeGennaro (1990: 203-214) studied the asset pricing model to study the relationship between risk and return. They used Federal Fund Rate as risk free return under the GARCH model and they found that the Federal Fund Rate had a significant impact on asset price returns. For Thailand, Disyatat and Vongsinsirikul (2002) studied the effect of 14-day RP rate on asset prices and other monetary policy transmission effects. They found that monetary tightening would cause lower asset price.

For Chapter 3, I developed the intrinsic value of the stock market under dividend discounted model, with the expected return under rational expectation followed by the perfect expectation model, capital asset pricing model (CAPM), intertemporal capital asset pricing model (ICAPM) and arbitrage pricing theory model (APT). The model finds the negative effects of investment risks on asset prices under ICAPM and APT. For monetary policy effect, I started with the monetary theory of money market equilibrium to find the relationship between policy rates and money supply. The model shows the negative effect of monetary policy on asset price valuations under ICAPM and APT. For CAPM, if beta of equity is less than one, there is negative effect of monetary policy on the asset price valuation but if beta of equity is more than one, there is positive effect of monetary policy on the asset price valuation.

For Chapter 4, I used the Engle-Granger (EG) cointegration test and Autoregressive Distributed Lag (ARDL) bound testing to detect the stock market bubbles. Secondly, I used error correction models to find the long term and short term effects of investment risks on asset prices. Finally, for monetary policy study, I started with the Vector autoregressive (VAR) model to find Granger causality effect and impulse response function effect between policy rate and real money supply, deposit rate and lending rate and the tests were also used to find the monetary policy transmission effect on the bond market rate. Error correction models were also used to find the long term and short term effects of monetary policies on asset prices.

Chapter 5 represented the data statistic and GARCH estimation for equity return volatility and inflation volatility. The scope of the study is from April 2002 to December 2012. The additive moving average is used for the seasonal data adjustment. For GARCH estimation, GARCH(1,1) is used for equity return volatility and inflation volatility. Unit root test is used to find whether the data are stationary or non-stationary processes.

For Chapter 6 on the empirical study of equity market bubbles, The results show that there is the cointegration between actual value of Log Price-to-Dividend ratio and fundamental values under all four models including perfect expectation model, CAPM, ICAPM and APT model. I can conclude that there is no bubble sign for Thailand stock market during 2002-2012. The limitation of the study is from the requirement of dividend data. The normal dividend data would come from after the Asia crises in 1997. Further studies would include the bubble test for individual stocks and other price multiplier valuation studies such as price-to-earnings and price-to-cash flow. Lastly, further studies on other factors that affect Log of Price-dividend ratio including the liquidity effects of the market or the change of shareholders benefit payment like treasury stocks will give a clearer picture in understanding the asset price bubbles.

For Chapter 7, empirical study on investment risk on asset price, the study shows that asset prices rely on their own equity return volatilities, global market volatilities and macroeconomic volatilities; therefore, financial and macro variables volatilities play important roles on asset price valuation.

For Chapter 8, firstly, I studied on monetary policy tools and transmission on bond market to find the proxy of monetary policy as a risk free rate. For the long term relationship between monetary policies and asset prices, I found significant effects from the RP rates, deposit rates and lending rates. For the short term effect, RP rate, deposit rate and lending rate have no short term effect on asset price valuation. For further study on individual markets, sector indices and individual stocks, CAPM can help explain that the lower risk assets will have a negative effect on the interest rate and higher risk assets will have a positive effect on the interest rate. In conclusion, Chapter 9 summarized all the details of the theory of asset prices, methodology of studies and result of studies.

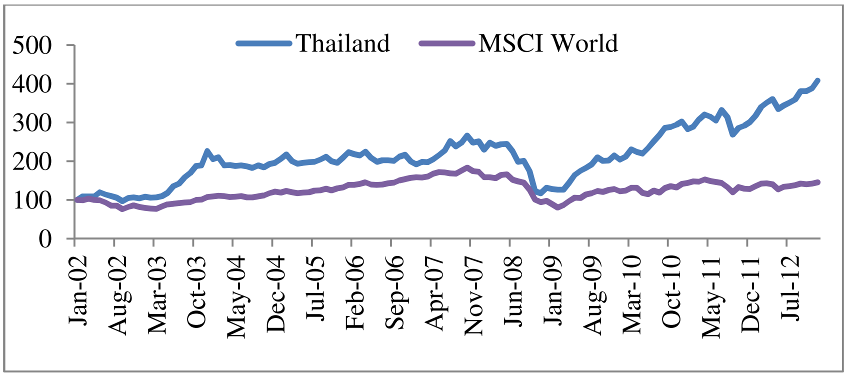

Figure 1.1 Performance of Thailand Stock Market Versus MSCI World Market

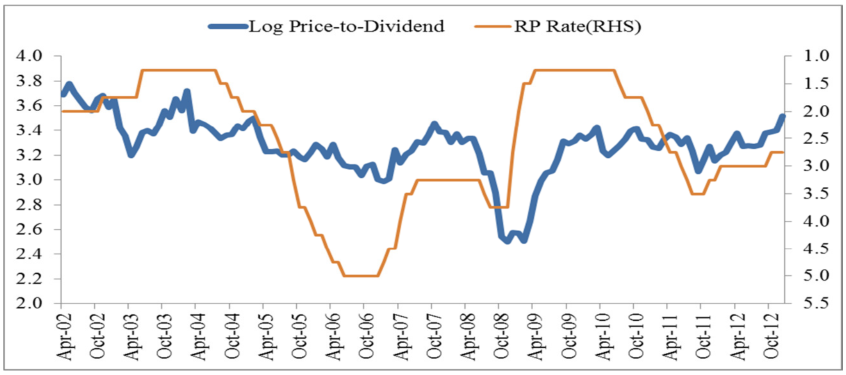

Figure 1.2 Relationship between Thailand Stock Market and Policy Rate

CHAPTER 2

LITERATURE REVIEWS

2.1 Background of Asset Price Bubbles

Asset price bubbles are the processes where asset prices are traded at valuation that deviates from intrinsic value or the fundamental value. The fundamental value usually comes from the value from the discounted future dividends and the price of the asset when it is sold in the indefinite future.

Under rational expectation, the bubbles should not arise because if the actual market price is above the fundamental value, investors will never buy an asset at more than what they consider the fundamental price, and investors holding assets will sell that asset until the actual market drops back to the fundamental price. Therefore, bubbles should be impossible.

Nevertheless, the asset price bubbles actually occurred in the past till the present and first originated in the Tulip mania in 1636-37, followed by the Mississippi bubble in 1719-20 and South Sea prices bubbles in 1720.

2.1.1 History of Asset Bubbles

Garber (1990: 35-54) explained three famous first bubbles. First, Tulip mania was in 1636-37. In 1636, Tulip prices rose sharply and attracted speculators into the market. Tulip prices rose until they peaked in February 1637 and then prices collapsed sharply. Another bubble was the Mississippi bubble in 1719-20 when Compagnie des Indes stock price involving tax collection and minting activities of the French government increased sharply in 1719 and then collapsed in 1720. The major reason for the Mississippi bubble was the monetary policy expansion causing rising inflation and the collapse came from the deflation of monetary policy. The South Sea bubble in 1720-21 occurred when the South Sea Company operating the South Sea trade monopoly expanded its operations dealing in government debt and loaned their own money to shareholders for stock subscription. Shares prices increased during 1720 until they collapsed sharply after August 1720.

Other bubbles include the Florida land bubble in the United States of America during 1920s after a real estate boom arose from speculators demands, easy credit for buyers, and rapid property prices appreciation. Another bubble was the Poseidon bubble in Australia in 1969-70 after company made a major nickel discovery. The dot-com bubbles in 1997-2000 came from the rising internet sectors stock prices, overconfidence in internet growth and speculative flow from investors, especially private equities and venture capital.

Bubbles in the Asia region started from Japan the asset price bubbles from 1986-1990. The bubbles came from rising asset prices due to overconfidence in economy, overheated economic activity and uncontrolled money supply and credit expansion. After the stock market collapsed in August 1990 from the monetary tightening then other asset prices started to collapse. The consequences of asset price bubbles created non-performing loans and difficulty in the financial sectors and brought about the long deflated economy referred to as “the Lost Decade”. The Asian financial crises in 1997 were also induced from the real estate and stock prices bubbles from cheap foreign capital funding. After the bubble, many Asia countries devalued currencies, received IMF program support under stringent fiscal and monetary policies, thus resulting in the collapse of financial and corporate sectors. The recent stock market bubble was China stock bubbles in 2005-2007 with strong economic and earnings expansion and rising real estate prices. After a government crackdown on speculation, tightening monetary policy as well as the subprime crisis in the US, the stock market plunged significantly in 2008 to around one-third of its peak level.

2.2 Background of Monetary Policy in Thailand

The Bank of Thailand (BOT) uses monetary policy via interest rates, debt instrument transactions, foreign exchange transactions and credit support to financial institutions with the objective of monetary and financial stability as well as payment system stability to achieve sustainable economic growth over the long term under the Bank of Thailand Act in 2008.

Monetary policy framework started with a pegged exchange rate regime after the Second World War. After the Asian crisis in 1997, under an IMF program, the the BOT adopted the floating exchange rate regime with monetary targeting from 1997 to 2000. Under the regime, BOT manages daily and quarterly money supply under a monetary base target. Since 2000, BOT has adopted an inflation target with the objective of maintaining price stability.

2.2.1 BOT Objective

The main objective of BOT is price stability that should be low and stable inflation. Price stability will support the low uncertainty for decisions on consumption, production, saving and investment by the private sector and support sustainable economic growth and employment over the long term. The major reason for low and stable inflation is to support the purchasing power of consumers and savers, and business competitiveness in both the domestic and international markets. Another reason is to reduce volatility in the financial market and lastly to reduce the uncertainty in decision-making or planning on investment and consumption to support a good overall economic environment.

2.2.2 Policy Rate

The policy rate is used for the monetary policy under the inflation-targeting. The 14-day RP rate was initially used at the policy rate until 16 January 2007 and then the policy rate was changed into the 1-day RP rate. From 12 February 2008, due to BOT's RP market closure, this was switched to the 1-day bilateral RP rate. BOT will conduct transactions at a fixed rate at the policy rate under bilateral repurchase operations.

2.2.3 Monetary policy instrument

There are many monetary policy instruments on as per the following:

2.2.3.1 Reserve Requirement

Reserve requirement is to help avoid excess volatility in money market rate. Commercial banks are required to maintain minimum reserves currently at 6% on average over a fortnightly period. The reserves consist of a minimum 1% in nonremunerated current account deposits at the BOT, a maximum 2.5% in Vault cash with the cash at the central cash centers of commercial banks. Cash that is in excess of 0.2% can be counted as vault cash and also eligible public securities including government bonds and bills, FIDF bonds, BOT bonds and bills, and State-Owned Enterprise bonds and term deposits at the BOT.

2.2.3.2 Open Market Operation (OMOs)

BOT undertakes transactions in financial markets to conduct open market operations in order to affect the reserve balances in the banking system and the short-term market rates. OMOs are the primary instrument used to maintain the policy rate and ensure the sufficient liquidity in the banking system. There are four major types of open market operations:

1) Bilateral Repurchase Operations (BRP)

The BOT uses bilateral repurchase and reverse repurchase transactions to temporarily inject or absorb the liquidity. The transaction involves a purchase or sale of securities including government bonds and bills, FIDF bonds, BOT bonds and bills, and State-Owned Enterprise bonds guaranteed by the government or with AAA rating with a simultaneous agreement to reverse the transaction at an agreement date and price in the future. The BRP is conducted through bilateral RP primary dealers. The BOT usually conducts a fixed-rate tender for the 1-day transaction or a variable-rate tender for all other longer-maturity transactions.

2) Issuance of Bank of Thailand bills/bonds

The BOT use bill/bonds issuance to manage short and long term liquidities to enhance the flexibility and efficiency of liquidity management. The BOT determines the size and maturity bonds depending on the money market conditions and the issuance schedule of public sector debts. BOT bills with less than 15 days, one month, three months, six months and one year maturities are issued twice a week and BOT bonds with two or three years maturity are issued once or twice a month.

3) Foreign Exchange Swap

The foreign exchange swap (FX swap) is used to increase or decrease short to medium term Baht liquidities. FX swap is like the repurchase agreement on Baht and foreign currency such as US dollar. Standard tenures are overnight, seven days, one month, three months, six months, nine months and up to one year.

4) Outright Purchase/Sale of Debt Securities

The BOT buys or sells debt securities outright to add or drain liquidity permanently. Government bonds and bills, BOT bonds and bills, and State-Owned Enterprise bonds guaranteed by the government or with AAA rating are the eligible securities for BOT outright purchase or sales. For procedure, BOT notifies the e-Outright counterparties for the specific securities that the BOT would like to buy or sell.

2.2.3.3 Standing facilities

The standing facilities are used to limit the volatility in money market through lending and deposit facility windows. BOT provides standing facilities for financial institutions to borrow from or deposit funds at the BOT overnight to help adjust their liquidity position at the end of the day. Interest rates on standing facilities are equal to the policy rate plus or minus a Margin. On the Lending Facility, availability of collateral will effectively act as a cap on the limit of the amount that each financial institution could borrow. The eligible securities that are used as collateral are the same set as BRP operation collateral but also include foreign government bonds like Japanese government bonds. These facilities are an important mechanism to safeguard money market stability to set a cap and a floor on overnight market interest rates, essentially forming an interest rate corridor.

2.2.4 Monetary Transmission Mechanism

Monetary transmission mechanism is including five main channels:

2.2.4.1 Interest Rate Channel

The policy rate will affect the short-term money market rates and under the price stickiness, real interest rates will be affected. Portfolio managements of financial institutions have to maintain competitiveness and profitability; therefore, they must adjust the deposit and lending rates along with the policy rate.

The change of real interest rates will affect the opportunity costs in consumption and investment, causing private domestic demand to adjust. The price level expectations are also adjusted under the interest rate channel from inflation expectations.

2.2.4.2 Exchange Rate Channel

The policy rate will affect short-term money market rates and returns on domestic investment relative to those from foreign investments, thus causing capital inflow/outflows. For lower interest rates, the baht depreciation will benefit exports, employment, income and lower imports. This would in turn stimulate consumption and investment.

2.2.4.3 Expectation channel

Changes in monetary policy stance affect expectations of inflation, employment, growth and future income that determines private economic activities. BOT Inflation forecasts help guide inflation expectations that are important to determine wage and actual inflation in each year as well as long-term interest rates.

2.2.4.4 Asset Price Channel

The change in interest rate will cause the reallocation of savings towards non-interest bearing assets such as real estate and equity. Therefore, the decrease in policy rate will support a rise in demand for these assets and result in higher prices and wealth increases and consumption will be higher. Higher equity prices will also increase the market value of firms, or lower equity funding costs that will stimulate investment.

2.2.4.5 Credit Channel

For decreasing the policy rate, the financial burden will decline, thus strengthening businesses' balance sheets. Strengthening balance sheet will support the financial institutions willingness to lend more given the lower risks. Therefore, investment will increase, resulting in higher economic growth.

2.3 Studies on Asset Price Bubbles

There are the several methods for testing equity bubbles. Firstly, the variance bounds tests for equity prices were initiated by Shiller (1981: 421-436). Shiller's test is to evaluate the present value model. Under a simple efficient market model, the stock price P is the following:

$$P_t = \sum_{i=1}^{t}[\frac{1}{(1+R)^i}E_t(D_{t+i})] \qquad (2.1)$$

Where P_t is price of assets, R_t is discount rate and D_{t+i} is dividend

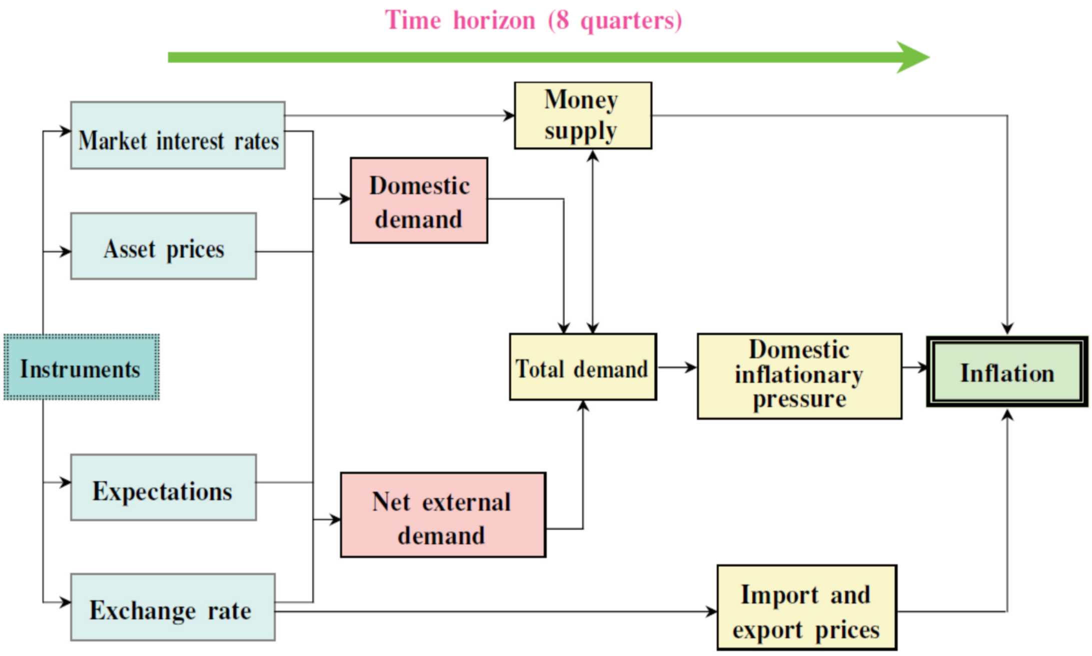

Figure 2.1 Monetary Transmission Mechanisms
Source: Bank of Thailand, 2004: 37-38.

Under expost rational price P_t^* is the present value of the future dividend; therefore,

$$P_t = E_t(P_t^*) \qquad (2.2)$$

Where $P_t^* = \sum_{i=1}^{t}[\frac{1}{(1+R)^i}(D_{t+i})]$

The difference between actual and expected dividends with rational expectation as per the following:

$$P_t^* = \sum_{i=1}^{t}[\frac{1}{(1+R)^i}(E_t(D_{t+i}) + \varepsilon_{t+i}] = P_t + \sum_{i=1}^{t}[\frac{1}{(1+R)^i}\varepsilon_{t+i}] \quad (2.3)$$

The variance bounds test is used for the test of market efficiency. The variance of P_t^* is

$$\sigma^2(P_t^*) = \sigma^2(P_t) + \gamma\sigma^2(e_t) \quad (2.4)$$

P_t^* is never been observed; therefore, P_t^* is constructed by using observed value of dividends. Shiller found that actual price variance was much higher than the variance of ex post rational price calculated from observed dividends and lower bound of stock prices variability was also much higher than upper bound of observed variability of dividends; therefore, he concluded that there was a failure of market efficiency.

However, the variance bound test may not suitable for stock bubble tests, especially the problem of non-stationary. March and Merton (1983: 483-498) found the variance bound test failed to test because there were non-stationary dividend and stock prices.

The second method is West's two-step test developed by West (1987: 553-580). Under no asset price bubble, the Euler equation comes from the consumer's optimization on the following:

$$P_t = \left(\frac{1}{(1+R)}\right) E_t(P_{t+1} + D_{t+1}|\varphi_t) \quad (2.5)$$

Where φ_t is consumer's set of information

Assume dividends follow AR(1) process on the following:

$$D_t = \theta D_{t-1} + u_{dt} \quad (2.6)$$

$$P_t^f = \sum_{i=1}^{t}[\frac{1}{(1+R)^i}(E_t D_{t+i}|\varphi_t)] \quad (2.7)$$

Where $\hat{\beta} = \left[\frac{\theta}{(1+R)}\right] / \left[1 - \frac{\theta}{(1+R)}\right]$

The actual price may have the bubble condition and it can be estimated as per the following:

$$P_t = \beta D_t + B_t \tag{2.8}$$

With bubble consideration, the estimation of β will be biased. West's test is to compare $\hat{\beta}$ from (2.7) and β from (2.8). In the case of no bubble, $\hat{\beta}$ and β is expected to be the same. Under Hausman coefficient restriction, West found that the hypothesis of equality between $\hat{\beta}$ and β is strongly rejected; therefore, there is the presence of a bubble.

The other test is the cointegration test and autoregressive distributed lag (ARDL) cointegration test. Herrera and Perry (2003: 127-162) use the relationship between price and dividend as per the following:

$$d_t - p_t = \frac{-k}{(1-\rho)} + \sum_{j=1}^{T} \rho^j (\Delta d_{t+1+j} + r_{t+1+j}) \tag{2.9}$$

They used Johansen cointegration, residuals-augmented least square (RALS) and autoregressive distributed lag (ARDL) tests for the bubble test and they found the bubble in the Latin America equity bubble.

The intrinsic bubble study is suggested by Froot and Obstfeld (1991: 1189-1214). They used the estimation of asset price based on 1) present value of the stock price assuming that log dividends follow a random walk with trends (fundamental value) 2) the intrinsic bubble model depending on dividend and time 3) the bubble component that overreacts on dividends. The models are as follows:

$$P_t = e^{-R} E_t(D_t + P_{t+1}) \tag{2.10}$$

$$P_t^f = \sum_{s=0}^{T} e^{t-R(s-t+1)} E_t(D_s) \tag{2.11}$$

Assume B_t is random variables as follows:

$$B_t = e^{-R} E_t(B_{t+1}) \tag{2.12}$$

Therefore,

$$P_t = P_t^f + B_t \tag{2.13}$$

Intrinsic stock bubble is from the non-linear relationship of (2.13). Assume log dividends are under geometric martingale as per the following:

$$d_{t+1} = \bar{d} + d_t + \varepsilon_{t+1} \tag{2.14}$$

Where $\bar{d}$ is trend of growth of dividend d_t is log of dividends and ε_{t+1} is normal random variables.

$$P_t^f = kD_t \tag{2.15}$$

$$B(D_t) = cD^{\lambda t} + \nu_t \tag{2.16}$$

So

$$P_t = P_t^f + B(D_t) = kD_t + cD^{\lambda t} + \nu_t \tag{2.17}$$

Under null hypothesis of no intrinsic bubbles, the price-to-dividend ratio is constant and the intrinsic bubble exists if there is a linear relationship between price-to-dividend ratio and dividend as per the following:

$$P_t/D_t = k + cD^{(\lambda-1)t} + \nu_t \tag{2.18}$$

For the test, they found the strong positive value of c; there should be the intrinsic bubble.

Intrinsic bubbles model can provide a plausible explanation of deviations from present-value model. Their potential explanation came from persistent deviations that appear to be moderately stable over long periods.

For the test of stock market bubbles in Thailand, Komain Jiranyakul (2008: 24-36) applied three different methods, including variance bounds test, equity price bubbles test, and cointegration tests to test the bubble in The Stock Exchange of Thailand Index (SET) and he found that there should be a bubble in Thailand's stock market.

2.4 Studies on Investment Risk on Asset Prices

There are many studies on investment risk of asset prices. Firstly, Schwert (1989: 1115-1153) shows that the stock return volatility increases during recessions and financial crises from 1834-1987. The evidence shows that stock prices are one of the major business cycle indicators. He used two different statistic models to show that stock return volatility increased after major financial crises and he found that there was weak support to control stock return volatility from the policy makers. Arnold and Vrugt (2008: 1425-1440) provided empirical evidence on the link between stock market volatility and macroeconomic uncertainty. They show that the United States of America's stock market volatility is significantly related to the variation in economic forecasts from the survey from 1969 to 1996. This link is much stronger during the strong stock market volatility and the macroeconomic volatility. Campbell (2005) found that, because the stock market volatility was attributable to return shocks, the Great Moderation has not had a significant effect on stock return volatility. These empirical findings were consistent with Campbell and Cochrane (1999: 205-251) habit formation asset pricing model. During a large drop in consumption volatility, the volatility of fundamental news shocks decreased while the volatility of return shocks stagnated. Chiang and Doong (1999: 187-200) tested the relationship between the stock excess return and risk factors measured by the macroeconomic factors volatilities and time-varying returns volatilities in Taiwan. They found that the stock excess returns were dependent on real and financial volatilities. Brennan and Xia (2001: 249-283) developed a dynamic general equilibrium model of stock prices which came from a stock price volatility and equity premium that were generated from the historical values. Dividends followed a stochastic process with an unobservable growth rate that was predicted from the growth rates of observable dividends and aggregate consumption. They also calibrated the model on consumption, dividends, interest rates and stock prices. Glosten, Jagannathan and Runkle (1993: 1779-1801) used GARCH-M model adjusted by the seasonal volatility, different impacts of conditional variance used to predict variance from positive or negative innovations and the nominal interest rate. They found that there was a negative relationship between the conditional expected return and conditional variance. Dennis, Mayhew and Stivers (2006: 381-406) studied the stock return and innovation from implied volatilities in option. They analyzed the innovations in different perspectives including the index-level and firm-level implied volatilities and separated innovations into systematic and idiosyncratic volatilities. They found that the innovation in systematic volatility was negative to stock returns but innovation in idiosyncratic volatility had no effect on the stock return; therefore, the asymmetric volatility was attributed from market factors rather than individual factors. Banerjee, Doran and Peterson (2007: 3183-3199) examined the market return from Chicago Board Option Exchange Market Volatility Index (VIX) level and its innovations. Secondly, they found the relationship between portfolio returns estimated on book-to-market equity, size and beta and VIX level and its innovations. They found VIX had the significant effect on portfolio returns especially high beta portfolio. Finally, Campello, Chen and Zhang (2008: 1297-1338) used the expected return measured from corporate bond yield to study the effect of beta, size, value and momentum on excess return because stocks and bonds had similar systematic risk and the corporate bond yield spread with a forward-look on risk premiums.

2.5 Studies on the Role of Monetary Policy on Asset Prices

The new Keynesian model is used to study the role of monetary policy on the asset price. The prominent study is from Bernanke and Gertler (1999: 17-51) who used Bernanke-Gertler-Gilchrist model (BGG model) under a dynamic new Keynesian model to calibrate the effect of monetary policy under different conditions, with and without asset price consideration. They found that monetary rules that directly targeted asset prices appeared to give undesirable side effects; therefore, it is appropriate to focus on price stability rather than asset prices. However, the central bank should consider asset prices in the case where the asset prices significantly affect the economy. Another paper using the New Keynesian model of BGG model is from Gilchrist and Leahy (2002: 75-97) and Kontonikas and Ioannidis (2005: 1105-1121). However, finding the opposite conclusion with former studies, Cecchetti, Genberg, Lipsky and Wadhwani (2000) employed simulations of the New Keynesian model and optimized the policy rule with respect to a bubble shock. They concluded that a proactive response by central banks on the asset price will reduce the possibility of asset price bubbles, thus reducing the risk of boom–bust cycles in the economy.

Other methodologies to study the role of monetary policy on the asset price include Rigobon and Sack (2003: 639-669) using the technique based on heteroskedasticity of stock market return to find the reaction of policy rates. Their results found that there was a significant reaction of monetary policy on stock market movements, if the movement impacted the economy. Bordo and Lane (2012: 1-55) studied the effect of monetary policy on asset prices. They studied house prices, stock market and commodity prices in 18 Organization for Economic Co-operation and Development (OECD) countries. They measured the effect of asset price booms from the expansionary monetary policy that deviates from Taylor rules and monetary aggregate growth. They also used VAR model techniques to control other determinants of asset booms to find the monetary effect. They found that the loosening of monetary policy did contribute to significant bubbles in house prices, commodity prices and to lessen bubbles in stock prices. They also discussed whether monetary policy should respond to asset prices. They tended to support that monetary policy is needed to tackle asset bubbles, if they were dangerously affecting the real economy; however, the specific policy tools would be effective, rather than the normal monetary policy. Eichengreen and Tong (2003) used GARCH model to estimate the volatility. They also used the regression to find the effect of monetary policy on the stock return volatility. They found a positive relationship between the monetary volatility and the stock market volatility. The fixed exchange rate regimes were generating relatively low levels of stock market volatility, but flexible exchange rate regimes were creating the high levels of stock market volatility. Financial internationalization has a positive relation with stock market volatility. Patelis (1997: 1951-1972) used VAR model under long and short periods in the United States of America's stock market to find the relationship between the excess return and monetary policy indicators including the fed fund rate, bond spread and reserve balance and used variance decomposition to find the effect on the individual components of excess returns. The monetary policy was significant in predicting the future excess return. Variance de-compositions indicated that monetary policy shocks play an important role on the expected excess returns impact, followed by expected dividend growth, but had little effect on expected real returns. Thorbecke (1997: 635-654) studied the monetary policy effects of Fed fund rate on asset price return. He found the changes in returns of Dow Jones Industrial Average (DJIA) and Dow Jones Composite Average (DJCA) were impacted negatively from the change on Fed Fund rates. He also found that innovation of Fed fund rate positively affected stock returns. Baillie and DeGennaro (1990: 203-214) studied the asset pricing model to study the relationship between risk and return. They used the Federal Fund Rate as risk free rate under GARCH model and they found that the weak relationship between mean returns and own variance but the Federal Fund Rate very significantly impacted asset price return. Bernanke and Kuttner (2005: 1221-1257) studied the impact of unexpected changes of Federal Fund rate targets on equity prices. They found that the unexpected change of Federal Fund rate has a negative impact on asset prices and equity prices across industries.

For Thailand, Piti Disyatat and Pinnarat Vongsinsirikul (2002) studied the effect of the 14-day RP rate on asset prices and other monetary policy transmission. They used the VAR model to find the impulse response function of SET index on 14-day RP rate and they found that monetary tightening by a 2% increase in interest rates will cause lower asset prices by 4% over six quarters and that rising asset prices also supported rising economic growth. June Charoenseang and Pornkamol Manakit (2007: 144-157) also studied the monetary transmission of policy rates on other financial interest rates, including interbank rate, lending rate and deposit rate. They found a long term relationship between policy rates and financial interest rates; however, there was a weak transmission effect of policy rates on financial interest rates.

CHAPTER 3

THEORY OF ASSET PRICE VALUATION

3.1 Dividend Discounted Model

Herrera and Perry (2003: 127-162) and Cogley (1999) valuate the stock prices by using the Gordon model. Firstly,

$$1 + R_{t+1} = \frac{(P_{t+1} + D_{t+1})}{P_t} \tag{3.1}$$

Where P_{t+1} is the equity price or index

R_{t+1} is the expected return and

D_{t+1} is the dividend payment.

Equation (3.1) can be written in log form as follows:

$$p_t = p_{t+1} + \log\left[1 + e^{(d_{t+1} - p_{t+1})}\right] - r_{t+1} \tag{3.2}$$

Where p_t is the log of equity price or index

d_{t+1} is the log of dividend payment and

r_{t+1} is the log of total expected return $(1 + R_{t+1})$

There are the non-linear relationships between log of prices, log of dividends, and log of returns; however, using a first order of Taylor expansion to generate approximately the linear relationship of log of prices, log of dividends, and log of returns as follows:

$$p_t = k + \rho p_{t+1} + (1 - \rho) d_{t+1} - r_{t+1} \tag{3.3}$$

Where ρ and k are constants of linearization,

$\rho = 1/[1 + e^{E_t(d_t - p_t)}]$ and

$k = -\log\rho - (1-\rho)\log(1/\rho - 1)$.

To adjust the Log Price-to-Dividend ratio, subtract current log of dividend from both sides of (3.3):

$$(p_t - d_t) = k + \rho(p_{t+1} - d_{t+1}) + \Delta d_{t+1} - r_{t+1} \tag{3.4}$$

Taking the expected value of both sides, and then,

$$E_t(p_t - d_t) = k + \rho[E_t(p_{t+1}) - E_t(d_{t+1})] + E_t(\Delta d_{t+1}) - E_t(r_{t+1}) \tag{3.5}$$

For iterating for K periods forward, the expected Log of Price-to-Dividend ratio can be expressed as follows:

$$E_t(p_t - d_t) = E_t \sum_{j=0}^{k-1} \rho^j (k + \Delta d_{t+j+1} - r_{t+j+1}) + \rho^k E_t(p_{t+k-} d_{t+k}) \tag{3.6}$$

The last term on the right of equation would be approximately to zero, as K grows to infinity as follows:

$$\lim_{k=\infty} \rho^k E_t(p_{t+k-} d_{t+k}) = 0 \tag{3.7}$$

The fundamental value of Log Price-to-Dividend ratio is represented in the relation between the present value of expected dividend growth and returns,

$$E_t(p_t - d_t) = F_t = k(1-\rho)^{-1} + E_t \sum_{j=0}^{k-1} \rho^j (\Delta d_{t+j+1} - r_{t+j+1}) \tag{3.8}$$

The notation F_t is the fundamental value of Log Price-to-Dividend ratio. Assume that r_t, $\log(1 + R_t)$ is about R_t.The equation (3.8) is:

$$F_t = k(1-\rho)^{-1} + E_t \sum_{j=0}^{k-1} \rho^j (\Delta d_{t+j+1} - R_{t+j+1}) \tag{3.9}$$

Under capital asset pricing model, the expected return can be classified into a risk-free rate, $R_{f,t}$, and a risk premium, $R_{p,t}$. Then,

$$F_t = k(1-\rho)^{-1} + E_t \sum_{j=0}^{k-1} \rho^j (\Delta d_{t+j+1} - R_{f,t+j+1} - R_{p,t+j+1}) \qquad (3.10)$$

Therefore, actual value of Log Price-to-Dividend ratio is separated into the fundamental value of Log Price-to-Dividend ratio and bubble component as follows:

$$(p_t - d_t) = F_t + B_t \qquad (3.11)$$

Where $B_t = \lim_{k=\infty} \rho^k E_t(p_{t+k-} d_{t+k}) > 0$ represents a bubble component on (3.11).

Assume D_t to D_{t+n} is from earnings and dividend payout ratio; therefore,

$$d_t = o_t - e_t \qquad (3.12)$$

Where e_t is log of earnings (E_t) on period t and o_t is log of dividend payout ratio (O_t) on period t.

Therefore, dividend growth is coming from earnings growth. Lee, Ng, and Bhaskaran (2009: 307-335) used the sustainable growth rate assumption to formulate the asset prices from free cash flow model. Therefore, it is assumed the expected earnings growth in the future period comes from a long term sustainable earning growth rate as per the following:

$$E_t \sum_{j=0}^{k} (\Delta d_{t+j+1}) = E_t \sum_{j=0}^{k} (\Delta e_{t+j+1})$$

$$= E_t \sum_{j=0}^{k} [\log(E_{t+j+1})/(E_{t+j})]$$

$$= E_t \sum_{j=0}^{k} [\%\Delta E_{t+j+1}]$$

$$= \sum_{j=0}^{k} (E_t(G_t)) = \sum_{j=0}^{k} ((1-O_t) ROE_t)$$

$$= \sum_{j=0}^{k} (G_t) \tag{3.13}$$

Where G_t = Long term Sustainable Earnings Growth Rate and ROE_t = Return on Equities; therefore,

$$(p_t - d_t) = k(1-\rho)^{-1} + \sum_{j=0}^{k} \rho^j (G_t - E_t(R_{t+j+1})) + B_t \tag{3.14}$$

Conrad and Kaul (1988: 409-425) modeled the expected return under first-order autoregressive process to study time variations in expected returns. Fama and French (1987: 3-25) also used the dividend yield in the form of autocorrelation to forecast the stock returns. Therefore, assume that R_t is under AR(1) as follows:

$$R_{t+1} = c + \theta R_t - \upsilon_t \tag{3.15}$$

$$E_t(R_{t+1}) = c + \theta E_t(R_t) \tag{3.16}$$

Therefore insert (3.16) into (3.14),

$$(p_t - d_t) = \left[c(1-\theta)^{-1} + k(1-\rho)^{-1}\right] + \sum_{j=0}^{k} \rho^j \left(G_t - \theta^{j+1} E_t(R_t)\right) + B_t \tag{3.17}$$

$$(p_t - d_t) = K + \sum_{j=0}^{k} \rho^j (G_t - \theta^{j+1} E_t(R_t)) + B_t \tag{3.18}$$

Where $K = [c(1-\theta)^{-1} + k(1-\rho)^{-1}]$ (3.19)

$F_t = K + \sum_{j=0}^{k} \rho^j (G_t - \theta^{j+1} E_t(R_t))$ and

B_t is bubble component

3.2 Rational Expectation of Expected Return

For rational expectation, expected return is assumed under several assumptions of expectation. For the study, the major assumptions for expected return are 1. Perfect expectation as actual return 2. Capital Asset Pricing Model (CAPM) 3.Intertemporal Asset Pricing Model (ICAPM) 4. Arbitrage Pricing Theory (APT)

3.2.1 Perfect Rational Expectation

Under assumption of perfect expectation of rational expectation, the expected return is as per the following:

$$E_t(R_t) = R_t \tag{3.20}$$

Take (3.20) and put into equation (3.18)

$$(p_t - d_t) = K + \sum_{j=0}^{k} \rho^j (G_t - \theta^{j+1} R_t) + B_t \tag{3.21}$$

Where $F_t = K + \sum_{j=0}^{k} \rho^j (G_t - \theta^{j+1} R_t)$

B_t is bubble component

3.3 Capital Asset Pricing Model (CAPM)

Under the capital asset pricing model by Sharpe (1964: 425-442), the return generating process is as follow:

$$E_t(R_i) = R_f + B(R_m - R_f) \tag{3.22}$$

Where R_f is risk free rate, R_m is market return and B is beta. For R_f, Damodaran (2008, 2012) and Pratt and Grabowski (2010) recommended the long term interest rate as risk free rate used for long term valuation consideration and the short term interest rate as risk free rate used for short term valuation consideration to match the cash flow.

Take (3.22) and put into equation (3.18)

$$(p_t - d_t) = K + \sum_{j=0}^{k} \rho^j [G_t - \theta^{j+1}(R_f + B(R_m - R_f))] + B_t \qquad (3.23)$$

Where $F_t = K + \sum_{j=0}^{k} \rho^j [G_t - \theta^{j+1}(R_f + B(R_m - R_f))]$

B_t is bubble component

3.4 Intertemporal Capital Asset Pricing Model (ICAPM)

Merton (1973: 867-887) Intertemporal Capital Asset Pricing developed the expected return of asset pricing as followings:

$$\mu_i = B_m \sigma_{im} + B_{z\sigma_{iz}} \qquad (3.24)$$

Where μ_i = Expected excess return of risky asset i

B_m= Weighted Average Coefficients relative risk aversion of investors

σ_{im}= Covariance between excess returns risky asset i and market portfolio

B_z= Coefficient of effect of state variable z

σ_{iz}= Covariance between excess returns risky asset i and state Variable z

Merton (1980: 323-361) showed that for market portfolio, under specific condition that variance of change in wealth is much larger than variance of change in state variable, the expected return can be represented as per the following:

$$\mu_m = B_m \sigma_m^2 \qquad (3.25)$$

Where μ_m = Expected excess return of market portfolio or $\mu_m = R_m - R_f$

B_m= Coefficients between excess return of market portfolio and its variance

σ_m^2= Variance of the market portfolio

The equation (3.18) under ICAPM, the $E_t(R_t)$ is the following equation:

$$(p_t - d_t) = K + \sum_{j=0}^{k} \rho^j [\, G_t - \theta^{j+1}(R_f + B_m \sigma_m^2)] + B_t \tag{3.26}$$

Where $F_t = K + \sum_{j=0}^{k} \rho^j [\, G_t - \theta^{j+1}(R_f + B_m \sigma_m^2)]$

B_t is bubble component

3.5 Arbitrage Pricing Theory Model (APT)

Under the Arbitrage pricing model by Ross (1976: 341-360), the return generating process is as follow:

$$R_t = E_t(R_t) + f_t B + \mu_t \tag{3.27}$$

Where R_t and $E_t(R_t)$ are the observed and the expected returns, respectively. f_t are the factors, and B is the beta.

The equation (3.27) under exact factor model and law of one price, the $E_t(R_t)$ is the following equation:

$$E_t(R_t) = R_f + B\lambda_t \tag{3.28}$$

Where $R_p = B\lambda_t$

The equation (3.18) under APT is the following equation:

$$(p_t - d_t) = K + \sum_{j=0}^{k} \rho^j [\, G_t - \theta^{j+1}(R_f + B\lambda_t)] + B_t \tag{3.29}$$

Where $F_t = K + \sum_{j=0}^{k} \rho^j [G_t - \theta^{j+1}(R_f + B\lambda_t)]$

B_t is bubble component

3.6 Investment Risk on Asset Price Valuation

3.6.1 Effect of Equity Return Volatilities on Equation Valuation

Differentiate (3.26) by σ_m^2, the result is as follows:

$$\frac{\partial(p_t - d_t)}{\partial \sigma_m^2} = -\sum_{j=0}^{k} \rho^j \theta^{j+1} B_m \tag{3.30}$$

Under random walk process θ = 1; therefore,

$$\frac{\partial(p_t - d_t)}{\partial \sigma_m^2} = -\sum_{j=0}^{k} \rho^j B_m \tag{3.31}$$

$\frac{\partial(p_t - d_t)}{\partial \sigma_m^2}$ is negative.

3.6.2 Effect of Risk Premium Factor on Equation Valuation

Differentiate (26) by λ_t, the result is as follows:

$$\frac{\partial(p_t - d_t)}{\partial \lambda_t} = -\sum_{j=0}^{k} \rho^j \theta^{j+1} B_i \tag{3.32}$$

Under random walk process θ = 1; therefore,

$$\frac{\partial(p_t - d_t)}{\partial \lambda_t} = -\sum_{j=0}^{k} \rho^j B_i \tag{3.33}$$

$\frac{\partial(p_t - d_t)}{\partial \lambda_t}$ is negative.

3.7 The Role of Monetary Policy on Asset Price Valuation

3.7.1 Theory of Money Market Equilibrium

Under the IS-LM model, the money market equilibrium for LM curve contribution is from the aggregate money demand as per the following:

$$M_t^d / AP_t = L(Y_t, i_t) \tag{3.34}$$

Where AP_t is the aggregate price level

M_t^d is money demand

Y_t is real national income

i_t is a measure of nominal interest rates on non-monetary assets

$L(Y_t, i_t)$ is the aggregate demand of real monetary assets

For money market equilibrium, the money demand is equal to money supply as per the following:

$$M_t^d = M_t^s \tag{3.35}$$

Where M_t^s is the money supply

Therefore, the money market equilibrium is as follows:

$$M_t^s / AP_t = L(Y_t, i_t) \tag{3.36}$$

Figure 3.1 show the effect of interest rates on money market equilibrium. If the interest rate decreases from R_1 to R_2, the money market equilibrium will move from E_1 to E_2 with rising real money supply.

Therefore, under money market equilibrium, Dornbusch (1976: 101-112) represented the money demand function as per the following:

$$m - ap = \emptyset y - \gamma i \tag{3.37}$$

Where m is log of nominal quantity of money

ap is the log of price level

y is the log of real income and

i is the interest rate

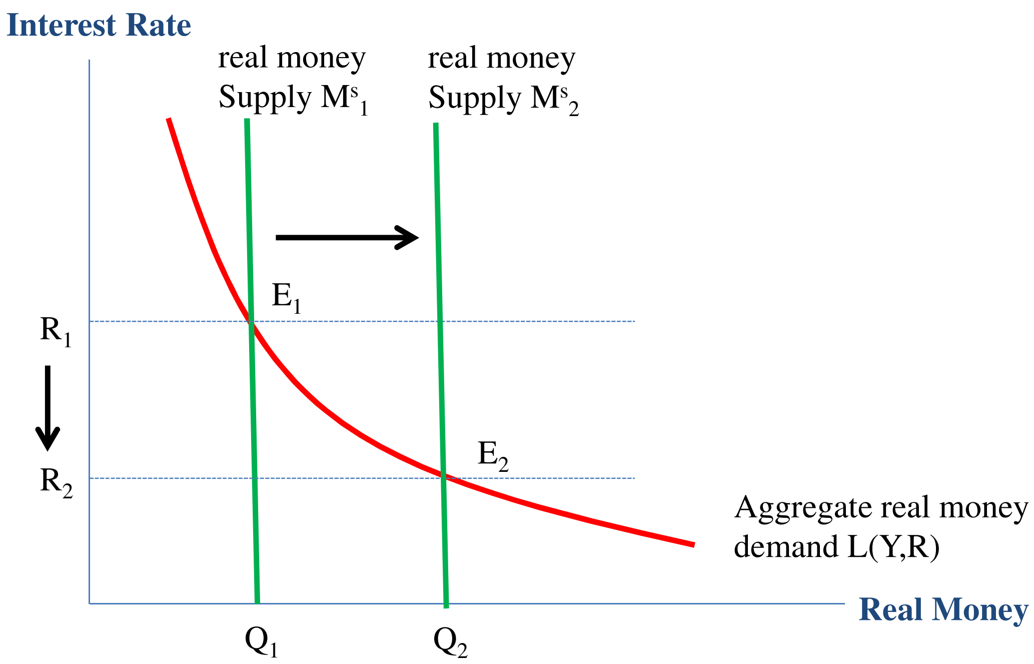

Figure 3.1 Change of Interest Rate on Money Market Equilibrium

3.7.2 CAPM Effect of Interest Rate on Asset Price Valuation

Differentiate (3.23) by R_f, the result is as follows:

$$\frac{\partial(p_t-d_t)}{\partial R_f} = -\sum_{j=0}^{k} \rho^j \theta^{j+1} (1-B) \tag{3.38}$$

Under random walk process $\theta = 1$; therefore,

$$\frac{\partial(p_t-d_t)}{\partial R_f} = -\sum_{j=0}^{k} \rho^j (1-B) \tag{3.39}$$

$\frac{\partial(p_t-d_t)}{\partial R_f}$ is negative if B< 1, no effect if B = 1 and positive if B> 1 or B has the positive effect on $(p_t - d_t)$ for change of R_f.

3.7.3 ICAPM Effect of Interest Rate on Asset Price Valuation

Differentiate (3.26) by R_f, the result is as follows:

$$\frac{\partial(p_t-d_t)}{\partial R_f} = -\sum_{j=0}^{k} \rho^j \theta^{j+1} \tag{3.40}$$

Under random walk process θ = 1; therefore,

$$\frac{\partial(p_t-d_t)}{\partial R_f} = -\sum_{j=0}^{k} \rho^j \tag{3.41}$$

$\frac{\partial(p_t-d_t)}{\partial R_f}$ is negative.

3.7.4 APT Effect of Interest Rate on Asset Price Valuation

Differentiate (3.29) by R_f, the result is as follows:

$$\frac{\partial(p_t-d_t)}{\partial R_f} = -\sum_{j=0}^{k} \rho^j \theta^{j+1} \tag{3.42}$$

Under random walk process θ = 1; therefore,

$$\frac{\partial(p_t-d_t)}{\partial R_f} = -\sum_{j=0}^{k} \rho^j \tag{3.43}$$

$\frac{\partial(p_t-d_t)}{\partial R_f}$ is negative.

CHAPTER 4

RESEARCH METHODOLOGY

4.1 GARCH Model

Engle (1982: 987-1007) developed the ARCH (Autoregressive Conditional Heteroscedasticity) model where the conditional variance was time-varying and then Bollerslev (1986: 307-327) extended to GARCH (Generalized Autoregressive Conditional Heteroscedasticity), which the conditional variance depended upon previous own lags.

The GARCH (p,q) are the following:

$$V_t = X_t'B + \varepsilon_t \tag{4.1}$$

$$\sigma_t^2 = C + \sum_{p=1}^{P} \lambda_p \varepsilon_{t-p}^2 + \sum_{q=1}^{Q} \theta_q \sigma_{t-q}^2 \tag{4.2}$$

Where σ_t^2= Conditional Variance

ε_{t-p}^2= ARCH term measured as the lag of the squared

σ_{t-q}^2= GARCH term past conditional variance

Lunde and Hansen (2005: 873-889) found that GARCH(1,1) was superior to forecast volatility models compared to other 330 volatility models; therefore, GARCH(1,1) was used for equity return volatilities and inflation volatilities.

4.1.1 GARCH(1,1) for Equity Return Volatilities

The model to estimate equity return volatilities is as follows:

$$R_{i,t} = \sum_{j=0}^{J} B_j R_{i,t-j} + \varepsilon_{R,t} \tag{4.3}$$

$$\sigma_{R,t}^2 = C + \lambda_1 \varepsilon_{R,t-1}^2 + \theta_1 \sigma_{R,t-1}^2 \tag{4.4}$$

Where $\sigma_{R,t}^2$ is the conditional variance for equity market return.

4.1.2 GARCH(1,1) for Inflation Volatilities

The model to estimate inflation volatilities is as per the following:

$$Inf_t = \sum_{j=0}^{J} B_j Inf_{t-j} + \varepsilon_{inf,t} \tag{4.5}$$

$$\sigma_{inf,t}^2 = C + \lambda_1 \varepsilon_{inf,t-1}^2 + \theta_1 \sigma_{inf,t-1}^2 \tag{4.6}$$

Where Inf_t is inflation and $\sigma_{inf,t}^2$ is the conditional variance for inflation.

4.2 Unit Root Test

According to Dickey and Fuller (1979: 427-431), the Dickey-Fuller test is used to determine whether a variable is stationary I(0) or non-stationary I(1). Under AR(1), the Dickey-Fuller tests represented as follows:

$$\Delta y_t = (\rho - 1) y_{t-1} + \nu_t \tag{4.7}$$

H_0: There is unit root process for y_t ($\rho - 1 = 0$)

H_1: There is unit root process for y_t ($\rho - 1 < 0$)

Augmented Dickey-Fuller Test (ADF) is developed for testing higher order autoregressive process. Under AR(p), ADF is from the following equation:

$$\Delta y_t = (\rho - 1) y_{t-1} + \sum_{i=1}^{p} \alpha_i \Delta y_{t-1} + \nu_t \tag{4.8}$$

The ADF test can also include a drift (constant) and deterministic time trend to ensure the good formation of a variable.

Test for a unit root with drift:

$$\Delta y_t = a + (\rho - 1)y_{t-1} + \sum_{i=1}^{p} \alpha_i \Delta y_{t-1} + \nu_t \tag{4.9}$$

Test for a unit root with drift and deterministic time trend:

$$\Delta y_t = a + Bt + (\rho - 1)y_{t-1} + \sum_{i=1}^{p} \alpha_i \Delta y_{t-1} + \nu_t \tag{4.10}$$

4.3 Engle-Granger Cointegration

Engle and Granger (1987) developed residual based test for cointegration. The cointegration test for the variables y and x on the following:

$$y_t = B_0 + X_t' B + \mu_t \tag{4.11}$$

Where *y* and *x* are non-stationary series. To test for cointegration between two or more non-stationary time series, the residuals μ_t from the equation estimation is tested by the ADF test to determine whether it is stationary or non-stationary. Augmented Dickey-Fuller Test (ADF) for residual is as per the following:

$$\Delta \mu_t = (\rho - 1)\mu_{t-1} + \sum_{i=1}^{p} \alpha_i \Delta \mu_{t-1} + \nu_t \tag{4.12}$$

4.3.1 Cointegration Test for Long Term Relationship

According to equation (3.18), the null and alternative hypotheses tested of the cointegration test are:

$$(p_t - d_t) = \delta + \beta_1 G_t + \beta_2 R_t + \varepsilon_t \tag{4.13}$$

$$(p_t - d_t) = \delta + \beta_1 G_t + \beta_2 R_f + \beta_3 R_m + \varepsilon_t \tag{4.14}$$

$$(p_t - d_t) = \delta + \beta_1 G_t + \beta_2 R_f + \beta_3 \sigma_{Ri}^2 + \varepsilon_t \tag{4.15}$$

$$(p_t - d_t) = \delta + \beta_1 G_t + \beta_2 R_f + \sum_{i=2}^{J} \beta_i R p_i + \varepsilon_t \quad (4.16)$$

H_0: Unit root (ADF Test (τ-statistic)) for ε_t is non-stationary (no cointegration)

H_a: Unit root (ADF Test (τ-statistic)) for ε_t is stationary (cointegration)

4.4 ARDL Bound Test

Pesaran, Shin and Smith (2001: 289-326) found that when there are both I(1) and I(0), a normal cointegration test on the long-run relation would create biased results in the long-run relationship between the variables. In order to solve the bias problem due to the co-existence between I(1) and I(0), the autoregressive distributed lag (ARDL) model, also known as bounds testing approach is suggested by Pesaran, Shin and Smith (2001: 289-326). The framework can examine both the short-run adjustment and long-run relationships between variables and the direction of their causality. Thus, a vector autoregression of order p, VAR(p) are as follows:

$$y_t = \alpha_0 + \sum_{i=1}^{p} \alpha_i y_{t-i} + \sum_{i=0}^{q} \sum_{J=1}^{J} \theta_j x_{j,t-i} + \varepsilon_t \quad (4.17)$$

Where y_t is a vector of the dependent variable,

x_{t-i} are exogenous variables,

α_i is a matrix of VAR parameters to be estimated and

ε_t is a white noise error term.

According to Pesaran, Shin and Smith (2001), the dependent variable must be I(1), while the independent variables can be either I(1) or I(0). Based on equation (4.17), I can develop an ARDL as follows:

$$\Delta y_t = \delta + \beta_0 y_{t-1} + \sum_{j=1}^{J} \beta_j x_{j,t-1} + \sum_{i=1}^{p} \alpha_i \Delta y_{t-i} + \sum_{i=0}^{q} \sum_{J=1}^{J} \theta_j \Delta x_{j,t-i} + \eta_t \quad (4.18)$$

Where y_t is a vector of the dependent variable,

$x_{j,t-i}$ are exogenous variables,

α_i is a matrix of VAR parameters to be estimated and

ε_t is a white noise error term.

To test the long term and short term relationship, the null and alternative hypotheses tested from (4.18) are:

H_0: $\sum_{i=0}^{I} \beta_i = 0$ (no long-run relationship)

H_a: $\sum_{i=0}^{I} \beta_i \neq 0$ (long-run relationship exists)

4.4.1 ARDL Bound Test for Long Term Relationship

According to equation (4.18), the null and alternative hypotheses tested of ARDL bound test are:

$$\Delta(\mathrm{p}_t - d_t) = \delta + \beta_0 \Delta(\mathrm{p}_t - d_t) + \sum_{j=1}^{J} \beta_j x_{j,t-1} + \sum_{i=1}^{p} \alpha_i \Delta(\mathrm{p}_{t-i} - d_{t-i}) + \sum_{i=0}^{q} \sum_{J=1}^{J} \theta_j \Delta x_{j,t-i} + \eta_t \qquad (4.19)$$

Where $x_{i,t-1}$ includes G_t and $R_{i,t}$ for perfect expectation model

$x_{i,t-1}$ includes G_t, $R_{f,t}$ and $R_{m,t}$ for CAPM

$x_{i,t-1}$ includes G_t, $R_{f,t}$ and $\sigma^2_{Ri,t}$ for ICAPM

$x_{i,t-1}$ includes G_t, $R_{f,t}$ and $R_{pi,t}$ for APT

H_0: $\sum_{i=0}^{I} \beta_i = 0$ (no long-run relationship)

H_a: $\sum_{i=0}^{I} \beta_i \neq 0$ (long-run relationship exists)

4.5 Error Correction Model

The error correction models are as per the following:

$$\Delta y_t = \delta + \beta ECT_{t-1} + \sum_{i=1}^{p} \alpha_i \Delta y_{t-i} + \sum_{i=0}^{q} \sum_{J=1}^{J} \theta_j \Delta x_{j,t-i} + \eta_t \qquad (4.20)$$

In the case of long term relationship of Log Price-to-Dividend and risk factor, an error correction model (ECM) is developed by:

$$\Delta(\mathrm{p}_t - d_t) = \delta + \beta ECT_{t-1} + \sum_{i=1}^{p} \alpha_i \Delta(\mathrm{p}_{t-i} - d_{t-i}) + \sum_{i=0}^{q} \sum_{J=1}^{J} \theta_j \Delta x_{j,t-i} + \eta_t \quad (4.21)$$

Where ECT_{t-1} is error correction term for long term relationship,

$\Delta(p_t - d_t)$ is the difference between $(p_t - d_t)$ and $(p_{t-1} - d_{t-1})$,

$x_{j,t}$ (independent variable) includes G_t, R_f and R_m for CAPM,

$x_{j,t}$ includes G_t, R_f and $\sigma^2_{Ri,t}$ for ICAPM and

$x_{j,t}$ includes G_t, R_f and $R_{pi,t}$ for APT

4.5.1 Long Term Relationship for ECM

$$(p_t - d_t) = \delta + \beta_1 G_t + \beta_2 R_f + \beta_3 R_m + ECT_t \quad (4.22)$$

$$(p_t - d_t) = \delta + \beta_1 G_t + \beta_2 R_f + \beta_3 \sigma^2_{Ri} + ECT_t \quad (4.23)$$

$$(p_t - d_t) = \delta + \beta_1 G_t + \beta_2 R_f + \sum_{i=2}^{J} \beta_i Rp_i + ECT_t \quad (4.24)$$

Where β_i is coefficient of long-run relationship between Log of Price-to-Dividend ratio and Risk factor i.

4.5.2 Short Term Relationship for ECM

$$\Delta(\mathrm{p}_t - d_t) = \delta + \beta_0 \Delta(\mathrm{p}_t - d_t) + \sum_{j=1}^{J} \beta_j x_{j,t-1} + \sum_{i=1}^{p} \alpha_i \Delta(\mathrm{p}_{t-i} - d_{t-i}) + \sum_{i=0}^{q} \sum_{J=1}^{J} \theta_j \Delta x_{j,t-i} + \eta_t \quad (4.25)$$

Where $x_{i,t-1}$ includes G_t and $R_{i,t}$ for Perfect expectation Model

$x_{i,t-1}$includes G_t, $R_{f,t}$ and $R_{m,t}$ for CAPM

$x_{i,t-1}$includes G_t, $R_{f,t}$ and $\sigma^2_{Ri,t}$ for ICAPM

$x_{i,t-1}$includes G_t, $R_{f,t}$ and $R_{pi,t}$ for APT

4.6 Vector Autoregressive (VAR) Models

Sims (1980: 1-48) initiated the Vector autoregressive (VAR) models to capture the mutual relationships of multivariate time series. A VAR system can be expressed as per the following:

$$V_t = \alpha_0 + \sum_{i=1}^{p} \alpha_i V_{t-i} + \varepsilon_t \qquad (4.26)$$

Where V_t is a vector of endogenous variables at time t

α_i is coefficient vector of variablesy_{t-i} at t-i

p is the number of lags included in the system for variable y_t

ε_t is vector of residuals

4.7 Granger Causality Test

Granger (1969: 424-438) is to find that how much past values can explain the current values. The models are as follows:

$$y_t = \alpha_0 + \sum_{i=1}^{p} \alpha_i y_{t-i} + \sum_{i=1}^{q} \pi_{xi} x_{t-i} + \varepsilon_t \qquad (4.27)$$

$$x_t = \alpha_0 + \sum_{i=1}^{p} \alpha_i x_{t-i} + \sum_{i=1}^{q} \pi_{yi} y_{t-i} + \varepsilon_t \qquad (4.28)$$

The reported F-statistic are the Wald statistic for the joint hypothesis that x does not granger cause y is as per the following:

H_o: $\sum_{i=1}^{q} \pi_{xi} = 0$

H_a: $\sum_{i=1}^{q} \pi_{xi} \neq 0$

The reported F-statistic are the Wald statistic for the joint hypothesis that y does not granger cause x is as per the following:

H_o: $\sum_{i=1}^{q} \pi_{yi} = 0$

H_a: $\sum_{i=1}^{q} \pi_{yi} \neq 0$

4.7.1 Granger Causality Test of Monetary Transmission

For the study monetary transmission, firstly, it is to find Granger causality of policy rate on monetary transmission on money supply, deposit rate and lending rate as per the following:

$$y_t = \alpha_0 + \sum_{i=1}^{p} \alpha_i y_{t-i} + \sum_{i=1}^{q} \pi_{xi} RP_{t-i} + \varepsilon_t \quad (4.29)$$

$$RP_t = \alpha_0 + \sum_{i=1}^{p} \alpha_i RP_{t-i} + \sum_{i=1}^{q} \pi_{yi} y_{t-i} + \varepsilon_t \quad (4.30)$$

Where $y_t = m_t$ (Real money supply), DR_t (Deposit rate) or MLR_t (Lending rate)

The reported F-statistic are the Wald statistic for the joint hypothesis that RP does not granger cause y is as per the following:

H_o: $\sum_{i=1}^{q} \pi_{RP,i} = 0$

H_a: $\sum_{i=1}^{q} \pi_{RP,i} \neq 0$

Secondly, I study the effect of monetary transmission on bond market rates and it is to find Granger causality of policy rate, real money supply, deposit rate and lending rate on monetary transmission on bond market rate. It is as follows:

$$y_t = \alpha_0 + \sum_{i=1}^{p} \alpha_i y_{t-i} + \sum_{i=1}^{q} \pi_{xi} x_{t-i} + \varepsilon_t \quad (4.31)$$

$$x_t = \alpha_0 + \sum_{i=1}^{p} \alpha_i x_{t-i} + \sum_{i=1}^{q} \pi_{yi} y_{t-i} + \varepsilon_t \quad (4.32)$$

Where $y_t = RF_{1y,t}$ (One year bond yield) or $y_t = RF_{3m,t}$(three month bond yield) and $x_t = RP_t$(RP Rate),m_t(Real money supply), DR_t(Deposit rate) or MLR_t(Lending rate)

The reported F-statistic are the Wald statistic for the joint hypothesis that monetary effect does not granger cause bond market rate is as follows:

H$_o$: $\sum_{i=1}^{q} \pi_{x,i} = 0$

H$_a$: $\sum_{i=1}^{q} \pi_{x,i} \neq 0$

4.8 Impulse Response Function

Under VAR model, an impulse response function is to find the shock impact of a variable to one of the innovations on current and future values of the endogenous variables. Lütkepohl and Reimes (1992: 53-78) initiated that the traditional impulse response analysis used the orthogonalization of shocks; therefore, the results were dependent on the ordering of the variables in the VAR. In order to solve this failure, Pesaran and Shin (1998: 17-29) developed the generalized impulse response functions which overcome the different ordering effect of the variables on impulse response functions. The impulse response functions are as per the following:

$$V_t = \alpha_0 + \sum_{i=1}^{p} \alpha_i V_{t-i} + \varepsilon_t \quad (4.33)$$

Where V_t is a vector of endogenous variables at time t

α_i is coefficient vector of variables y_{t-i} at t-i

p is the number of lags included in the system for variable y_t

ε_t is vector of residuals

Then

$$V_t = \Psi(L)\varepsilon_t \quad (4.34)$$

Where $E(\varepsilon_t \varepsilon_t') = $ H

The generalized impulse response function of V_i to a unit (one standard deviation) shock in V_j is given by:

$$\Psi_{ij,h} = \sigma_{ii}^{-1/2}(e_j' \mathrm{H} e_i) \quad (4.35)$$

where σ_{ii} is the i th diagonal element of H, e_i is a selection vector with the i th element equal to one and all other elements equal to zero, and h is the horizon.

CHAPTER 5

DATA AND ESTIMATION

5.1 Data

The study covers the monthly stock market data in Thailand from April 2002-December 2012. The stock market index (P_t) is the Stock Exchange of Thailand Index (SET Index) from Bloomberg. The actual dividends for 12 trailing months (D_t) are used for the test. The total returns of indices, including dividend effects are used for equities indices return (R_i) calculation. The risk free rates (R_f) are 10 Year Thailand Treasury bond yields. Global market return comes from MSCI World index return (R_m) and VIX Index (VIX) and JP Morgan Emerging Market Spread (Spread) is used for risk premium (R_p).

5.1.1 Real Money Adjustment

The money supply is adjusted to the same base level as the consumer prices to calculate the real money supply. The 2011 base level is calculated for the money supply to conform to the consumer price with base level from the Ministry of Commerce. The real money supply is calculated from the following:

$$m_{r,t} = m_{sa,t}/cpi_t \tag{5.1}$$

$$m_{a,t} = Log\ M_{s,t}/M_{s,2011} \tag{5.2}$$

Where $m_{r,t}$ is the log of real money supply,

$m_{sa,t}$ is the seasonal log of money supply with 2011based index =100

$m_{a,t}$ is the log money supply with 2011 based index =100

$M_{s,t}$ is the money supply at time t

$M_{s,2011}$ is the money supply at the 2011 average level = 1353.82bn and

cpi_t is the log of the seasonal CPI with a base index = 100

The appendix A is shown the data of real money supply.

5.1.2 Seasonal Data Adjustment

The stock equity return found the monthly seasonal effects from many studies including Gultekin and Gultekin (1983: 469-482), Boudreaux (1995: 15-20) and Yakob, Beal and Delpachitra (2005: 298-318). The monthly seasonal pattern on both short term and long term interest rates due to the seasonal effect of credit demand and supply was also found from Diller (1971: 35-133). Miron (1986: 125-140) also explained no seasonal effect on the interest rate after World War II because the Federal Reserve used the open market operation to adjust money supply seasonally or, without seasonal money stock, the interest rate will be seasonal. Therefore, all financial data have been seasonally adjusted for the study. Additive moving average is used for the seasonal adjustment. The process is as follows:

$$x_t = 0.5y_{t-6}+\ldots+y_t+\ldots+0.5y_{t-6} \quad (5.3)$$

$$D_t = y_t - x_t \quad (5.4)$$

For the monthly series, the seasonal index i_m for month m is computed by the average of D_t using observations only for month m. The seasonal factors are computed by the following:

$$s_j = i_j - i \quad (5.5)$$

Where i is the average of all seasonal indices and the seasonally adjusted series is calculated by

$$Y_j = y_t - s_j \quad (5.6)$$

All non-seasonal and seasonal data is in appendix A.

5.1.3 Data Description and Statistic

The data descriptions are as follows:

1) Log Price-to-Dividend ($p_t - d_t$) = Log (Stock Exchange Index/Total Dividend 12 Months Payment of Index) of Thailand. SET Index and Total trailing dividend 12 months payment are from Bloomberg.

2) Sustainable Growth Rate (G_t) = Return on Equities of Index * (1-Dividend Payout Ratio) of Thailand. Return on equities and dividend payout ratio are from Bloomberg.

3) Rate of Return ($R_{i,t}$) = Monthly Stock Exchange Index Total Return of Thailand from Bloomberg.

4) 10year treasury yield ($R_{f,t}$) = 10 Year Government Bond Yield (interpolated curve) of Thailand from Thai BMA.

5) Inflation Rate (Inf_t) = Monthly percentage change of consumer price index from the Ministry of Commerce.

6) RP Rate (RP_t) = Policy rate from the Bank of Thailand.

7) Log of Real Money Supply ($m_{r,t}$) = Log of real money supply adjusted with base level of money supply and consumer price at 2011. The money supply is M1 money supply from Bank of Thailand and consumer price index is from the Ministry of Commerce.

8) Deposit Rate (DR_t) = Average one year deposit rate of four big banks including Bangkok Bank, Siam Commercial Bank, Kasikorn Bank and Krungthai Bank from the Bank of Thailand

9) Minimum Lending Rate (MLR_t) = Average minimum lending rate of four big banks including Bangkok Bank, Siam Commercial Bank, Kasikorn Bank and Krungthai Bank from the Bank of Thailand

10) three month treasury yield ($R_{3m,t}$) = Three months Government Bond Yield (interpolated curve) of Thailand from Thai BMA.

11) one year treasury yield ($R_{1y,t}$) = One Year Government Bond Yield (interpolated curve) of Thailand from Thai BMA.

12) Industrial production index (IP_t) = Industrial production index from Office of Industrial Economics

13) World Market Rate of Return ($R_{m,t}$) = Monthly Stock Exchange Index Return of MSCI World Index from Bloomberg

14) VIX Index (VIX_t) = Implied Volatility Index of S&P500 over 30 days period from Bloomberg.

15) JP Morgan Emerging Market Spread ($SPREAD_t$) = Emerging Market Spread of emerging market bonds calculated by JP Morgan. (spread between JP Morgan Emerging Market Bond Index yield over the United States of America's government treasury yield at the same maturity)

Data statistic summary is in Table 5.1 for non-seasonal data. The major data are Log Price-to-Dividend $(p_t - d_t)$, Sustainable Growth Rate (G_t), Rate of Return $(R_{i,t})$, 10 year treasury yield $(R_{f,t})$, Inflation Rate (Inf_t), RP Rate (RP_t), Deposit Rate (DR_t), Minimum Lending Rate (MLR_t), Money Supply ($M_{s,t}$), Log Adjusted Money Supply ($m_{a,t}$), Consumer Price Index (CPI_t), three month treasury yield($R_{3m,t}$), one year treasury yield($R_{1y,t}$), World Market Rate of Return ($R_{m,t}$), VIX Index (VIX_t)and JP Morgan Emerging Market Spread ($SPREAD_t$). Most of the data are non-normal distribution under the Jarque-Bera Statistic test. There is leptokurtic distribution from positive kurtosis with negative skewness on some data including Log Price-to-Dividend ($p_t - d_t$), Sustainable Growth Rate (G_t), Rate of Return ($R_{i,t}$), Inflation Rate (Inf_t), Money Supply ($M_{s,t}$), Log of Adjusted Money Supply ($m_{a,t}$), Consumer Price Index (CPI_t) and World Market Rate of Return ($R_{m,t}$) and positive skewness on some data including 10 year treasury yield ($R_{f,t}$), RP Rate (RP_t), Deposit Rate (DR_t), Minimum Lending Rate (MLR_t), three month treasury yield($R_{3m,t}$), one year treasury yield($R_{1y,t}$),VIX Index (VIX_t) and JP Morgan Emerging Market Spread ($SPREAD_t$).

Table 5.2 shows the seasonal adjustment factor under additive moving average. The major data for seasonal adjustment are Log Price-to-Dividend ($p_t - d_t$), Sustainable Growth Rate (G_t), Rate of Return ($R_{i,t}$), 10 year treasury yield ($R_{f,t}$), Inflation Rate (Inf_t), RP Rate (RP_t), Deposit Rate (DR_t), Minimum Lending Rate (MLR_t), Log of Adjusted Money Supply ($m_{a,t}$), Consumer Price Index (CPI_t), three month treasury yield ($R_{3m,t}$), one year treasury yield ($R_{1y,t}$), World Market Rate of Return ($R_{m,t}$), VIX Index (VIX_t) and JP Morgan Emerging Market Spread

($\mathrm{SPREAD_t}$). For Log Price-to-Dividend ($\mathrm{p_t - d_t}$), the data usually have the negative seasonality during the second quarter and October and November and have the positive seasonality during December through February and during the third quarter. For Sustainable Growth Rate ($\mathrm{G_t}$), the data usually have the negative seasonality during the first half of the year and have the positive seasonality during the second half of the year. For Rate of Return ($\mathrm{R_{i,t}}$), the data usually have the positive seasonality in February, April, June through August and December and have negative seasonality in January that is surprisingly not in line with the January effect. Other months of negative seasonality are March, May and September through November. For interest rate variables including 10 year treasury yield ($\mathrm{R_{f,t}}$), RP Rate ($\mathrm{RP_t}$), Deposit Rate ($\mathrm{DR_t}$) and Minimum Lending Rate ($\mathrm{MLR_t}$), almost all data usually have the negative seasonality during the first half of the year and the positive seasonality during the second half of the year. For Log of Adjusted Money Supply ($\mathrm{m_{a,t}}$), the data usually have the negative seasonality during June through November and have the positive seasonality for the rest. For Monthly Inflation Rate ($\mathrm{Inf_t}$), the data usually have the negative seasonality during the second half of the year and the positive seasonality during the first half of the year. For Consumer Price Index ($\mathrm{CPI_t}$), the data usually have the negative seasonality during November through February and have the positive seasonality during March through October. For three month treasury yield ($R_{3m,t}$), the data usually have the negative seasonality during January through June and have the positive seasonality for the rest. For one year treasury yield ($R_{1y,t}$), the data usually have the negative seasonality during January through May and have the positive seasonality for the rest. For World Market Rate of Return ($\mathrm{R_{m,t}}$), the data usually have the positive seasonality in March, April, July, October through December and surprisingly the same as SET Index return, there is negative seasonality in January. For VIX Index ($\mathrm{VIX_t}$), the data usually have the negative seasonality in December and February through August and have the positive seasonality for the rest. For JP Morgan Emerging Market Spread ($\mathrm{SPREAD_t}$), the data usually have the negative seasonality during March through September and have the positive seasonality for the rest.

Finally, Table 5.3 represents Data statistical summary of the seasonal data. The major data for seasonal adjustment are Log Price-to-Dividend $(p_t - d_t)$, Sustainable Growth Rate (G_t), Rate of Return $(R_{i,t})$, 10 year treasury yield $(R_{f,t})$, Inflation Rate (Inf_t), RP Rate (RP_t), Deposit Rate (DR_t), Minimum Lending Rate (MLR_t), Log of Adjusted Money Supply $(m_{a,t})$, Consumer Price Index (CPI_t), Log of Industrial production index (IP_t), Log of Real Money Supply $(m_{r,t})$, three month treasury yield$(R_{3m,t})$, one year treasury yield$(R_{1y,t})$, World Market Rate of Return $(R_{m,t})$, VIX Index (VIX_t) and JP Morgan Emerging Market Spread $(SPREAD_t)$. Most of the data, except 10 year treasury yield $(R_{f,t})$, Log of Adjusted Money Supply $(m_{a,t})$ and Log of Real Money Supply $(m_{r,t})$, are non-normal distribution under Jarque-Bera Statistic test. There are the leptokurtic distribution from positive kurtosis with negative skewness on some data including Log Price-to-Dividend $(p_t - d_t)$, Sustainable Growth Rate (G_t), Rate of Return $(R_{i,t})$, Inflation Rate (Inf_t), Consumer Price Index (CPI_t), Log of Industrial production index (ip_t) and World Market Rate of Return $(R_{m,t})$ and positive skewness on some data including RP Rate (RP_t), Deposit Rate (DR_t), Minimum Lending Rate (MLR_t), three month treasury yield$(R_{3m,t})$, one year treasury yield$(R_{1y,t})$, VIX Index (VIX_t) and JP Morgan Emerging Market Spread $(SPREAD_t)$. For Log Price-to-Dividend, it was between 2.50 and 3.78 with 3.28 Mean. For Sustainable Growth Rate, it was between -1.11 and 19.49 with 10.74 Mean. For Rate of Return, it was between -28.02 and 16.66 with 1.56 Mean. For 10 year treasury yield, it was between 2.38 and 6.43 with 4.27 Mean. For the inflation Rate, it was between -0.0026 and 0.0019 with 0.0003 Mean. For RP Rate, it was between 1.09 and 5.10 with 2.58 Mean. For the deposit Rate, it was between 0.66 and 4.09 with 2.00 Mean. For the Minimum Lending Rate, it was between 5.66 and 7.70 with 6.55 Mean. For Log of Adjusted Money Supply, it was between 3.72 and 4.75 with 4.25 Mean. For Log of Industrial production index, it was between 4.11 and 4.73 with 4.51 Mean. For the Consumer Price Index, it was between 4.32 and 4.65 with 4.49 Mean. For Log of Real Money Supply, it was between -0.61 and 0.10 with -0.24 Mean. For three month treasury yield, it was between 1.00 and 5.06 with 2.49 Mean. For one year treasury yield, it was between 1.12 and 5.18 with 2.71 Mean. For World Market Rate of Return, it was between -20.50 and 10.90 with 0.59 Mean. For VIX

Index, it was between 7.75 and 56.54 with 21.45 Mean. For JP Morgan Emerging Market Spread, it was between 156.95 and 933.69 with 381.23 Mean.

Table 5.1 Non-Seasonal Data Statistical Summary

	Log Price-to-Dividend ($p_t - d_t$)	**Sustainable Growth Rate(G_t)**	**Rate of Return($R_{i,t}$)**	**10 year treasury yield($R_{f,t}$)**
Mean	3.28	10.74	1.58	4.27
Median	3.30	10.88	2.16	4.12
Maximum	3.76	19.43	19.58	6.58
Minimum	2.49	-1.15	-30.07	2.38
Standard deviation (SD)	0.23	4.45	6.53	0.82
Skewness	-1.05	-0.64	-0.85	0.24
Kurtosis	5.49	3.80	6.53	2.42
Jarque-Bera Stat.	57.04	12.13	82.39	3.02
P-Value	*(0.00)*	*(0.00)*	*(0.00)*	*(0.22)*
Sum	422.88	1,385.80	204.45	550.57
Sum of SD	6.99	2,535.46	5,454.49	86.21
Observation	129	129	129	129

	Inflation Rate(Inf_t)	**RP Rate(RP_t)**	**Deposit Rate(DR_t)**	**Minimum Lending Rate(MLR_t)**
Mean	0.00249	2.59	2.00	6.55
Median	0.00251	2.50	2.07	6.69
Maximum	0.02229	5.00	4.00	7.69
Minimum	-0.02968	1.25	0.68	5.69
Standard deviation (SD)	0.00587	1.15	0.96	0.66
Skewness	-1.19	0.51	0.39	0.00
Kurtosis	10.66	2.23	2.26	1.59
Jarque-Bera Stat.	345.86	8.82	6.31	10.75
P-Value	*(0.00)*	*(0.00)*	*(0.04)*	*(0.00)*
Sum	0.32149	333.50	257.56	844.88
Sum of SD	0.00441	168.94	118.24	56.19
Observation	129	129	129	129

Table 5.1 (Continued)

	Money Supply($M_{s,t}$)	**Log adjusted Money Supply($m_{a,t}$)**	**Consumer Price Index(CPI_t)**	**three month treasury yield($R_{3m,t}$)**
Mean	984.48	10.74	89.42	2.49
Median	919.14	10.88	89.50	2.36
Maximum	1,598.26	19.43	104.27	4.97
Minimum	570.03	-1.15	76.10	1.02
Standard deviation (SD)	261.45	4.45	8.63	1.14
Skewness	0.44	-0.64	-0.02	0.52
Kurtosis	2.20	3.80	1.78	2.33
Jarque-Bera Stat.	7.55	12.13	8.05	8.20
P-Value	*(0.02)*	*(0.00)*	*(0.02)*	(0.02)
Sum	126,998	1,385.80	11,535.57	321.08
Sum of SD	8,749,903	2,535.46	9,541.99	166.84
Observation	129	129	129	129.00

	one year treasury yield($R_{1y,t}$)	**World Market Rate of Return($R_{m,t}$)**	**VIX Index(VIX_t)**	**JP Morgan Emerging Market Spread($SPREAD_t$)**
Mean	2.71	0.60	21.45	381.14
Median	2.75	1.19	18.63	337.04
Maximum	5.22	11.88	59.89	932.00
Minimum	1.07	-19.79	10.42	154.86
Standard deviation (SD)	1.13	4.97	9.16	167.60
Skewness	0.48	-0.79	1.58	1.19
Kurtosis	2.30	4.75	6.03	4.03
Jarque-Bera Stat.	7.67	29.83	103.09	36.23
P-Value	(0.02)	*(0.00)*	*(0.00)*	*(0.00)*
Sum	349.86	78.00	2,767.12	49,167.5
Sum of SD	162.07	3,165.20	10,740.3	3,595,319
Observation	129.00	129	129	129

Table 5.2 Seasonal Adjustment Factor under Additive Moving Average

Scaling Factors:	**Log Price-to-Dividend ($p_t - d_t$)**	**Sustainable Growth Rate(G_t)**	**Rate of Return($R_{i,t}$)**	**10 year treasury yield($R_{f,t}$)**
1	0.003	0.037	-3.044	-0.068
2	0.018	-0.060	1.215	-0.030
3	-0.018	-0.448	-1.089	-0.070
4	-0.019	-0.521	2.215	-0.155
5	-0.022	-0.541	-0.545	-0.065
6	-0.001	-0.040	0.477	0.003
7	0.031	0.338	1.074	0.045
8	0.013	0.036	0.584	-0.079
9	0.001	0.573	-0.542	0.014
10	-0.014	0.320	-2.049	0.150
11	-0.011	0.372	-1.214	0.183
12	0.019	-0.065	2.918	0.070

Scaling Factors:	**Inflation Rate(Inf_t)**	**RP Rate(RP_t)**	**Deposit Rate(DR_t)**	**Minimum Lending Rate(MLR_t)**
1	0.001	-0.014	0.025	0.026
2	0.001	-0.097	-0.014	0.003
3	0.003	-0.031	-0.016	0.016
4	0.006	-0.063	-0.024	0.014
5	0.003	-0.120	-0.090	-0.028
6	-0.001	-0.104	-0.074	-0.030
7	0.000	-0.049	-0.018	-0.039
8	-0.003	0.050	0.017	-0.016
9	-0.001	0.094	0.084	0.014
10	-0.001	0.161	0.061	0.018
11	-0.004	0.103	0.043	0.017
12	-0.005	0.069	0.005	0.004

Table 5.2 (Continued)

Scaling Factors:	Log adjusted Money Supply($m_{a,t}$)	Consumer Price Index(CPI_t)	three month treasury yield($R_{3m,t}$)	one year treasury yield($R_{1y,t}$)
1	0.966	-0.641	-0.037	-0.089
2	1.802	-0.511	-0.096	-0.135
3	1.284	-0.280	-0.095	-0.144
4	1.301	0.277	-0.081	-0.106
5	1.794	0.572	-0.097	-0.083
6	-1.271	0.538	-0.087	0.038
7	-2.429	0.622	0.036	0.080
8	-1.659	0.286	0.082	0.076
9	-2.173	0.158	0.117	0.110
10	-1.946	0.039	0.137	0.127
11	-0.015	-0.317	0.102	0.119
12	2.346	-0.743	0.019	0.007

Scaling Factors:	World Market Rate of Return($R_{m,t}$)	VIX Index(VIX_t)	JP Morgan Emerging Market Spread($SPREAD_t$)
1	-1.836	0.300	6.793
2	-0.497	-0.125	4.048
3	0.646	-0.629	-0.204
4	2.415	-2.053	-12.943
5	-0.929	-1.420	-2.091
6	-1.203	-1.571	-7.903
7	0.774	-0.884	-20.695
8	-1.256	-0.324	-13.067
9	-0.449	2.355	-1.686
10	0.708	3.348	15.745
11	0.077	1.734	23.727
12	1.549	-0.733	8.277

Table 5.3 Seasonal Data Statistical Summary

	Log Price-to-Dividend ($p_t - d_t$)	**Sustainable Growth Rate(G_t)**	**Rate of Return($R_{i,t}$)**	**10 year treasury yield($R_{f,t}$)**
Mean	3.28	10.74	1.56	4.27
Median	3.30	10.89	2.02	4.19
Maximum	3.78	19.49	16.66	6.43
Minimum	2.50	-1.11	-28.02	2.38
Standard deviation (SD)	0.23	4.44	6.34	0.82
Skewness	- 1.06	-0.64	-0.75	0.20
Kurtosis	5.52	3.82	5.82	2.36
Jarque-Bera Stat.	58.39	12.54	54.87	3.09
P-Value	*(0.00)*	*(0.00)*	*(0.00)*	*(0.21)*
Sum	422.88	1,385.32	201.53	550.40
Sum of SD	6.97	2,517.88	5,145.95	86.05
Observation	129	129	129	129

	Inflation Rate(Inf_t)	**RP Rate(RP_t)**	**Deposit Rate(DR_t)**	**Minimum Lending Rate(MLR_t)**
Mean	0.003	2.58	2.00	6.55
Median	0.003	2.53	2.09	6.68
Maximum	0.019	5.10	4.09	7.70
Minimum	-0.026	1.09	0.66	5.66
Standard deviation (SD)	0.005	1.15	0.96	0.66
Skewness	-1.304	0.51	0.40	0.01
Kurtosis	10.782	2.24	2.27	1.58
Jarque-Bera Stat.	362.09	8.69	6.34	10.85
P-Value	*(0.00)*	*(0.01)*	*(0.04)*	*(0.00)*
Sum	0.327	333.36	257.55	844.93
Sum of SD	0.003	167.95	118.00	56.21
Observation	129	129	129	129

Table 5.3 (Continued)

	Log adjusted Money Supply($M_{a,t}$)	**Consumer Price Index (CPI_t)**	**Industrial productio n index (IP_t)***	**Log of Real Money Supply ($m_{r,t}$)**	**three month treasury yield ($R_{3m,t}$)**
Mean	4.25	4.49	4.51	-0.24	2.49
Median	4.23	4.49	4.54	-0.27	2.45
Maximum	4.75	4.65	4.73	0.10	5.06
Minimum	3.72	4.32	4.11	-0.61	1.00
Standard deviation (SD)	0.26	0.10	0.17	0.17	1.14
Skewness	0.02	-0.14	-0.64	0.09	0.52
Kurtosis	2.14	1.78	2.33	2.33	2.34
Jarque-BeraStat.	4.01	8.50	11.24	2.60	8.23
P-Value	*(0.13)*	*(0.01)*	*(0.00)*	*(0.27)*	(0.02)
Sum	548.58	579.03	581.15	-30.45	320.85
Sum of SD	8.92	1.21	3.70	3.71	165.87
Observation	129	129	129	129	129.00

	one year treasury yield($R_{1y,t}$)	**World Market Rate of Return ($R_{m,t}$)**	**VIX Index (VIX_t)**	**JP Morgan Emerging Market Spread ($SPREAD_t$)**
Mean	2.71	0.59	21.45	381.23
Median	2.75	1.26	19.20	338.71
Maximum	5.18	10.90	56.54	933.69
Minimum	1.12	-20.50	7.75	156.95
Standard deviation (SD)	1.12	4.85	9.03	167.82
Skewness	0.49	-0.88	1.38	1.17
Kurtosis	2.32	5.05	5.29	4.05
Jarque-Bera Stat.	7.70	38.97	69.08	35.58
P-Value	(0.02)	*(0.00)*	*(0.00)*	*(0.00)*
Sum	349.49	76.31	2,766.67	49,178.21
Sum of SD	161.05	3,016.38	10,433.89	3,604,790.00
Observation	129.00	129	129	129

Note: Industrial production index (IP_t)* is originally the seasonal data from the Office of Industrial Economics.

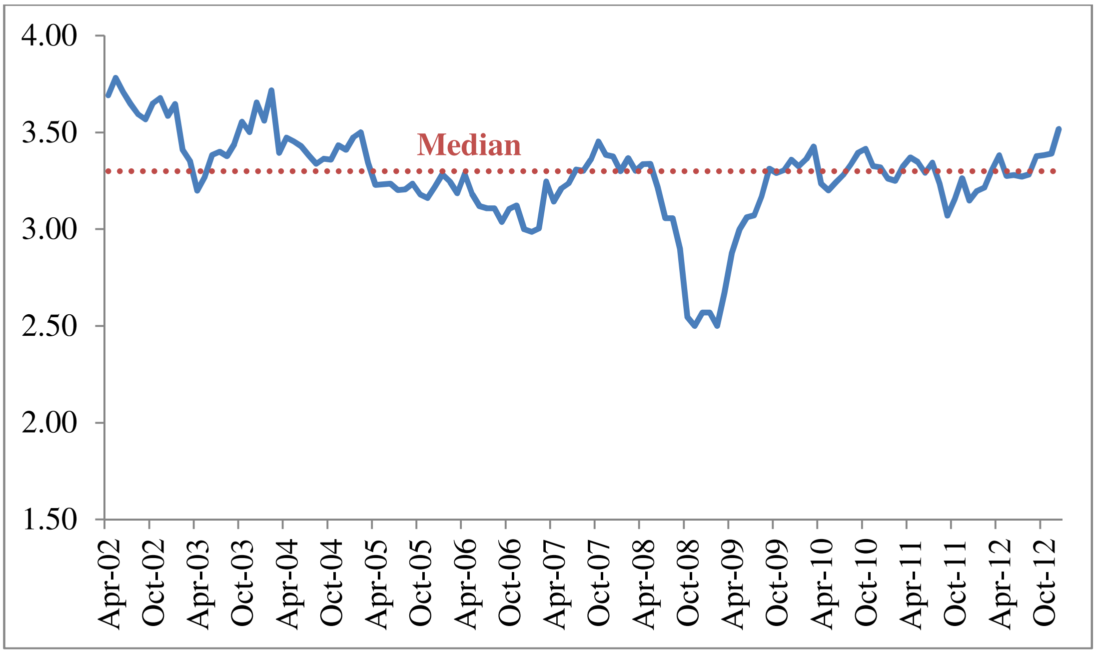

Figure 5.1 The Log of Price-to-Dividend Ratio of Thailand

5.2 GARCH Estimation

GARCH(1,1) are used for the stock return and inflation volatilities estimation from conditional variance with the result in Table 5.4 and Table 5.5, respectively. Table 5.6 shows the summary of data statistic of equity return volatility and inflation volatility. Figure 5.2 and Figure 5.3 show the equity return volatilities and inflation volatilities respectively.

5.2.1 Conditional Variance for Equity Return Volatility

For Table 5.4, the equity return volatility is estimated from the lag effect of t-1 and t-3 with minimizing Akaike info criterion. For the variance equation, residual square ($\varepsilon^2_{R,t-1}$) has a significant effect on conditional variance ($\sigma^2_{R,t}$) but a lag of conditional variance ($\sigma^2_{R,t-1}$) has no significant effect on conditional variance ($\sigma^2_{R,t}$).

For Table 5.6, the equity return volatility ($\sigma^2_{R,t}$) are non-normal distribution under the Jarque-Bera Statistic test. They are the leptokurtic distribution from positive kurtosis with positive skewness. The data was between 23.17 and 203.38 with 37.21 Mean. For Figure 5.2, the equity return volatility increased in 2004 during the United

States of America's interest rate hike, 2008 during the subprime crisis in the United States of America and 2011 during the United States of America's debt ceiling problem.

5.2.2 Conditional Variance for Inflation Volatility

For Table 5.5, the inflation volatility is estimated from the lag effect of t-8 with minimizing Akaike info criterion. For variance equation, residual square ($\varepsilon^2_{inf,t-1}$) and lag of conditional variance ($\sigma^2_{inf,t-1}$) have significant effects on conditional variance ($\sigma^2_{R,t}$).

For Table 5.6, the inflation volatility ($\sigma^2_{inf,t}$) are non-normal distribution under the Jarque-Bera Statistic test. They are the leptokurtic distribution from positive kurtosis with positive skewness. The data was between 0.00001 and 0.000246 with an 0.000026 Mean. (The inflation data is in value form not in percentage form; therefore, the inflation volatility is much smaller.) For Figure 5.3, the inflation volatility increased in 2008 during the subprime crisis in the United States of America causing the macroeconomic variable in Thailand to be volatile.

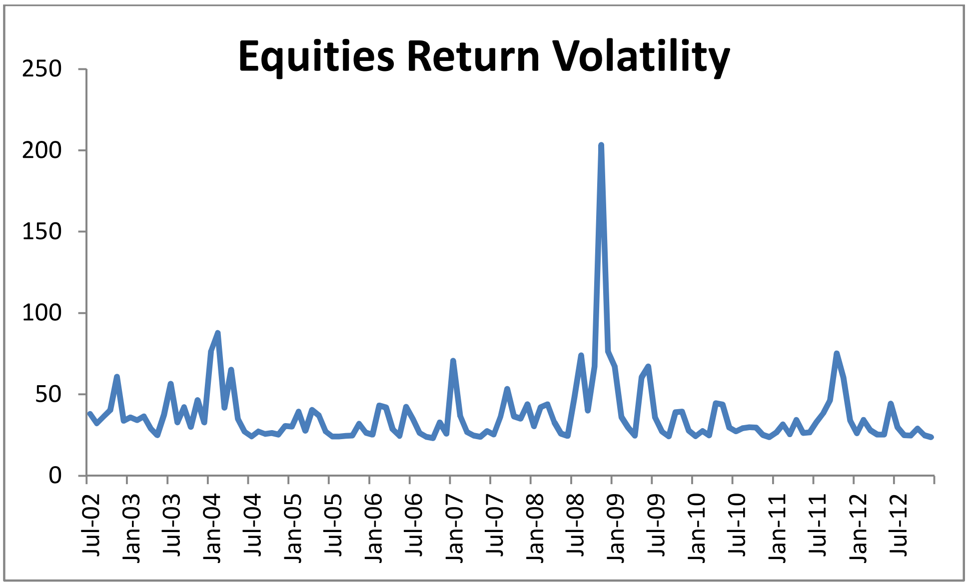

Figure 5.2 Estimation of Equity return Volatilities under GARCH(1,1)

Table 5.4 GARCH(1,1) for Equity return Volatilities Estimation

	Coefficient	t-Statistic	P-Value
Constant	**1.254****	2.14	0.03
Equity Rate of Return (t-1)	**0.226****	2.13	0.03
Equity Rate of Return (t-3)	**0.156**	1.59	0.11
		Variance Equation	
Constant	**16.363**	1.43	0.15
$\varepsilon^2_{R,t-1}$	**0.277****	2.24	0.03
$\sigma^2_{R,t-1}$	**0.285**	0.83	0.41
R-squared	**0.081**		
Akaike info criterion	**6.469**		
Schwarz criterion	**6.604**		
Hannan-Quinn criter.	**6.524**		
Test			
LM Correlation test		**0.06**	0.80
Residual Unit Root Test	**I(0)**		
Augmented Dickey-Fuller Test		**-11.37***	0.00

Note: *1%, **5%, ***10% Significance level

Table 5.5 GARCH(1,1) for Inflation Volatilities Estimation

	Coefficient	t-Statistic	P-Value
Constant	**0.003***	6.05	0.00
Inflation (t-8)	**-0.165****	-2.06	0.04
	Variance Equation		
Constant	**0.00*****	1.77	0.08
$\varepsilon^2_{inf,t-1}$	**0.254****	2.20	0.03
$\sigma^2_{inf,t-1}$	**0.616***	3.71	0.00
R-squared	**0.020**		
Akaike info criterion	**-7.935**		
Schwarz criterion	**-7.819**		
Hannan-Quinn criter.	**-7.888**		
Test			
LM Correlation test		**0.01**	0.92
Residual Unit Root Test	**I(0)**		
Augmented Dickey-Fuller Test		**-8.11***	0.00

Note: *1%, **5%, ***10% Significance level

Table 5.6 Data Statistical Summary for Equity return and Inflation Volatilities

	Equity return Volatility ($\sigma^2_{R,t}$)	**Inflation Volatility ($\sigma^2_{inf,t-1}$)**
Mean	37.21	0.00003
Median	31.83	0.00002
Maximum	203.38	0.00025
Minimum	23.17	0.00001
Std. Dev.	20.28	0.00003
Skewness	4.86	4.20
Kurtosis	37.39	23.63
Jarque-Bera Statistic	6,705.61	2,500.64
P-Value	*(0.00)*	*(0.00)*
Sum	4,688.24	0.00315
Sum Sq. Dev.	51,404.86	0.00000
Observations	126	121

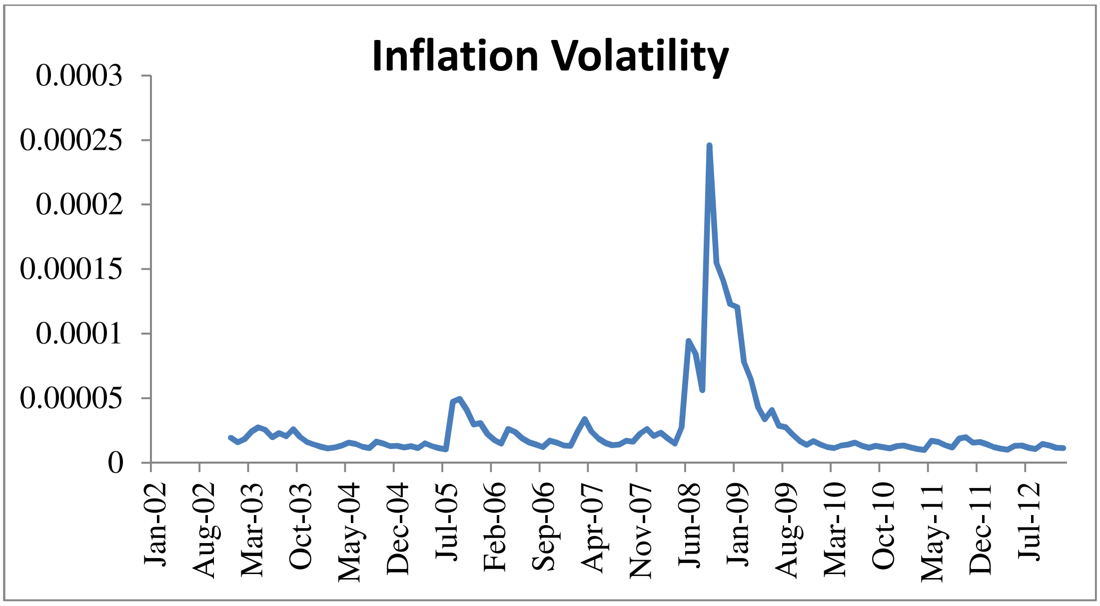

Figure 5.3 Estimation of Inflation Volatilities under GARCH(1,1)

5.3 Unit Root Test

The results of the unit root test are in Table 5.7. The ADF test with and without trends are used for the test. The test found that under a test without a trend assumption, Log Price-to-Dividend, Sustainable growth rate, 10 year treasury yield, RP rate, Deposit rate, MLR rate, three month treasury yield, one year treasury yield and JP Morgan Emerging market spread failed to reject the hypothesis that there is a unit root process. Therefore, Log Price-to-Dividend, Sustainable growth rate, 10 year treasury yield, RP rate, Deposit rate, MLR rate, three month treasury yield, one year treasury yield, and JP Morgan Emerging market spread are non-stationary.

Under the ADF test with a trend assumption, Log of Industrial Production, Log of adjusted money supply, Log of consumer price index and log of real money supply are failed to reject the hypothesis that there is a unit root process. Therefore, Log of Industrial Production, Log of adjusted money supply, Log of consumer price index and log of real money supply are non-stationary.

Rate of stock return, Equity return volatility, Inflation volatility, Inflation rate, VIX index and World Market rate of return under an ADF test rejected the hypothesis that there is a unit root process. Therefore, Rate of stock return, Equity return volatility, Inflation volatility, Inflation rate, VIX Index and World Market rate of return are on the stationary process.

Table 5.7 Unit Root Test

Variables	Without trend			With trend		
	ADF t-Statistic	P-Value	Result	ADF t-Statistic	P-Value	Result
Log Price-to-Dividend	**-2.54**	**0.110**	**I(1)**	-2.28	0.443	I(1)
Sustainable growth rate	**-1.88**	**0.340**	**I(1)**	-2.21	0.482	I(1)
Rate of return	**-9.25**	**0.000**	**I(0)**	-9.21	0.000	I(0)
10year treasury yield	**-2.81**	**0.060**	**I(1)**	-2.90	0.165	I(1)
RP Rate	**-2.28**	**0.179**	**I(1)**	-2.27	0.447	I(1)
three month treasury yield	**-2.07**	**0.256**	**I(1)**	-2.10	0.540	I(1)
one year treasury yield	**-2.02**	**0.280**	**I(1)**	-2.00	0.600	I(1)
Equity return Volatility	**-7.14**	**0.000**	**I(0)**	-7.12	0.000	I(0)
Inflation Volatility	**-3.55**	**0.008**	**I(0)**	-3.53	0.041	I(0)
Inflation	**-8.36**	**0.000**	**I(0)**	-8.33	0.000	I(0)
Log IP	-2.40	0.143	I(1)	**-3.06**	**0.120**	**I(1)**
Log M1	-0.58	0.869	I(1)	**-2.09**	**0.545**	**I(1)**
Log CPI	-0.33	0.915	I(1)	**-2.74**	**0.222**	**I(1)**
Log Real Money	-0.71	0.839	I(1)	**-1.86**	**0.668**	**I(1)**
Deposit Rate	**-2.61**	**0.093**	**I(1)**	-2.65	0.259	I(1)
MLR	**-2.65**	**0.085**	**I(1)**	-2.89	0.168	I(1)
Rate of return-MSCI World	**-8.99**	**0.000**	**I(0)**	-8.96	0.000	I(0)
VIX	**-2.96**	**0.042**	**I(0)**	-2.99	0.140	I(1)
JP Emerging Market Spread	**-2.23**	**0.198**	**I(1)**	-2.26	0.452	I(1)

Note: * 5% Significance level

CHAPTER 6

EMPIRICAL STUDY OF EQUITY MARKET BUBBLES

6.1 Engle-Granger Cointegration Test

The results of the Engle-Granger Cointegration test are in Table 6.1. For the asset pricing valuation under perfect expectation model, the ADF test statistic is -3.95 that reject the unit root hypothesis. For the asset pricing valuation under CAPM, the ADF test statistic is -2.92 that reject the unit root hypothesis. For the asset pricing valuation under ICAPM, the ADF test statistic is -3.60 that reject the unit root hypothesis and for the asset pricing valuation under APT model, the ADF test statistic is -4.66 that reject the unit root hypothesis.

The Engle-Granger Cointegration test found that ADF tests for the error term for the regression under assumption of all four models including the perfect expectation model, CAPM, ICAPM and APT rejected the hypothesis of a unit root process. Therefore, under Engle-Granger Cointegration test, there are cointegration under all four models including perfect expectation model, CAPM, ICAPM and APT and it is concluded that there are no bubbles in Thailand stock market.

Although the Engle-Granger Cointegration test indicates the long term relationship between log of price-to-dividend ratio and fundamental value under all four assumptions, including perfect expectation model, CAPM, ICAPM and APT, some variables are I(1) or I(0), autoregressive distributed lag model (ARDL) bound test can solve the test of a relationship between variables with I(1) and I(0).

Table 6.1 Engle-Granger Cointegration Test

	Actual Return	CAPM	ICAPM	APT Model
Coefficient				
Constant	**3.034***	**3.066***	**3.346***	**3.427***
t-Statistic	*(61.00)*	*(29.92)*	*(31.69)*	*(26.04)*
P-Value	[0.00]	[0.00]	[0.00]	[0.00]
Sustainable Growth	**0.0213***	**0.0199***	**0.021***	**0.007*****
t-Statistic	*(5.04)*	*(4.34)*	*(4.79)*	*(1.68)*
P-Value	[0.00]	[0.00]	[0.00]	[0.10]
Rate of Return	**0.010***			
t-Statistic	*(3.38)*			
P-Value	[0.00]			
10year Treasury Yield		**-0.0017**	**-0.043***	**-0.021**
t-Statistic		*(-0.07)*	*(-1.78)*	*(-0.93)*
P-Value		[0.95]	[0.00]	[0.36]
Rate of Return-MSCI world		**0.0086****		
t-Statistic		*(2.18)*		
P-Value		[0.03]		
Equity return Volatilities			**-0.003***	
t-Statistic			*(-3.64)*	
P-Value			[0.00]	
VIX				**-0.009***
t-Statistic				*(-3.13)*
P-Value				[0.00]
SPREAD				**0.00035****
t-Statistic				*(2.20)*
P-Value				[0.03]
Inflation Volatilities				**-3,255.2***
t-Statistic				*(5.62)*
P-Value				[0.00]
R-squared	0.206	0.166	0.248	0.540
Akaike info criterion	-0.264	-0.200	-0.373	-0.902
Schwarz criterion	-0.198	-0.111	-0.283	-0.763
Hannan-Quinn criter.	-0.237	-0.164	-0.337	-0.845
Test				
LM Correlation test	298.30*	261.43*	143.45*	62.54*
P-Value	*[0.00]*	*[0.00]*	*[0.00]*	*[0.00]*
Heteroskedastic test (BPG)	4.66*	7.26*	6.06*	9.77*
P-Value	*[0.01]*	*[0.00]*	*[0.00]*	*[0.00]*
Residual Unit Root Test	**I(0)**	**I(0)**	**I(0)**	**I(0)**
ADF Test	-3.95*	-2.92**	-3.60*	-4.66*
P-Value	*[0.00]*	*[0.05]*	*[0.01]*	*[0.00]*

Note: *1%, **5%, ***10% Significance level

6.2 ARDL Bound Test

The lag length selection under the VAR model is used for the estimation of the ARDL model is in Table 6.2. The results of the ARDL Bound test are in Table 6.3-6.6. For the perfect expectation model, Table 6.3 shows that the Wald test is at 7.15 that is a 1% significance level. For the residual test, the residuals are not autocorrelated, have no heteroskedastic problem. The residuals are also under a stationary process. For CAPM, Table 6.4 shows that the Wald test is at 9.25 that is a 1% significance level. For the residual test, the residuals are not autocorrelated and have no heteroskedastic problem. The residuals are also under a stationary process. For ICAPM, Table 6.5 shows that the Wald test is at 2.95 that is a 10% significance level. For the residual test, the residuals are not autocorrelated and have no heteroskedastic problem. The residuals are also under a stationary process. For the APT model, Table 6.6 shows that the Wald test is at 4.06 that is a 1% significance level. For the residual test, the residuals are not autocorrelated and have no heteroskedastic problem. The residuals are also under a stationary process.

Therefore, the ARDL Bound test found that there were cointegrations under the perfect expectation model, CAPM, ICAPM and APT model and it is concluded that there are no bubbles in the Thailand stock market.

Table 6.2 Lag Length Criteria under VAR Model

	Lag criteria	LR	FPE	AIC	SC	HQ
Log Price to Dividend	5	5	5	5	1	1
Sustainable Growth	5	5	5	5	1	1
Rate of Return	4	4	4	4	1	1
10year Treasury Yield	1	4	6	6	1	1
Rate of Return-MSCI world	1	1	1	1	1	1
Equity return Volatility	2	2	2	2	2	2
VIX	1	1	2	2	1	1
SPREAD	2	2	2	2	1	2
Inflation Volatility	1	1	2	2	1	1

Table 6.3 ARDL Bound Testing for Thailand for Perfect Expectation Model

Variable	Perfect Expectation Model		
	Coefficient	**t-Statistic**	**P-Value**
Constant	**0.267***	2.62	0.01
Log Price-to-Dividend (t-1)	**-0.091***	-2.70	0.01
Sustainable Growth (t-1)	**0.001**	0.67	0.50
Rate of Return (t-1)	**0.010***	4.48	0.00
Δ Log Price-to-Dividend(t-1)	**-0.157**	-1.62	0.11
Δ Log Price-to-Dividend(t-2)	**0.106**	1.14	0.26
Δ Log Price-to-Dividend(t-3)	**0.166****	2.05	0.04
Δ Log Price-to-Dividend(t-4)	**0.073**	0.89	0.38
Δ Log Price-to-Dividend(t-5)	**0.014**	0.17	0.87
Δ Sustainable Growth(t)	**0.018***	5.57	0.00
Δ Sustainable Growth(t-1)	**0.004**	1.20	0.23
Δ Sustainable Growth(t-2)	**-0.000**	-0.13	0.90
Δ Sustainable Growth(t-3)	**-0.016***	-4.54	0.00
Δ Sustainable Growth(t-4)	**-0.008****	-2.05	0.04
Δ Sustainable Growth(t-5)	**0.005**	1.30	0.20
Δ Rate of Return (t)	**0.012***	16.04	0.00
Δ Rate of Return (t-1)	**0.003**	1.24	0.22
Δ Rate of Return (t-2)	**0.002**	0.86	0.39
Δ Rate of Return (t-3)	**-0.001**	-0.74	0.46
Δ Rate of Return (t-4)	**0.000**	0.05	0.96
R-squared	0.80		
Akaike info criterion	-3.19		
Schwarz criterion	-2.73		
Hannan-Quinn criter.	-3.00		
Test	t/F-Statistic	P-Value	
Wald Test (F-Value)	**7.15***		
LM Correlation test (F-Value)	1.82	0.17	
Heteroskedastic test- Breusch-Pagan-Godfrey (F-Value)	0.78	0.73	
Residual Unit Root Test	**I(0)**		
Augmented Dickey-Fuller Test	-10.84 *	0.00	

Note: *1%, **5%, ***10% Significance level

Table 6.4 ARDL Bound Testing for Thailand for CAPM Model

Variable	CAPM Coefficient	t-statistic	P-Value
Constant	**0.494***	2.95	0.00
Log Price-to-Dividend (t-1)	**-0.137****	-2.73	0.01
Sustainable Growth (t-1)	**-0.000**	-0.09	0.93
10 Year Treasury Yield (t-1)	**-0.013**	-1.32	0.19
World Market Rate of Return (t-1)	**0.014***	5.08	0.00
Δ Log Price-to-Dividend(t-1)	**-0.135**	-1.29	0.20
Δ Log Price-to-Dividend(t-2)	**0.012**	0.11	0.91
Δ Log Price-to-Dividend(t-3)	**-0.029**	-0.35	0.73
Δ Log Price-to-Dividend(t-4)	**0.109**	1.34	0.18
Δ Log Price-to-Dividend(t-5)	**-0.014**	-0.18	0.86
Δ Sustainable Growth(t)	**0.019***	3.69	0.00
Δ Sustainable Growth(t-1)	**0.005**	0.96	0.34
Δ Sustainable Growth(t-2)	**0.001**	0.20	0.84
Δ Sustainable Growth(t-3)	**-0.006**	-1.20	0.23
Δ Sustainable Growth(t-4)	**-0.008**	-1.57	0.12
Δ Sustainable Growth(t-5)	**0.007**	1.41	0.16
Δ 10 Year Treasury Yield (t)	**0.007**	0.34	0.74
Δ 10 Year Treasury Yield (t-1)	**-0.000**	-0.02	0.99
Δ World Market Rate of Return (t)	**0.011***	7.36	0.00
Δ World Market Rate of Return (t-1)	**-0.001**	-0.48	0.63
R-squared	0.55		
Akaike info criterion	-2.37		
Schwarz criterion	-1.92		
Hannan-Quinn criter.	-2.19		
Test	t/F-Statistic	P-Value	
Wald Test (F-Value)	**9.25***		
LM Correlation test	0.44	0.64	
Heteroskedastic test- Breusch-Pagan-Godfrey	1.05	0.41	
Residual Unit Root Test	**I(0)**		
Augmented Dickey-Fuller Test	-11.04*	0.00	

Note: *1%, **5%, ***10% Significance level

Table 6.5 ARDL Bound Testing for Thailand for ICAPM Model

	ICAPM		
Variable	**Coefficient**	**t-statistic**	**P-Value**
Constant	**0.637***	3.04	0.00
Log Price-to-Dividend (t-1)	**-0.157***	-2.53	0.01
Sustainable Growth (t-1)	**0.002**	0.54	0.59
10 Year Treasury Yield (t-1)	**-0.026****	-2.07	0.04
Equities Volatility (t-1)	**-0.001**	-1.26	0.21
Δ Log Price-to-Dividend(t-1)	**0.007**	0.06	0.95
Δ Log Price-to-Dividend(t-2)	**0.022**	0.19	0.85
Δ Log Price-to-Dividend(t-3)	**0.065**	0.62	0.54
Δ Log Price-to-Dividend(t-4)	**0.188*****	1.81	0.07
Δ Log Price-to-Dividend(t-5)	**-0.015**	-0.15	0.88
Δ Sustainable Growth(t)	**0.025***	3.69	0.00
Δ Sustainable Growth(t-1)	**-0.003**	-0.50	0.62
Δ Sustainable Growth(t-2)	**0.004**	0.63	0.53
Δ Sustainable Growth(t-3)	**-0.014****	-2.19	0.03
Δ Sustainable Growth(t-4)	**-0.010**	-1.63	0.11
Δ Sustainable Growth(t-5)	**-0.001**	-0.11	0.91
Δ 10 Year Treasury Yield (t)	**0.018**	0.71	0.48
Δ 10 Year Treasury Yield (t-1)	**0.002**	0.09	0.93
Δ Equities Volatility(t)	**-0.001**	-1.33	0.19
Δ Equities Volatility(t-1)	**0.001****	1.67	0.10
Δ Equities Volatility(t-2)	**0.000**	0.02	0.98
R-squared	0.32		
Akaike info criterion	-1.95		
Schwarz criterion	-1.47		
Hannan-Quinn criter.	-1.75		
Test	t/F-Statistic	P-Value	
Wald Test (F-Value)	**2.95*****		
LM Correlation test	2.80	0.07	
Heteroskedastic test- Breusch-Pagan-Godfrey	0.82	0.69	
Residual Unit Root Test	**I(0)**		
Augmented Dickey-Fuller Test	-11.35*	0.00	

Note: *1%, **5%, ***10% Significance level

Table 6.6 ARDL Bound Testing for Thailand for APT Model

	APT		
Variable	**Coefficient**	**t-statistic**	**P-Value**
Constant	**1.082***	4.40	0.00
Log Price-to-Dividend (t-1)	**-0.259***	-3.64	0.00
Sustainable Growth (t-1)	**-0.003**	-1.02	0.31
10 Year Treasury Yield (t-1)	**-0.025****	-1.98	0.05
VIX Index (t-1)	**-0.005****	-2.24	0.03
Emerging Market Spread (t-1)	**0.000**	0.51	0.61
Inflation Volatilities (t-1)	**-652.836**	-1.30	0.20
Δ Log Price-to-Dividend(t-1)	**-0.060**	-0.57	0.57
Δ Log Price-to-Dividend(t-2)	**0.006**	0.05	0.96
Δ Log Price-to-Dividend(t-3)	**-0.037**	-0.40	0.69
Δ Log Price-to-Dividend(t-4)	**0.187****	2.16	0.03
Δ Log Price-to-Dividend(t-5)	**-0.033**	-0.39	0.70
Δ Sustainable Growth(t)	**0.019***	3.48	0.00
Δ Sustainable Growth(t-1)	**0.005**	0.90	0.37
Δ Sustainable Growth(t-2)	**0.003**	0.50	0.62
Δ Sustainable Growth(t-3)	**-0.004**	-0.79	0.43
Δ Sustainable Growth(t-4)	**-0.008**	-1.44	0.15
Δ Sustainable Growth(t-5)	**0.004**	0.80	0.43
Δ Rf Rate(t)	**0.004**	0.19	0.85
Δ Rf Rate(t-1)	**0.018**	0.82	0.42
Δ VIX Index(t)	**-0.007***	-2.58	0.01
Δ VIX Index(t-1)	**-0.002**	-0.62	0.53
Δ Emerging Market Spread(t)	**-0.000030**	-0.09	0.93
Δ Emerging Market Spread(t-1)	**0.000204**	0.68	0.50
Δ Emerging Market Spread(t-2)	**-0.000003**	-0.01	0.99
Δ Inflation Volatilities (t)	**-315.439**	-0.84	0.41
Δ Inflation Volatilities (t-1)	**-430.634**	-0.96	0.34
R-squared	0.59		
Akaike info criterion	-2.31		
Schwarz criterion	-1.68		
Hannan-Quinn criter.	-2.06		
Test	t/F-Statistic	P-Value	
Wald Test (F-Value)	**4.06***		
LM Correlation test	1.35	0.26	
Heteroskedastic test-Breusch,Pagan,Godfrey	0.58	0.95	
Residual Unit Root Test	**I(0)**		
Augmented Dickey-Fuller Test	-10.50*	0.00	

Note: *1%, **5%, ***10% Significance level

6.3 Result Analysis and Summary

The summary of the Engle-Granger cointegration test and the ARDL Bound test are in Table 6.7. The results show cointegration between actual value of Log Price-to-Dividend ratio and their fundamental values under all four models including perfect expectation Model, CAPM, ICAPM and APT model. I can conclude that there are no bubble signs for the Thailand stock market during 2002-2012.

Table 6.7 Summary of Bubble Tests

	Perfect expectation Model	**CAPM**	**ICAPM**	**APT**
Engle-Granger Cointegration Test				
ADF Test	-3.95*	-2.92**	-3.60*	-4.66*
P-Value	*[0.00]*	*[0.05]*	*[0.01]*	*[0.00]*
Result	Cointegration	Cointegration	Cointegration	Cointegration
ARDL Bound Test				
Wald Test (F-Value)	7.15*	9.25*	2.95***	4.06*
Result	Cointegration	Cointegration	Cointegration	Cointegration

Note: *1%, **5%, ***10% Significance level

6.4 Discussion

The studies show that there is no bubble in Thailand. If I look at Figure 5.1, the Log of Price-to-Dividend Ratio is just above median at the end of 2012 and that is in line with the test. The limitation of the study is from the requirement of dividend data. The Southeast Asia market just recovered from the Asian financial crises during 1997; therefore, the dividend data dropped suddenly to an unusual level. After 2002, the economic recovery and financial status recovery supported dividend payment back to normal level, especially Thailand which faced the most severe financial crises in 1997. The requirement of dividend payments is important information in calculating the Log of Price-to-Dividend Ratio; therefore, the periods of study have been limited for the short period after the Asian crises.

An alternative study method is to use other relative valuation ratios. If I assume the earnings and operating cash flow are relatively stable to dividends. The earnings can be easily calculated and usually be positive but will be much more volatile during an economic cycle than dividends. The operating cash flow would be more representative of a relative valuation study, because of less volatility during the boom-bust cycle; however, the operating cash flow data may fluctuate from asset/liability increase/decrease that may not represent the asset price valuation. The model can be adjusted for price-to-earnings valuation from (3.18) as per the following:

$$(p_t - e_t) = K + \sum_{j=0}^{k} \rho^j (G_t - \theta^{j+1} E_t(R_t)) + B_t + C \qquad (6.1)$$

Where e_t = Log of Earnings E_t,

O_t is constant payout ratio; therefore, $D_t = E_t O_t$

$o_t = \log O_t = C$ = Constant value

The model can be adjusted for price-to-operating cashflow valuation from (3.18) as follows:

$$(p_t - cf_t) = K + \sum_{j=0}^{k} \rho^j (G_t - \theta^{j+1} E_t(R_t)) + B_t - Q \qquad (6.2)$$

Where cf_t = Log of Operating Cashflow CF_t,

Q_t is constant cashflow-to-dividend; therefore, $CF_t = D_t Q_t$,

$q_t = \log Q_t = Q$ = Constant value

Although there is no sign of asset bubble on the equity market indices, some individual stocks increased aggressively after 2008. The bubble test for the individual stocks would be interesting for further studies. There are many factors that cause the individual stocks to be traded at the different relative valuation from the equity market index.

6.4.1 Relative Valuation of Equities under CAPM

To measure an effect of rising equity market valuation, the relative term will reduce the effect. For securities i, relative price to market price is as follows:

$$(p_{i,t} - d_{i,t}) = K_i + \sum_{j=0}^{k} \rho_i^j [\, G_{i,t} - \theta^{j+1}(R_f + B_i(R_m - R_f))] + B_{i,t} \qquad (6.3)$$

$$(p_{m,t} - d_{m,t}) = K_m + \sum_{j=0}^{k} \rho_m^j [\, G_{m,t} - \theta^{j+1}(R_m))] + B_{m,t} \qquad (6.4)$$

Relative price (6.3) – (6.4)

$$(p_{i,t} - d_{i,t}) - (p_{m,t} - d_{m,t}) = (K_i - K_m) + (\sum_{j=0}^{k} \rho_i^j\, G_{i,t} - \sum_{j=0}^{k} \rho_m^j\, G_{m,t})$$

$$-[(\sum_{j=0}^{k} \rho_i^j \theta^{j+1}(R_f + B_i(R_m - R_f))$$

$$-(\sum_{j=0}^{k} \rho_m^j \theta^{j+1}(R_m))] + (B_{i,t} - B_{m,t}) \qquad (6.5)$$

6.4.2 Effect of Risk Free Rate on Relative Equity Valuation

Differentiate (6.5) by R_f, the result is as follows:

$$\frac{\partial \Delta(p_t - d_t)}{\partial R_f} = -\sum_{j=0}^{k} \rho_i^j \theta^{j+1}(1 - B_i) \qquad (6.6)$$

Therefore, $\frac{\partial \Delta(p_t - d_t)}{\partial R_f}$ is negative if $B_i < 1$ and positive if $B_i > 1$.

After 2008, the global central banks kept the short and long term interest rates at low levels with quantitative easing (QE) and under CAPM Model, the low beta stocks would get the benefits from a higher valuation relative to market under equation (6.6). Furthermore, the lower beta risk of the individual stocks will give the higher valuation relative to market under the equation (6.6). The strong rise of some sectors and stocks in Commerce, Telecom and Hospital sectors in many countries that are classified as defensive sectors could be partly explained under these methodologies and some further studies may be challenging to explore.

Lastly, there are other factors that affect Log of Price-dividend ratio including the liquidity effects or the change in shareholders benefit payments like treasury stocks. Those factors could be significantly affecting the valuation and further studies may help to clarify the possibility of asset bubbles.

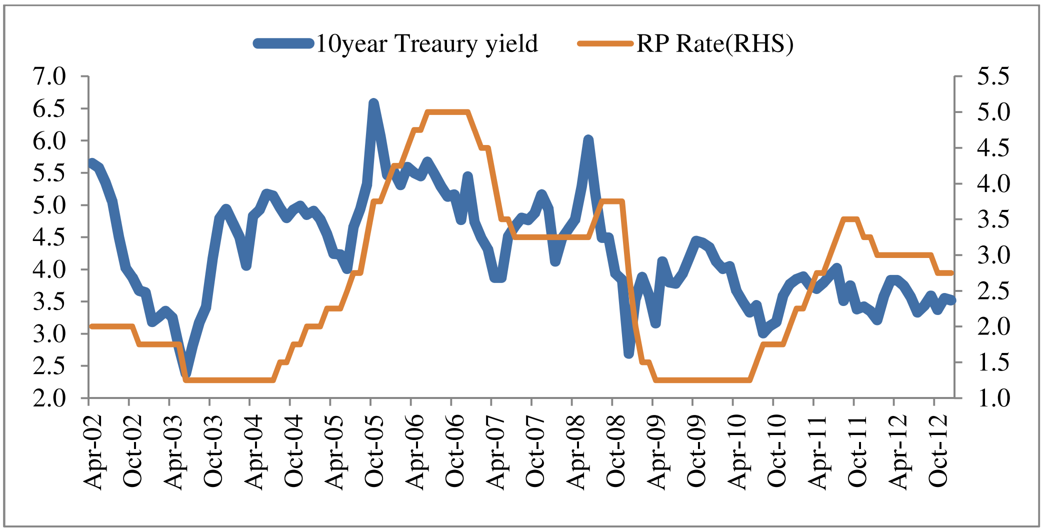

Figure 6.1 Thailand Policy Rate and Long-term Interest Rate

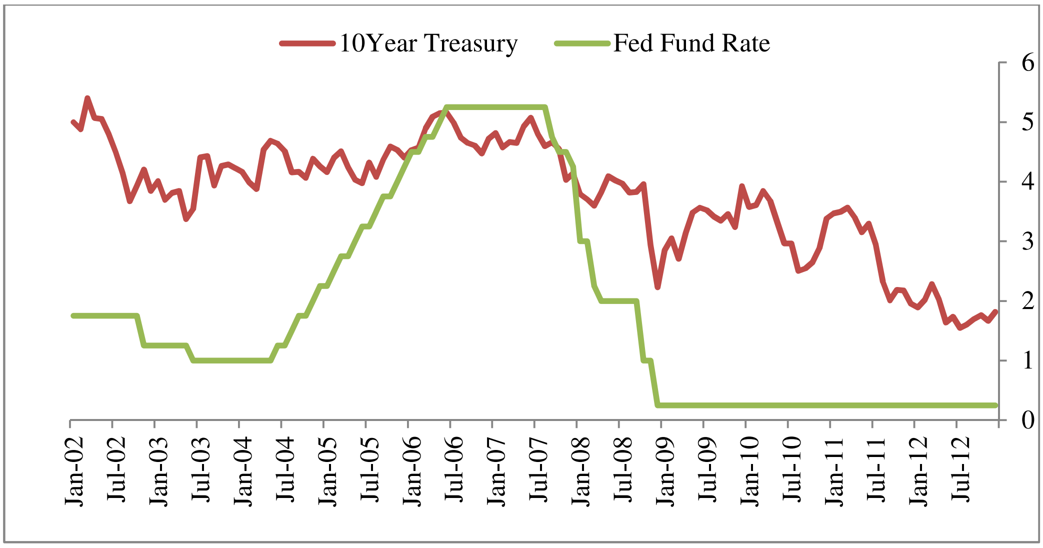

Figure 6.2 The United States of America's Policy Rate and Long-term Interest Rate

CHAPTER 7

EMPIRICAL STUDY OF THE EFFECT OF INVESTMENT RISKS ON ASSET PRICE VALUATION

7.1 Error Correction Model

The long term relationship between the log of price-to-dividend ratio and risk factors are in Table 7.1. Error Correction Model under ICAPM and APT model are in Table 7.2 and 7.3, respectively. For the long term relationship, the Wald tests under ARDL bound test are used for the study and it is found that there is cointegration between the actual log of price-to-dividend ratio under the ICAPM and APT model.

For the short term relationship, the Wald tests for short term variables are used for the study and it is found that there is a significant effect of equity return volatility on the actual log of price-to-dividend ratio under ICAPM and there is a significant effect of the VIX index on the actual log of price-to-dividend ratio under the APT model. However, the test found there are no effects of JP Morgan Emerging Market Spread and the inflation volatility on the actual log of price-to-dividend ratio under the APT model.

7.1.1 Long Term Relationship Between Investment Risks and Asset Prices

Table 7.4 summarizes the result of long term relationship between the log of price-to-dividend ratio and risk factors. For equity return volatility, the effect of equity return volatilities on Log Price-to-Dividend on average is -0.003. Table 7.5 shows the sensitivity of equity return volatilities on Price-to-Dividend. The increase of equity return volatilities by 20 will have negative effects on Price-to-Dividend by 6.22%.

Table 7.1 Long Term Relationship Between Risk Factors and Asset Prices

	ICAPM	APT Model
Coefficient		
Constant	**3.346***	**3.427***
t-Statistic	*(31.69)*	*(26.04)*
P-Value	[0.00]	[0.00]
Sustainable Growth	**0.021***	**0.007*****
t-Statistic	*(4.79)*	*(1.68)*
P-Value	[0.00]	[0.10]
Rate of Return		
t-Statistic		
P-Value		
10year Treasury Yield	**-0.043***	**-0.021**
t-Statistic	*(-1.78)*	*(-0.93)*
P-Value	[0.00]	[0.36]
Rate of Return-MSCI world		
t-Statistic		
P-Value		
Equity return Volatilities	**-0.003***	
t-Statistic	*(-3.64)*	
P-Value	[0.00]	
VIX		**-0.009***
t-Statistic		*(-3.13)*
P-Value		[0.00]
SPREAD		**0.00035****
t-Statistic		*(2.20)*
P-Value		[0.03]
Inflation Volatilities		**-3,255.2***
t-Statistic		*(5.62)*
P-Value		[0.00]
R-squared	0.248	0.540
Akaike info criterion	-0.373	-0.902
Schwarz criterion	-0.283	-0.763
Hannan-Quinn criter.	-0.337	-0.845
Test		
LM Correlation test	143.45*	62.54*
P-Value	*[0.00]*	*[0.00]*
Heteroskedastic test (BPG)	6.06*	9.77*
P-Value	*[0.00]*	*[0.00]*
Residual Unit Root Test	**I(0)**	**I(0)**
ADF Test	-3.60*	-4.66*
P-Value	*[0.01]*	*[0.00]*

Note: *1%, **5%, ***10% Significance level

Table 7.2 Error Correction Model under ICAPM

	ICAPM		
Variable	Coefficient	t-Statistic	P-Value
Constant	**-0.001**	-0.12	0.91
Error Correction Term(t-1)	**-0.156***	-2.63	0.01
Δ Log Price-to-Dividend(t-1)	**0.051**	0.49	0.63
Δ Log Price-to-Dividend(t-2)	**0.054**	0.52	0.61
Δ Log Price-to-Dividend(t-3)	**0.091**	0.93	0.36
Δ Log Price-to-Dividend(t-4)	**0.196****	2.07	0.04
Δ Log Price-to-Dividend(t-5)	**-0.019**	-0.21	0.83
Δ Sustainable Growth(t)	**0.026***	4.12	0.00
Δ Sustainable Growth(t-1)	**-0.005**	-0.71	0.48
Δ Sustainable Growth(t-2)	**0.004**	0.59	0.56
Δ Sustainable Growth(t-3)	**-0.015****	-2.39	0.02
Δ Sustainable Growth(t-4)	**-0.010**	-1.63	0.11
Δ Sustainable Growth(t-5)	**-0.000**	-0.06	0.95
Δ 10year Treasury Yield(t)	**0.024**	0.96	0.34
Δ 10year Treasury Yield(t-1)	**-0.011**	-0.44	0.66
Δ Equities Volatility(t)	**-0.001**	-1.36	0.18
Δ Equities Volatility(t-1)	**0.001**	1.58	0.12
Δ Equities Volatility(t-2)	**-0.0002**	-0.38	0.71
R-squared	0.29		
Akaike info criterion	-1.95		
Schwarz criterion	-1.54		
Hannan-Quinn criter.	-1.78		
Test	**t/F-Statistic**	**P-Value**	
Wald Test (Equity effect)	2.27***	0.08	
Wald Test (Long term)	2.95***		
LM Correlation test	3.10**	0.05	
Heteroskedastic test- Breusch-Pagan-Godfrey	0.86	0.63	
Residual Unit Root Test	**I(0)**		
Augmented Dickey-Fuller Test	-11.36*	0.00	

Note: *1%, **5%, ***10% Significance level

Table 7.3 Error Correction Model under APT Model

Variable	APT Coefficient	t-Statistic	P-Value
Constant	**-0.001**	-0.21	0.84
Error Correction Term(t-1)	**-0.269***	-4.08	0.00
Δ Log Price-to-Dividend(t-1)	**0.010**	0.10	0.92
Δ Log Price-to-Dividend(t-2)	**0.090**	0.95	0.34
Δ Log Price-to-Dividend(t-3)	**0.035**	0.42	0.67
Δ Log Price-to-Dividend(t-4)	**0.228***	2.95	0.00
Δ Log Price-to-Dividend(t-5)	**-0.001**	-0.02	0.99
Δ Sustainable Growth(t)	**0.022***	4.30	0.00
Δ Sustainable Growth(t-1)	**0.002**	0.40	0.69
Δ Sustainable Growth(t-2)	**0.000**	0.02	0.98
Δ Sustainable Growth(t-3)	**-0.006**	-1.22	0.23
Δ Sustainable Growth(t-4)	**-0.008**	-1.55	0.13
Δ Sustainable Growth(t-5)	**0.004**	0.72	0.48
Δ Rf Rate(t)	**0.009**	0.43	0.67
Δ Rf Rate(t-1)	**0.005**	0.23	0.82
Δ VIX Index(t)	**-0.007***	-2.61	0.01
Δ VIX Index(t-1)	**-0.003**	-1.26	0.21
Δ Emerging Market Spread(t)	**0.000**	0.07	0.94
Δ Emerging Market Spread(t-1)	**0.000**	0.80	0.42
Δ Emerging Market Spread(t-2)	**-0.000**	-0.17	0.87
Δ Inflation Volatility(t)	**-360.70**	-1.00	0.32
Δ Inflation Volatility(t-1)	**-316.02**	-0.79	0.43
R-squared	0.55		
Akaike info criterion	-2.32		
Schwarz criterion	-1.81		
Hannan-Quinn criter.	-2.11		
Test	**t/F-Statistic**	**P-Value**	
Wald Test (VIX effect)	3.98**	0.02	
Wald Test (Spread effect)	0.23	0.88	
Wald Test (Inflation Volatility effect)	0.59	0.56	
Wald Test (Long term)	4.06*		
LM Correlation test	1.92	0.15	
Heteroskedastic test- Breusch-Pagan-Godfrey	0.61	0.90	
Residual Unit Root Test	**I(0)**		
Augmented Dickey-Fuller Test	-10.37*	0.00	

Note: *1%, **5%, ***10% Significance level

For inflation volatilities, the effect of inflation volatilities on Log Price-to-Dividend on average is -3,255.2 in Table 7.4. Table 7.5 shows the sensitivity of inflation volatilities on Price-to-Dividend, the increase of inflation volatilities by 0.00002 will have a negative effect on Price-to-Dividend by 6.30%.

For VIX Index, the effect of VIX Index on Log Price-to-Dividend on average is -0.009 in Table 7.4. Table 7.5 shows the sensitivity of VIX Index on Price-to-Dividend, the increase of VIX Index by 10 will have negative effect on Log Price-to-Dividend by 8.87%.

For JP Morgan Emerging Market Spread, the effect of spread on Log Price-to-Dividend on average is 0.00035. The spread has a positive effect that is contradicted by the APT theory because there could be other factors including the United States of America's long term treasury yield to explain the conflict relationships.

Table 7.4 Long Term Relationship of Risk on Equity valuation

Y = Log Price-to-Dividend	Equity return Volatility	VIX	Emerging Market Spread	Inflation Volatility
Coefficient Value	-0.003*	-0.009*	0.00035**	-3,255.2*

Note: *1%, **5%, ***10% Significance level

Table 7.5 Long Term Relationship of Risk on Equity valuation

	% Δ Price-to-Dividend
Equity return Volatility	
$\Delta = 20$	-6.22%
VIX Index	
$\Delta = 10$	-8.87%
JP Morgan Emerging Market Spread	
$\Delta = 150$	5.31%
Inflation Volatility	
$\Delta = 0.00002$	-6.30%

7.1.2 Short Term Relationship Between Investment Risks and Asset Prices

For the error correction model under ICAPM, the Wald test on coefficients of differentials of equity return volatilities found the F-value is 2.27 and has a significant effect on differentials of Log Price-to-Dividend ratios. Therefore, there is a short term effect of equity return volatilities on Log Price-to-Dividend ratios.

For the error correction model under APT, VIX Index change has a significant effect on differentials of Log Price-to-Dividend ratio with F-Value at 3.98; however, differentials of other risk factors including JP Morgan Emerging Market Spread and inflation volatilities have no effect on differentials of Log Price-to-Dividend ratios. Therefore, there is only short term effect of the VIX Index on Log Price-to-Dividend ratios.

Table 7.6 Short term Effect of Risk on Equity valuation

	F-Value	P-Value
ICAPM Model		
Equity return Volatility	2.27**	0.08
APT Model		
VIX Index	3.98**	0.02
Emerging Market Spread	0.23	0.88
Inflation Volatility	0.59	0.56

Note: *1%, **5%, ***10% Significance level

7.2 Result Analysis and Summary

For the long term effects of risk factors on asset prices, I found significant effects from equity return volatilities, inflation volatilities, VIX index and JP Morgan Emerging Market Spread from the ARDL bound test.

For effect calibration, the effect of equity return volatilities on Log Price-to-Dividend on average is -0.003, or the increase of equity return volatilities by 20 will have a negative effect on Price-to-Dividend by 6.22%. For inflation volatilities, the effect of inflation volatilities on Log Price-to-Dividend on average is -3,255.2 or the increase of inflation volatilities by 0.00002 will have a negative effect on Price-to-Dividend by 6.30%. For VIX Index, the effect of VIX Index on Log Price-to-Dividend on average is -0.009 or the increase of VIX Index by 10 will have a negative effect on Price-to-Dividend by 8.87%. For JP Morgan Emerging Market Spread, the effect of spread on Log Price-to-Dividend on average is 0.0003 which is contradictory to the APT theory because there could be other factors including the United States of America's long term treasury yield to explain the conflict relationships.

For the short term effect, the change of equity return volatilities have the significant effect on differentials of Log Price-to-Dividend ratio and VIX Index change also has a significant effect on differentials of Log Price-to-Dividend ratio; however, differentials of other risk factors including JP Morgan Emerging Market Spread and inflation volatilities have no effects on differentials of Log Price-to-Dividend ratio.

7.3 Discussion

The study shows that asset prices rely on their own equity return volatilities, other market volatilities and macroeconomic volatilities; therefore, the financial and macro volatilities play the important role on asset price valuation.

The limitation of the study is from the requirement of dividend data. Thailand just recovered from Asian financial crises during 1997; therefore, the dividend data dropped suddenly to unusual levels until the recovery. The short period of study may not represent the most concrete result. For example, the positive effect of Emerging Market spread would come from the short period of the study and major rising the United States of America's bond yield which caused the lower Emerging Market spread during 2003-2006 would be the reason for an unconnected relationship between asset prices and Emerging Market spread.

Further study is needed on the mutual relationship between volatilities and asset price valuation. Under the high asset price valuation in a bubble situation, it is likely to cause high financial and macro volatilities and negative effects on the economy at some future time.

CHAPTER 8

EMPIRICAL STUDY OF THE EFFECT OF THE ROLE OF MONETARY POLICY ON ASSET PRICE VALUATION

8.1 Monetary Policy Transmission Studies

8.1.1 Policy rate on monetary transmission

The VAR model is used to study the effect of the Bank of Thailand's policy rate (RP rate) on monetary transmissions. The effect of RP rate on money supply under money demand and supply model is from the Granger causality and impulse response function. For the VAR estimation, lag length criteria is at seven lag in Table 8.1. The result of VAR model is in Table 8.2.

Under the Granger causality test and impulse response function in Table 8.3 and Figure 8.1 respectively, the result indicates that the RP rate has a significantly negative effect on money supply that conforms to the money demand and supply model.

Table 8.1 Lag Length Criteria under VAR Model between Money Supply and Policy Rate

Lag	LR	FPE	AIC	SC	HQ
0	NA	0.00	0.57	0.64	0.60
1	992.87	0.00	-7.99	-7.71	-7.87
2	56.56	0.00	-8.35	-7.85*	-8.15
3	28.53	0.00	-8.46	-7.75	-8.17*
4	16.25	0.00	-8.46	-7.54	-8.09
5	13.92	0.00	-8.44	-7.32	-7.99
6	6.99	0.00	-8.36	-7.02	-7.82
7	29.16	4.08e-08*	-8.51*	-6.96	-7.88
8	9.58	0.00	-8.46	-6.70	-7.75
9	6.28	0.00	-8.38	-6.41	-7.58
10	5.88	0.00	-8.30	-6.11	-7.41
11	18.18*	0.00	-8.36	-5.97	-7.39

Table 8.2 VAR Model between Money Supply and Policy Rate

	Log of Real Money Supply	Log of Industrial Production Index	RP Rate
Log of Real Money Supply (-1)	**0.506**	**0.035**	**-1.078**
t-statistic	*[5.44]*	*[0.12]*	*[-1.26]*
Log of Real Money Supply (-2)	**0.085**	**-0.007**	**0.428**
t-statistic	*[0.84]*	*[-0.02]*	*[0.46]*
Log of Real Money Supply (-3)	**0.277**	**-0.047**	**0.759**
t-statistic	*[2.78]*	*[-0.15]*	*[0.83]*
Log of Real Money Supply (-4)	**-0.108**	**-0.269**	**-1.323**
t-statistic	*[-1.04]*	*[-0.84]*	*[-1.40]*
Log of Real Money Supply (-5)	**0.224**	**0.011**	**0.069**
t-statistic	*[2.24]*	*[0.03]*	*[0.07]*
Log of Real Money Supply (-6)	**-0.187**	**0.161**	**0.981**
t-statistic	*[-1.90]*	*[0.53]*	*[1.09]*
Log of Real Money Supply (-7)	**0.203**	**0.173**	**0.223**
t-statistic	*[2.27]*	*[0.62]*	*[0.27]*
Log of Industrial Production (-1)	**0.009**	**1.056**	**0.284**
t-statistic	*[0.26]*	*[10.19]*	*[0.93]*
Log of Industrial Production (-2)	**0.025**	**-0.602**	**-0.198**
t-statistic	*[0.52]*	*[-4.01]*	*[-0.45]*
Log of Industrial Production (-3)	**-0.006**	**0.465**	**-0.020**
t-statistic	*[-0.11]*	*[2.95]*	*[-0.04]*
Log of Industrial Production (-4)	**0.010**	**-0.292**	**0.007**
t-statistic	*[0.19]*	*[-1.81]*	*[0.02]*
Log of Industrial Production (-5)	**-0.004**	**0.229**	**-0.223**
t-statistic	*[-0.08]*	*[1.45]*	*[-0.48]*
Log of Industrial Production (-6)	**-0.028**	**-0.048**	**0.269**
t-statistic	*[-0.58]*	*[-0.32]*	*[0.62]*
Log of Industrial Production (-7)	**-0.001**	**0.072**	**-0.133**
t-statistic	*[-0.04]*	*[0.73]*	*[-0.46]*
RP Rate (-1)	**-0.013**	**0.030**	**1.297**
t-statistic	*[-1.19]*	*[0.86]*	*[12.57]*
RP Rate (-2)	**0.009**	**-0.002**	**-0.183**
t-statistic	*[0.52]*	*[-0.04]*	*[-1.13]*
RP Rate (-3)	**-0.009**	**-0.055**	**0.040**
t-statistic	*[-0.53]*	*[-0.99]*	*[0.25]*

Table 8.2 (Continued)

	Log of Real Money Supply	Log of Industrial Production Index	RP Rate
RP Rate (-4)	**-0.008**	**-0.029**	**-0.177**
t-statistic	*[-0.47]*	*[-0.51]*	*[-1.08]*
RP Rate (-5)	**-0.006**	**0.067**	**-0.216**
t-statistic	*[-0.35]*	*[1.20]*	*[-1.32]*
RP Rate (-6)	**0.065**	**-0.059**	**0.382**
t-statistic	*[3.58]*	*[-1.04]*	*[2.29]*
RP Rate (-7)	**-0.043**	**0.047**	**-0.183**
t-statistic	*[-3.73]*	*[1.33]*	*[-1.74]*
Constant	**0.004**	**0.562**	**0.195**
t-statistic	*[0.043]*	*[1.99]*	*[0.23]*
R-squared	0.99	0.89	0.98
Adj. R-squared	0.99	0.86	0.98
Sum sq. resids	0.03	0.32	2.77
S.E. equation	0.02	0.06	0.17
F-statistic	424.39	37.31	279.38
Log likelihood	327.91	189.73	57.75
Akaike AIC	-5.01	-2.75	-0.59
Schwarz SC	-4.51	-2.24	-0.08
Mean dependent	-0.22	4.52	2.62
S.D. dependent	0.16	0.15	1.17
Determinant resid covariance (dof adj.)		0.00	
Determinant resid covariance		0.00	
Log likelihood		584.49	
Akaike information criterion		-8.50	
Schwarz criterion		-6.98	

Table 8.3 Granger Causality Test between Money Supply and Policy Rate

Dependent variable: Log of Real Money Supply		
	Chi-sq	Prob.
Log of Industrial Production Index	3.14	0.87
RP Rate	**29.31***	**0.00**
Dependent variable: Log of Industrial Production Index		
Log of Real Money Supply	2.52	0.93
RP Rate	8.66	0.28
Dependent variable: RP Rate		
Log of Real Money Supply	5.90	0.55
Log of Industrial Production Index	1.68	0.98

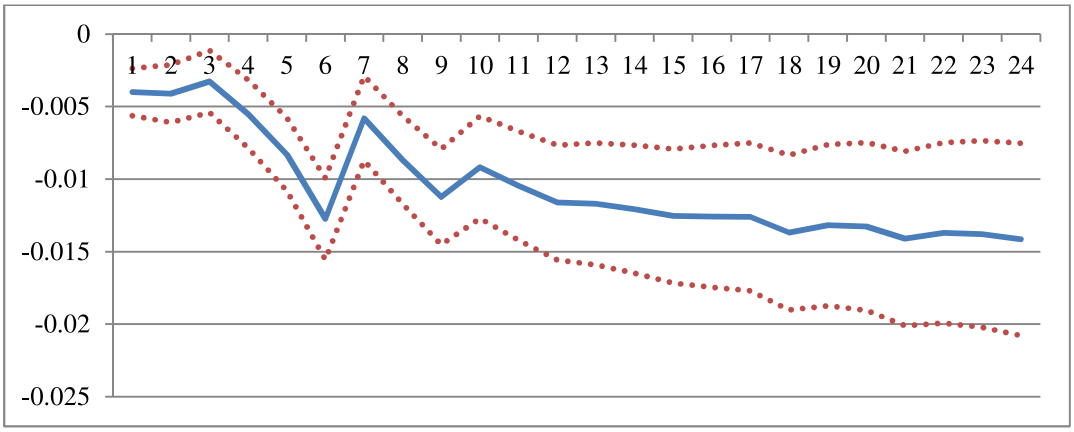

Figure 8.1 Generalized Impulse Response of Money Supply from Policy Rate

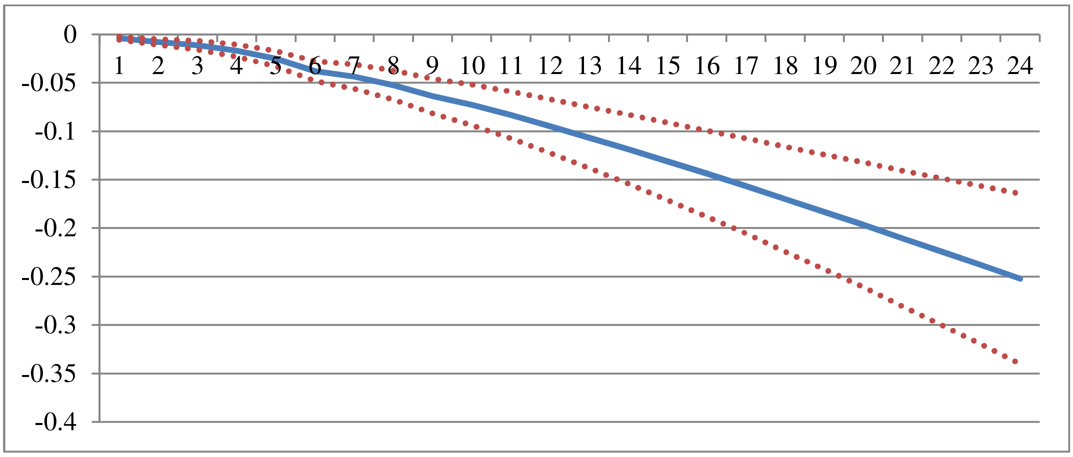

Figure 8.2 Generalized Accumulated Impulse Response of Money Supply from Policy Rate

The VAR model is used to study the effect of Bank of Thailand's policy rate (RP rate) on monetary transmissions. The effect of RP rate on deposit rates in monetary transmissions is from the Granger causality and impulse response function. For VAR estimation, lag length criteria is at four lag in Table 8.4. The result of VAR model is in Table 8.5.

Under the Granger causality test and impulse response function in Table 8.6 and Figure 8.3, respectively, the result indicates that RP rate has a positive Granger causality effect on the deposit rate. The RP rate will have a positive effect up to eight months before a declining impact on deposit rates in Figure 8.3.

Table 8.4 Lag Length Criteria under VAR Model between Deposit Rate and Policy Rate

Lag	LR	FPE	AIC	SC	HQ
0	NA	0.14	3.68	3.73	3.70
1	640.23	0.00	-1.82	-1.68	-1.76
2	43.42	0.00	-2.13	-1.90*	-2.04*
3	6.38	0.00	-2.12	-1.79	-1.99
4	12.14*	0.00039*	-2.16*	-1.74	-1.99
5	3.08	0.00	-2.13	-1.61	-1.92
6	7.81	0.00	-2.13	-1.52	-1.89
7	5.04	0.00	-2.11	-1.41	-1.83
8	5.61	0.00	-2.10	-1.30	-1.78
9	3.28	0.00	-2.07	-1.18	-1.71
10	2.42	0.00	-2.03	-1.04	-1.62
11	1.90	0.00	-1.98	-0.90	-1.54

Table 8.5 VAR Model between Deposit Rate and Policy Rate

	RP Rate	Deposit Rate
RP Rate (-1)	**0.939**	**0.013**
t-statistic	*[7.58]*	*[0.09]*
RP Rate (-2)	**0.095**	**-0.031**
t-statistic	*[0.56]*	*[-0.16]*
RP Rate (-3)	**0.129**	**0.300**
t-statistic	*[0.76]*	*[1.60]*
RP Rate (-4)	**-0.160**	**-0.199**
t-statistic	*[-1.43]*	*[-1.59]*
Deposit Rate(-1)	**0.433**	**1.189**
t-statistic	*[3.96]*	*[9.79]*
Deposit Rate(-2)	**-0.388**	**-0.189**
t-statistic	*[-2.58]*	*[-1.13]*
Deposit Rate(-3)	**-0.022**	**0.009**
t-statistic	*[-0.14]*	*[0.05]*
Deposit Rate(-4)	**-0.076**	**-0.144**
t-statistic	*[-0.66]*	*[-1.13]*
Constant	**0.105**	**0.050**
t-statistic	*[2.94]*	*[1.27]*
R-squared	0.984	0.972
Adj. R-squared	0.98	0.97
Sum sq. resids	2.68	3.29
S.E. equation	0.15	0.17
F-statistic	889.593	496.455
Log likelihood	62.86	49.89
Akaike AIC	-0.86	-0.65
Schwarz SC	-0.66	-0.45
Mean dependent	2.600	1.975
S.D. dependent	1.16	0.97
Determinant resid covariance (dof adj.)		0.00
Determinant resid covariance		0.000
Log likelihood		148.98
Akaike information criterion		-2.10
Schwarz criterion		-1.69

Table 8.6 Granger Causality Test between Deposit Rate and Policy Rate

	Chi-sq	Prob.
Dependent variable: RP Rate		
	Chi-sq	Prob.
Deposit Rate	**21.96***	**0.00**
Dependent variable: Deposit Rate		
	Chi-sq	Prob.
RP Rate	**9.36****	**0.05**

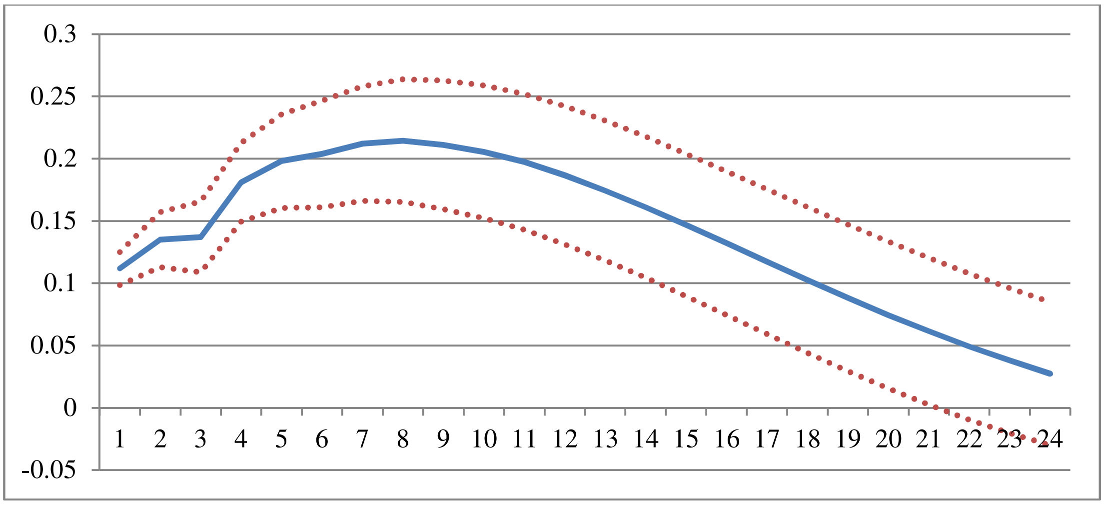

Figure 8.3 Generalized Impulse Response of Deposit Rate from Policy Rate

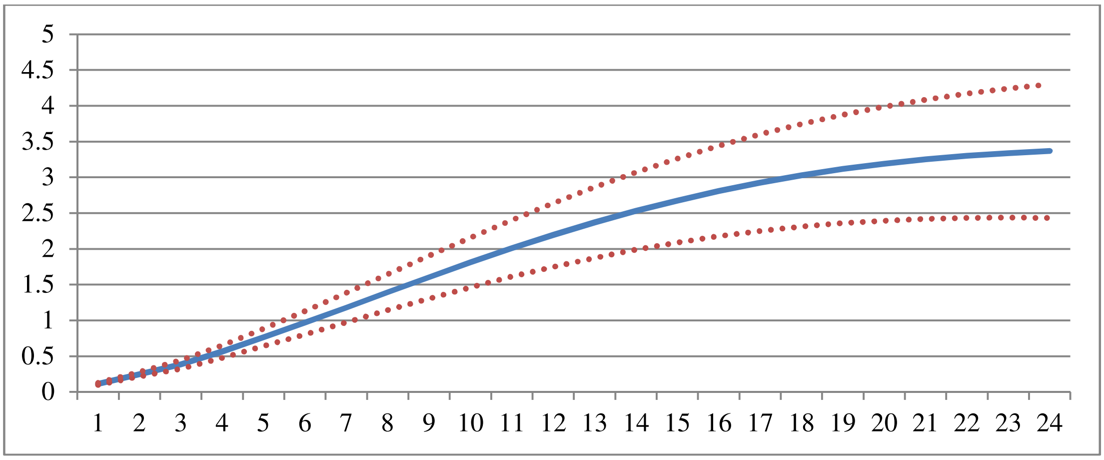

Figure 8.4 Generalized Accumulated Impulse Response of Deposit Rate from Policy Rate

VAR model is used to study the effect of Bank of Thailand's policy rate (RP rate) on the monetary transmission. The effect RP rate on lending rate (MLR rate) on monetary transmission is from Granger causality and impulse response function. For VAR estimation, lag length criteria is at six lag in Table 8.7. The result of VAR model is in Table 8.8.

The Granger causality test and impulse response function are in Table 8.9 and Figure 8.5, respectively, the result indicates that RP rate has a positive Granger causality effect on lending rates. The RP rate will have a positive effect up to four months before a declining impact on lending rates in Figure 8.5.

Table 8.7 Lag Length Criteria under VAR Model under MLR Rate and Policy Rate

Lag	LR	FPE	AIC	SC	HQ
0	NA	0.15	3.78	3.83	3.80
1	741.60	0.00	-2.60	-2.46	-2.54
2	32.24	0.00	-2.82	**-2.58***	**-2.72***
3	2.63	0.00	-2.77	-2.45	-2.64
4	11.95	0.00	-2.82	-2.39	-2.64
5	3.19	0.00	-2.78	-2.26	-2.57
6	**13.48***	**0.0002***	**-2.84***	-2.23	-2.59
7	6.96	0.00	-2.84	-2.13	-2.55
8	2.87	0.00	-2.80	-2.00	-2.47
9	1.82	0.00	-2.75	-1.86	-2.39
10	2.38	0.00	-2.71	-1.72	-2.31
11	3.49	0.00	-2.67	-1.59	-2.24

Table 8.8 VAR Model Between MLR Rate and Policy Rate

	MLR Rate	**RP Rate**
MLR Rate(-1)	**1.154**	**0.509**
t-statistic	*[10.08]*	*[3.24]*
MLR Rate(-2)	**-0.309**	**-0.503**
t-statistic	*[-1.93]*	*[-2.28]*
MLR Rate(-3)	**0.229**	**0.186**
t-statistic	*[1.42]*	*[0.84]*
MLR Rate(-4)	**-0.156**	**-0.289**
t-statistic	*[-0.98]*	*[-1.32]*
MLR Rate(-5)	**0.280**	**0.384**
t-statistic	*[1.75]*	*[1.75]*
MLR Rate(-6)	**-0.314**	**-0.434**
t-statistic	*[-2.66]*	*[-2.68]*
RP Rate(-1)	**0.098**	**1.028**
t-statistic	*[1.19]*	*[9.06]*
RP Rate(-2)	**-0.048**	**-0.033**
t-statistic	*[-0.42]*	*[-0.21]*
RP Rate(-3)	**0.135**	**0.101**
t-statistic	*[1.16]*	*[0.63]*
RP Rate(-4)	**-0.297**	**-0.240**
t-statistic	*[-2.53]*	*[-1.50]*
RP Rate(-5)	**0.029**	**-0.153**
t-statistic	*[0.25]*	*[-0.95]*
RP Rate(-6)	**0.131**	**0.313**
t-statistic	*[1.65]*	*[2.86]*
Constant	**0.634**	**0.923**
t-statistic	*[3.43]*	*[3.64]*
R-squared	0.976	0.985
Adj. R-squared	0.97	0.98
Sum sq. resids	1.30	2.45
S.E. equation	0.11	0.15
F-statistic	375.263	611.028
Log likelihood	105.35	66.22
Akaike AIC	-1.50	-0.87
Schwarz SC	-1.20	-0.57
Mean dependent	6.524	2.611
S.D. dependent	0.67	1.17

Table 8.8 (Continued)

	MLR Rate	RP Rate
Determinant resid covariance (dof adj.)		0.00
Determinant resid covariance		0.000
Log likelihood		195.80
Akaike information criterion		-2.76
Schwarz criterion		-2.17
S.D. dependent	0.67	1.17
Determinant resid covariance (dof adj.)		0.00
Determinant resid covariance		0.000
Log likelihood		204.13
Akaike information criterion		-2.85
Schwarz criterion		-2.17

Table 8.9 Granger Causality Test between MLR Rate and Policy Rate

Dependent variable: MLR Rate		
	Chi-sq	Prob.
RP Rate	**16.69***	**0.01**
Dependent variable: RP Rate		
	Chi-sq	Prob.
MLR Rate	**29.56***	**0.00**

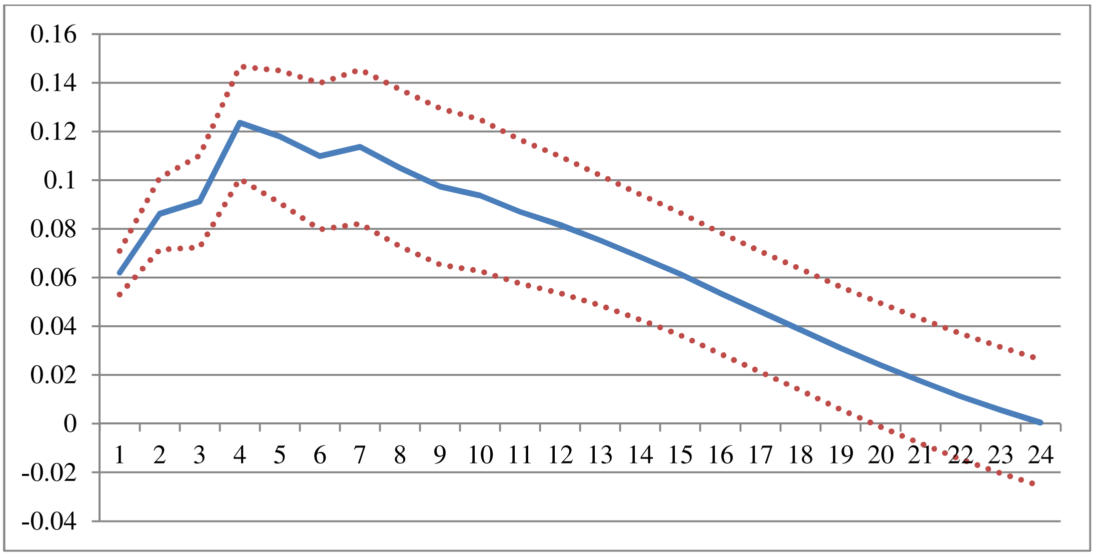

Figure 8.5 Generalized Impulse Response of MLR Rate from Policy Rate

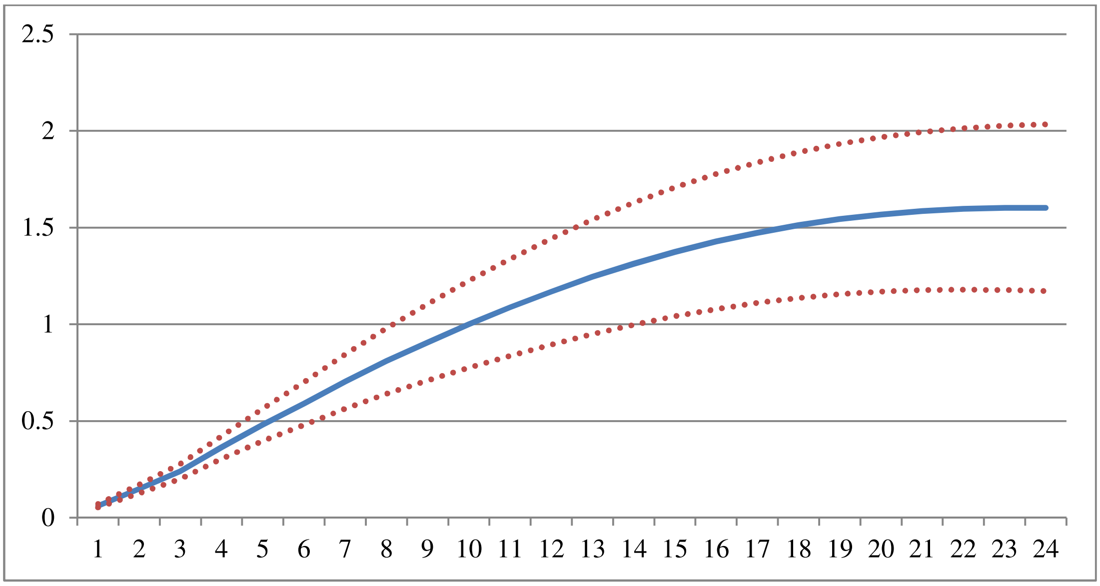

Figure 8.6 Generalized Accumulated Impulse Response of MLR Rate from Policy Rate

8.1.2 Monetary Policy Transmission on Bond Market Interest Rate

The VAR model is used to study the effect of the Bank of Thailand's policy rate (RP rate) on bond market rates. The effect of RP rates on short term treasury yields on monetary transmission is from Granger causality test and impulse response functions. For VAR estimation, lag length criteria is at two and three for one year treasury yield and three month treasury yield in Table 8.10 under optimal selection criteria from FPE, AIC, SC and HQ. The result of VAR model between RP rate and bond market rate is in Table 8.11. Granger causality test and impulse response function are in Table 8.12 and Figure 8.7 and Figure 8.8, respectively. The result indicates that RP rate has a Granger causality effect on one year treasury yields with Chi-square at 12.71 that is significant at a 1% significance level. But there is no effect of RP rate on three month treasury yield with Chi-square at 3.47 which is insignificant. For impulse response function, The RP rate has positive effects on one year and three month treasury yields.

For money supply, VAR model is used to study the effect of real money supply on the bond market rate. The effect of money supply on short term treasury yields on monetary transmission is from Granger causality test and impulse response functions. For VAR estimation, lag length criteria is at three for both one year treasury yield and three month treasury yield in Table 8.13 under optimal selection criteria from FPE, AIC, SC and HQ. The result of VAR model between money supply and bond market rate is in Table 8.14. Granger causality test and impulse response function are in Table 8.15 and Figure 8.9 and Figure 8.10, respectively. The result indicates that real money supply has no Granger causality on one year treasury yield and three month treasury yield with Chi-square at 0.97 and 4.46, respectively. For impulse response function, the real money supply has negative effects on one year and three month treasury yields for the first six months and the negative effect diminishes after six months.

For deposit rate, VAR model is used to study the effect of deposit rates on the bond market rates. The effect deposit rate on short term treasury yields on monetary transmission is from Granger causality and impulse response function. For VAR estimation, lag length criteria is at four and three for one year treasury yield and three month treasury yield in Table 8.16 under optimal selection criteria from FPE, AIC, SC and HQ. The result of VAR model between deposit rate and bond market rate is in Table 8.17. Granger causality test and impulse response function are in Table 8.18 and Figure 8.11 and Figure 8.12, respectively. The result indicates that deposit rate has Granger caused an effect on one year treasury yield with Chi-square at 9.79 that is significant at a 5% significance level and there is an effect of deposit rates on three month treasury yield with Chi-square at 9.80 that is significant at a 5% significance level. For impulse response function, the deposit rate has positive effects on one year and three month treasury yields and the effect started to decline after four months.

For lending rate, VAR model is used to study the effect of lending rates on the bond market rates. The effect of lending rates on short term treasury yields on monetary transmission is from Granger causality and impulse response function. For VAR estimation, lag length criteria is at six and three for one year treasury yield and three month treasury yield in Table 8.19 under optimal selection criteria from FPE, AIC, SC and HQ. The result of VAR model between lending rates and bond market rates is in Table 8.20. Granger causality test and impulse response function are in Table 8.21 and Figure 8.13 and Figure 8.14, respectively. The result indicates that lending rate has a Granger causality effect on one year treasury yield with Chi-square at 12.37 that is significant at a 5% significance level and there is the effect of lending rates on three month treasury yield with Chi-square at 11.10 that is significant at a 1% significance level. For impulse response function, the lending rate has positive effects on one year and three month treasury yields and the effect started to decline after four months.

8.1.3 Monetary Policy Transmission Discussion

The results show that policy rate has a significant effect on market interest rate, deposit and lending rates and other monetary channels including money supply; therefore, BOT's monetary policy is effective to use as a policy rate on money transmission effect and BOT also use monetary tools to manage liquidity adjusted along with BOT policy rate.

For banking interest rate effects on deposit rates and lending rates, the effect of policy rate causes changes in deposit and lending rates. A lower deposit rate and lending rate also cause a lower bond market. The Banking system is still playing important role in the saving and borrowing by investors in the Thai financial markets.

For liquidity effect, the real money supply has a temporary negative effect on bond market interest rate from impulse response function; nevertheless, for a permanent effect, there is no significant effect on bond market interest rates from the Granger causality test. Therefore, the money supply has no permanent effect on bond market interest rates because BOT uses the liquidity management to support the effectiveness of policy rates to meet BOT objectives. If there is a shock to increase real money supply; for example, a huge capital inflow, BOT will sterilize the money supply eventually to mitigate the effect on market interest rates and the economy. The expectation of the market is confidence that BOT will control any shock of liquidity like capital inflows and outflows to affect the financial markets overall. The BOT will use monetary tools to manage liquidity to support BOT policy rates and objectives. Therefore, there is the effectiveness of BOT monetary policy to manage liquidity to ensure that the policy rate plays an important role on monetary transmissions, although the shock of money supply will cause temporary effects on the bond market but not have any permanent effect.

For the study monetary policy transmission, I can conclude that the policy rate, deposit rate and lending rate will have an effect on the bond market rate and can be used as a proxy to study the effect of monetary policy on asset prices; however, the real money supply as a liquidity effect has no effect on bond market rates and the real money supply should not be used as proxy of risk free rates to study the effect of monetary policy on asset prices.

Table 8.10 Lag Length Criteria under VAR Model between Policy Rate on Bond Market Rate

Lag	LR	FPE	AIC	SC	HQ
One year treasury yield					
0	-195.83	NA	0.10	3.35	3.40
1	123.98	623.36	0.00	-2.00	**-1.86***
2	128.13	7.95	**0.0004***	**-2.00***	-1.77
3	129.59	2.75	0.00	-1.96	-1.63
4	130.42	1.53	0.00	-1.91	-1.48
5	133.43	5.47	0.00	-1.89	-1.37
6	141.60	14.54	0.00	-1.96	-1.35
7	146.14	7.92	0.00	-1.97	-1.26
8	149.09	5.04	0.00	-1.95	-1.15
9	150.61	2.56	0.00	-1.91	-1.02
10	152.79	3.57	0.00	-1.88	-0.89
11	159.39	**10.63***	0.00	-1.92	-0.84
Three month treasury yield					
0	-119.66	NA	0.03	2.06	2.11
1	133.63	493.70	0.00	-2.16	-2.02
2	150.64	32.57	0.00	-2.38	**-2.15***
3	157.52	**12.94***	**0.0003***	**-2.43***	-2.10
4	159.01	2.77	0.00	-2.39	-1.97
5	160.50	2.70	0.00	-2.35	-1.83
6	164.43	6.99	0.00	-2.35	-1.74
7	169.37	8.62	0.00	-2.36	-1.66
8	170.46	1.87	0.00	-2.31	-1.51
9	172.37	3.20	0.00	-2.28	-1.39
10	172.77	0.66	0.00	-2.22	-1.23
11	174.54	2.85	0.00	-2.18	-1.10

Table 8.11 VAR Model between Policy Rate and Bond Market Rate

	ONE YEAR YIELD	RP RATE
ONE YEAR YIELD(t-1)	**1.186**	**0.429**
t-statistic	*[10.95]*	*[5.85]*
ONE YEAR YIELD(t-2)	**0.026**	**0.122**
t-statistic	*[0.20]*	*[1.35]*
RP RATE(t-1)	**0.022**	**0.597**
t-statistic	*[0.13]*	*[5.46]*
RP RATE(t-2)	**-0.262**	**-0.139**
t-statistic	*[-2.19]*	*[-1.72]*
Constant	**0.049**	**-0.085**
t-statistic	*[1.05]*	*[-2.68]*
R-squared	0.973	0.988
Adj. R-squared	0.97	0.99
Sum sq. resids	4.38	2.01
S.E. equation	0.19	0.13
F-statistic	1,087.421	2,515.939
Log likelihood	33.58	83.20
Akaike AIC	-0.45	-1.23
Schwarz SC	-0.34	-1.12
Mean dependent	2.717	2.592
S.D. dependent	1.13	1.15
Determinant resid covariance (dof adj.)		0.00
Determinant resid covariance		0.000
Log likelihood		141.78
Akaike information criterion		-2.08
Schwarz criterion		-1.85

Table 8.11 (Continued)

	RP RATE	THREE MONTHS YIELD
RP RATE(-1)	**0.698**	**0.262**
t-statistic	*[5.39]*	*[1.74]*
RP RATE(-2)	**-0.154**	**-0.045**
t-statistic	*[-1.05]*	*[-0.27]*
RP RATE(-3)	**0.119**	**-0.046**
t-statistic	*[1.06]*	*[-0.36]*
THREE MONTHS YIELD(-1)	**0.625**	**1.142**
t-statistic	*[5.53]*	*[8.74]*
THREE MONTHS YIELD(-2)	**0.058**	**-0.089**
t-statistic	*[0.40]*	*[-0.53]*
THREE MONTHS YIELD(-3)	**-0.361**	**-0.252**
t-statistic	*[-2.81]*	*[-1.70]*
Constant	**0.072**	**0.056**
t-statistic	*[2.18]*	*[1.47]*
R-squared	0.986	0.981
Adj. R-squared	0.99	0.98
Sum sq. resids	2.37	3.18
S.E. equation	0.14	0.16
F-statistic	1,377.090	1,012.137
Log likelihood	71.43	53.08
Akaike AIC	-1.02	-0.73
Schwarz SC	-0.87	-0.57
Mean dependent	2.596	2.497
S.D. dependent	1.16	1.15
Determinant resid covariance (dof adj.)		0.00
Determinant resid covariance		0.000
Log likelihood		170.62
Akaike information criterion		-2.49
Schwarz criterion		-2.17

Table 8.12 Granger Causality Test between Policy Rate and Bond Market Rate

Dependent variable: One year treasury yield		
	Chi-sq	Prob.
RP RATE	12.71*	0.00
Dependent variable: Three month treasury yield		
	Chi-sq	Prob.
RP RATE	3.47	0.32

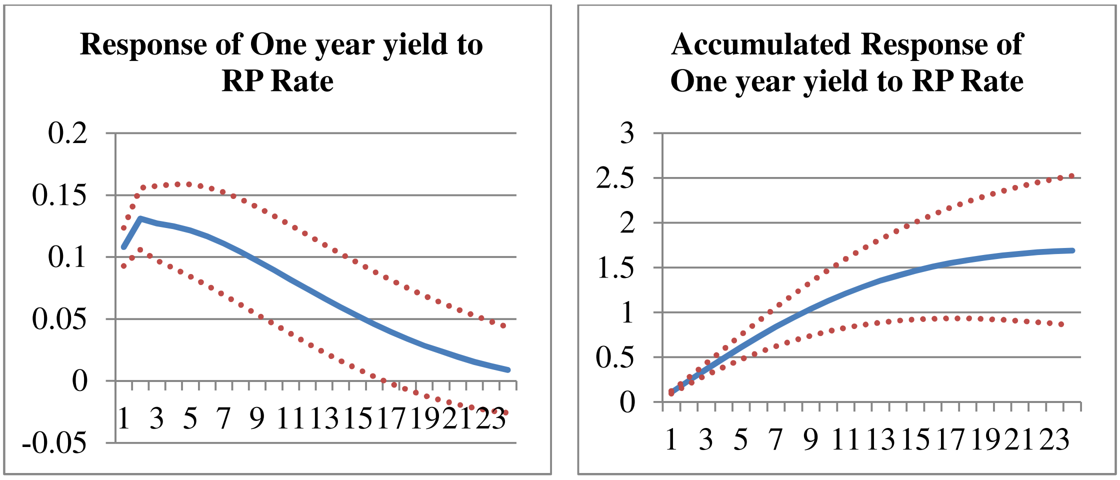

Figure 8.7 Generalized Impulse Response of Policy Rate and One Year Treasury Yield

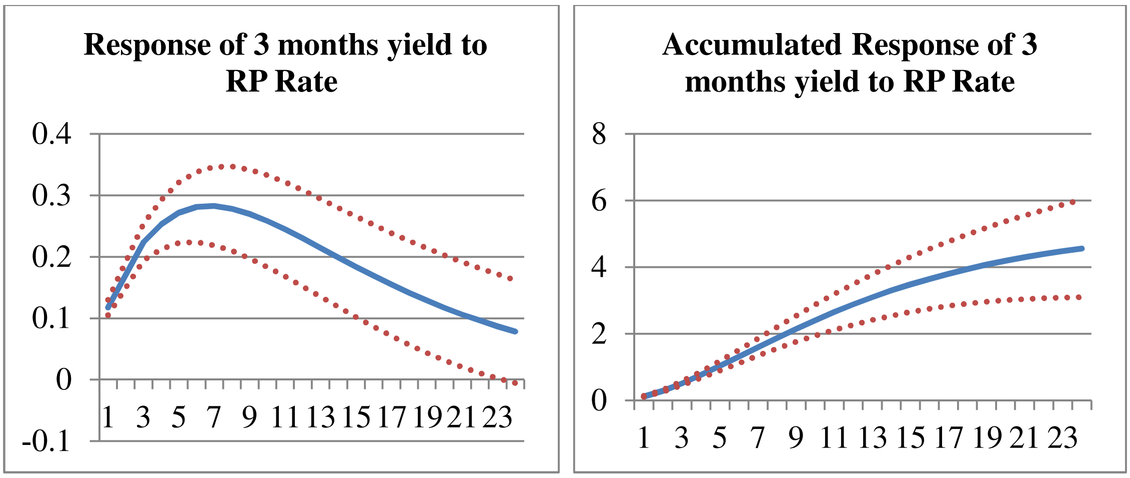

Figure 8.8 Generalized Impulse Response of Policy Rate and Three Month Treasury Yield

Table 8.13 Lag Length Criteria under VAR Model between Money Supply on Bond Market Rate

Lag	LR	FPE	AIC	SC	HQ
One year treasury yield					
0	-25.65	0.00	0.49	0.56	0.51
1	470.94	0.00	-7.78	-7.50	-7.66
2	495.91	0.00	-8.05	**-7.56***	-7.85
3	513.84	**5.52e-08***	**-8.20***	-7.50	**-7.91***
4	517.09	0.00	-8.10	-7.19	-7.73
5	524.78	0.00	-8.08	-6.95	-7.62
6	528.98	0.00	-8.00	-6.66	-7.46
7	535.77	0.00	-7.96	-6.41	-7.33
8	540.06	0.00	-7.88	-6.12	-7.17
9	543.86	0.00	-7.79	-5.82	-6.99
10	548.32	0.00	-7.72	-5.53	-6.83
11	561.15	0.00	-7.78	-5.39	-6.81
Three month treasury yield					
0	-29.77	0.00	0.56	0.63	0.58
1	481.13	0.00	-7.95	-7.67	-7.84
2	514.49	0.00	-8.36	**-7.87***	-8.16
3	532.67	**4.01e-08***	**-8.52***	-7.82	**-8.23***
4	537.19	0.00	-8.44	-7.53	-8.07
5	546.75	0.00	-8.45	-7.33	-8.00
6	553.23	0.00	-8.41	-7.07	-7.87
7	562.78	0.00	-8.42	-6.87	-7.79
8	567.66	0.00	-8.35	-6.59	-7.64
9	570.74	0.00	-8.25	-6.28	-7.45
10	575.52	0.00	-8.18	-5.99	-7.29
11	583.71	0.00	-8.16	-5.77	-7.19

Table 8.14 VAR Model between Money Supply and Bond Market Rate

One year treasury yield	LOG OF REAL MONEY SUPPLY	LOG OF IP	ONE YEAR YIELD
LOG OF REAL MONEY SUPPLY(-1)	**0.514**	**0.093**	**-0.518**
t-statistic	*[6.00]*	*[0.36]*	*[-0.59]*
LOG OF REAL MONEY SUPPLY(-2)	**0.151**	**0.077**	**0.252**
t-statistic	*[1.61]*	*[0.27]*	*[0.26]*
LOG OF REAL MONEY SUPPLY(-3)	**0.328**	**-0.083**	**0.389**
t-statistic	*[3.92]*	*[-0.33]*	*[0.45]*
LOG OF IP(-1)	**0.033**	**1.075**	**0.258**
t-statistic	*[1.07]*	*[11.76]*	*[0.82]*
LOG OF IP(-2)	**-0.008**	**-0.496**	**-0.415**
t-statistic	*[-0.19]*	*[-3.82]*	*[-0.93]*
LOG OF IP(-3)	**-0.018**	**0.274**	**0.081**
t-statistic	*[-0.59]*	*[2.95]*	*[0.25]*
ONE YEAR YIELD(-1)	**-0.028**	**0.019**	**1.206**
t-statistic	*[-3.19]*	*[0.74]*	*[13.36]*
ONE YEAR YIELD(-2)	**0.027**	**0.008**	**0.046**
t-statistic	*[1.91]*	*[0.18]*	*[0.32]*
ONE YEAR YIELD(-3)	**-0.004**	**-0.026**	**-0.283**
t-statistic	*[-0.40]*	*[-0.99]*	*[-3.12]*
Constant	**-0.008**	**0.689**	**0.462**
t-statistic	*[-0.09]*	*[2.80]*	*[0.55]*
R-squared	0.988	0.889	0.973
Adj. R-squared	0.99	0.88	0.97
Sum sq. resids	0.04	0.37	4.35
S.E. equation	0.02	0.06	0.19
F-statistic	1,027.38	102.78	462.36
Log likelihood	326.56	188.80	33.34
Akaike AIC	-5.02	-2.84	-0.37
Schwarz SC	-4.80	-2.61	-0.15
Mean dependent	-0.228	4.514	2.721
S.D. dependent	0.16	0.16	1.13
Determinant resid covariance (dof adj.)		0.00	
Determinant resid covariance		0.000	
Log likelihood		550.44	
Akaike information criterion		-8.26	
Schwarz criterion		-7.59	

Table 8.14 (Continued)

Three month treasury yield	Log of real money supply	LOG OF IP	three month yield
LOG OF REAL MONEY SUPPLY(-1)	**0.525**	**0.031**	**-1.365**
t-statistic	*[6.12]*	*[0.12]*	*[-1.86]*
LOG OF REAL MONEY SUPPLY(-2)	**0.135**	**0.104**	**0.541**
t-statistic	*[1.41]*	*[0.36]*	*[0.66]*
LOG OF REAL MONEY SUPPLY(-3)	**0.334**	**-0.051**	**0.921**
t-statistic	*[3.93]*	*[-0.20]*	*[1.27]*
LOG OF IP(-1)	**0.028**	**1.088**	**0.282**
t-statistic	*[0.89]*	*[11.82]*	*[1.07]*
LOG OF IP(-2)	**-0.004**	**-0.486**	**-0.274**
t-statistic	*[-0.09]*	*[-3.69]*	*[-0.73]*
LOG OF IP(-3)	**-0.019**	**0.256**	**-0.034**
t-statistic	*[-0.60]*	*[2.76]*	*[-0.13]*
three month yield(-1)	**-0.028**	**0.009**	**1.291**
t-statistic	*[-2.70]*	*[0.28]*	*[14.33]*
three month yield(-2)	**0.027**	**-0.005**	**-0.047**
t-statistic	*[1.52]*	*[-0.09]*	*[-0.31]*
three month yield(-3)	**-0.003**	**-0.004**	**-0.275**
t-statistic	*[-0.25]*	*[-0.14]*	*[-3.09]*
Constant	**-0.004**	**0.664**	**0.233**
t-statistic	*[-0.05]*	*[2.70]*	*[0.33]*
R-squared	0.987	0.887	0.981
Adj. R-squared	0.99	0.88	0.98
Sum sq. resids	0.04	0.37	3.09
S.E. equation	0.02	0.06	0.16
F-statistic	1,002.207	100.799	675.982
Log likelihood	325.02	187.72	54.77
Akaike AIC	-5.00	-2.82	-0.71
Schwarz SC	-4.78	-2.60	-0.49
Mean dependent	-0.228	4.514	2.497
S.D. dependent	0.16	0.16	1.15
Determinant resid covariance (dof adj.)		0.00	
Determinant resid covariance		0.000	
Log likelihood		569.94	
Akaike information criterion		-8.57	
Schwarz criterion		-7.90	

Table 8.15 Granger Causality Test between Money Supply and Bond Market Rate

Dependent variable: One year treasury yield		
	Chi-sq	Prob.
LOG OF REAL MONEY SUPPLY	0.97	0.81
LOG OF INDUSTRIAL PRODUCTION	1.30	0.73
Dependent variable: Three month treasury yield		
	Chi-sq	Prob.
LOG OF REAL MONEY SUPPLY	4.46	0.22
LOG OF INDUSTRIAL PRODUCTION	1.51	0.68

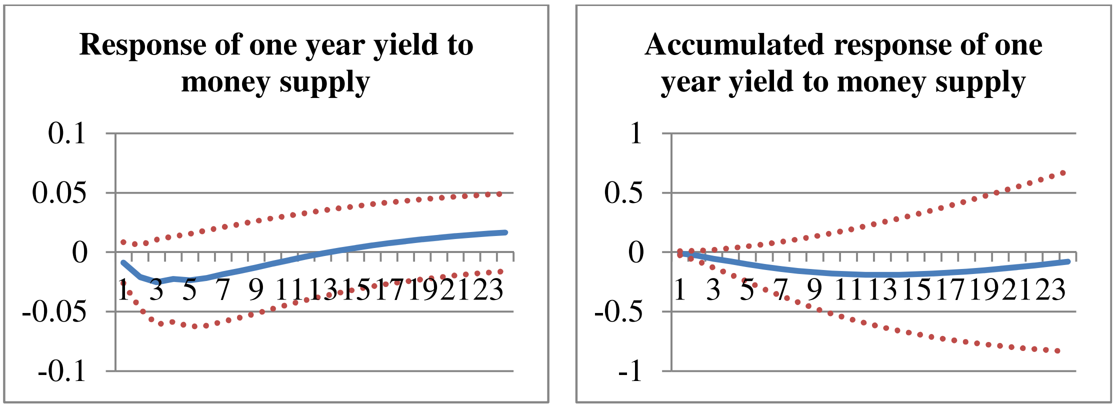

Figure 8.9 Generalized Impulse Response of Money Supply and One Year Treasury Yield

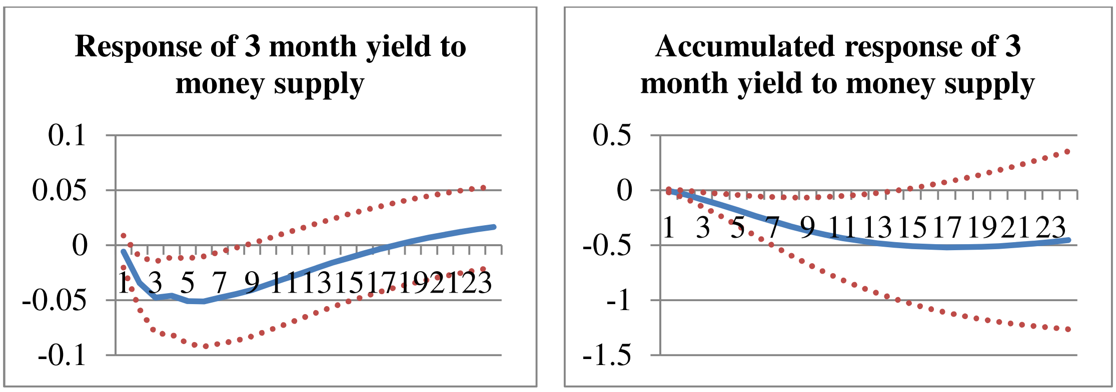

Figure 8.10 Generalized Impulse Response of Money Supply and Three Month Treasury Yield

Table 8.16 Lag Length Criteria under VAR Model between Deposit Rate on Bond Market Rate

Lag	LR	FPE	AIC	SC	HQ
One year treasury yield					
0	-248.13	0.24	4.24	4.29	4.26
1	107.92	0.00	-1.73	**-1.59***	**-1.67***
2	113.77	0.00	-1.76	-1.52	-1.66
3	119.93	0.00	-1.80	-1.47	-1.66
4	126.31	**0.0005***	**-1.84***	-1.41	-1.66
5	127.60	0.00	-1.79	-1.27	-1.58
6	131.16	0.00	-1.78	-1.17	-1.53
7	132.19	0.00	-1.73	-1.03	-1.45
8	134.43	0.00	-1.70	-0.90	-1.38
9	138.13	0.00	-1.70	-0.80	-1.33
10	140.45	0.00	-1.67	-0.68	-1.27
11	141.96	0.00	-1.63	-0.55	-1.19
Three month treasury yield					
0	-211.29	0.13	3.62	3.66	3.63
1	111.37	0.00	-1.79	-1.65	-1.73
2	127.04	0.00	-1.98	-1.75	-1.89
3	139.71	**0.0004***	**-2.13***	**-1.80***	**-2.00***
4	142.95	0.00	-2.12	-1.70	-1.95
5	146.93	0.00	-2.12	-1.60	-1.91
6	149.11	0.00	-2.09	-1.48	-1.84
7	149.75	0.00	-2.03	-1.33	-1.74
8	152.11	0.00	-2.00	-1.20	-1.68
9	154.17	0.00	-1.97	-1.08	-1.61
10	156.40	0.00	-1.94	-0.95	-1.54
11	159.45	0.00	-1.92	-0.84	-1.48

Table 8.17 VAR Model between Deposit Rate and Bond Market Rate

	ONE YEAR YIELD	DEPOSIT RATE
ONE YEAR YIELD(-1)	**1.112**	**0.206**
t-statistic	*[9.40]*	*[2.05]*
ONE YEAR YIELD(-2)	**0.033**	**0.124**
t-statistic	*[0.20]*	*[0.89]*
ONE YEAR YIELD(-3)	**-0.241**	**-0.444**
t-statistic	*[-1.47]*	*[-3.19]*
ONE YEAR YIELD(-4)	**0.132**	**0.209**
t-statistic	*[1.08]*	*[2.00]*
DEPOSIT RATE(-1)	**0.036**	**1.032**
t-statistic	*[0.27]*	*[8.99]*
DEPOSIT RATE(-2)	**-0.011**	**-0.256**
t-statistic	*[-0.06]*	*[-1.62]*
DEPOSIT RATE(-3)	**0.073**	**0.419**
t-statistic	*[0.39]*	*[2.66]*
DEPOSIT RATE(-4)	**-0.208**	**-0.319**
t-statistic	*[-1.63]*	*[-2.94]*
Constant	**0.126**	**-0.012**
t-statistic	*[2.50]*	*[-0.29]*
R-squared	0.975	0.975
Adj. R-squared	0.97	0.97
Sum sq. resids	4.07	2.92
S.E. equation	0.19	0.16
F-statistic	554.962	561.480
Log likelihood	36.69	57.38
Akaike AIC	-0.44	-0.77
Schwarz SC	-0.24	-0.57
Mean dependent	2.727	1.975
S.D. dependent	1.14	0.97
Determinant resid covariance (dof adj.)		0.00
Determinant resid covariance		0.000
Log likelihood		124.00
Akaike information criterion		-1.70
Schwarz criterion		-1.29

Table 8.17 (Continued)

	three month yield	DEPOSIT RATE
three month yield(-1)	**1.186**	**0.299**
t-statistic	*[10.54]*	*[2.59]*
three month yield(-2)	**-0.084**	**0.106**
t-statistic	*[-0.51]*	*[0.63]*
three month yield(-3)	**-0.078**	**-0.308**
t-statistic	*[-0.69]*	*[-2.65]*
DEPOSIT RATE(-1)	**0.109**	**0.986**
t-statistic	*[0.98]*	*[8.64]*
DEPOSIT RATE(-2)	**0.057**	**-0.217**
t-statistic	*[0.37]*	*[-1.39]*
DEPOSIT RATE(-3)	**-0.242**	**0.106**
t-statistic	*[-2.22]*	*[0.95]*
Constant	**0.095**	**0.005**
t-statistic	*[2.69]*	*[0.14]*
R-squared	0.982	0.973
Adj. R-squared	0.98	0.97
Sum sq. resids	3.02	3.17
S.E. equation	0.16	0.16
F-statistic	1,065.507	708.134
Log likelihood	56.25	53.12
Akaike AIC	-0.78	-0.73
Schwarz SC	-0.62	-0.57
Mean dependent	2.497	1.980
S.D. dependent	1.15	0.97
Determinant resid covariance (dof adj.)		0.00
Determinant resid covariance		0.000
Log likelihood		142.72
Akaike information criterion		-2.04
Schwarz criterion		-1.73

Table 8.18 Granger Causality Test between Deposit Rate and Bond Market Rate

Dependent variable: One year treasury yield		
	Chi-sq	Prob.
DEPOSIT RATE	9.79**	0.04
Dependent variable: Three month treasury yield		
	Chi-sq	Prob.
DEPOSIT RATE	9.80**	0.02

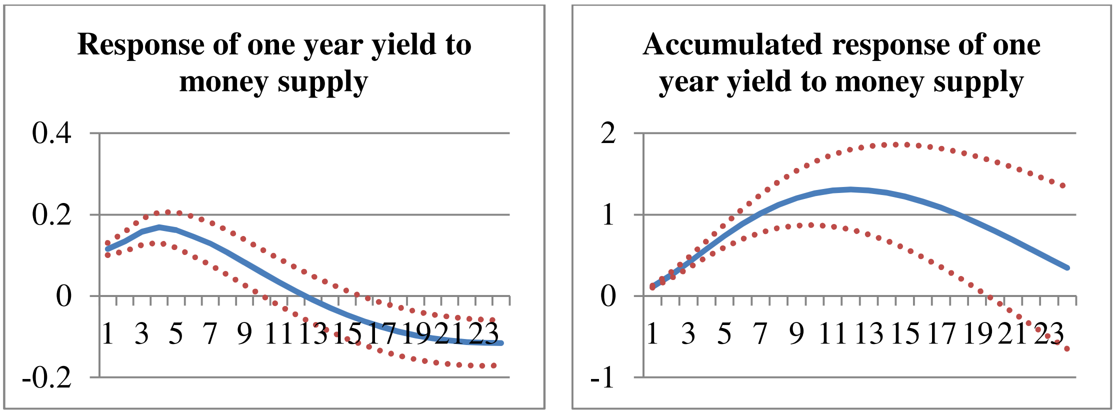

Figure 8.11 Generalized Impulse Response of Deposit Rate and One Year Treasury Yield

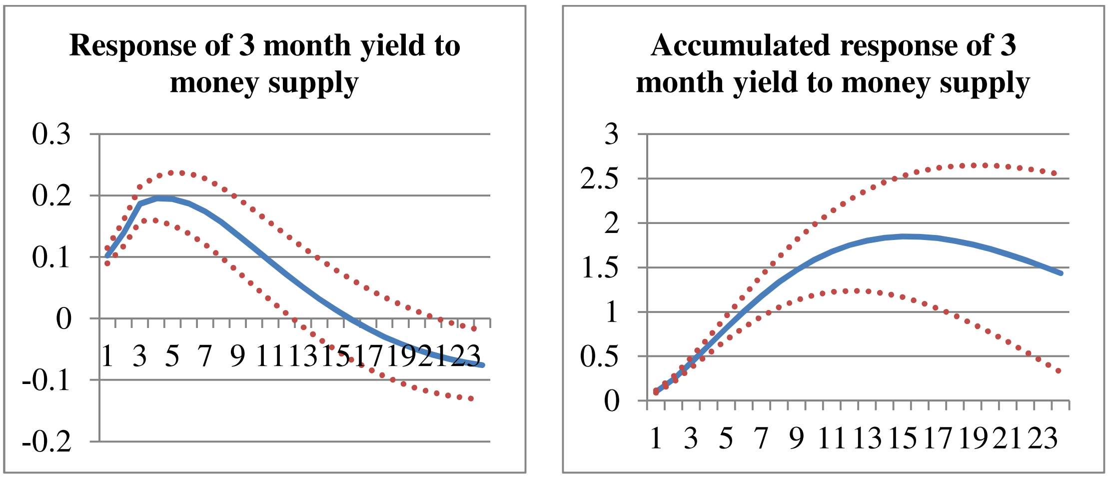

Figure 8.12 Generalized Impulse Response of Deposit Rate and Three Month Treasury Yield

Table 8.19 Lag Length Criteria under VAR Model between Lending Rate on Bond Market Rate

Lag	LR	FPE	AIC	SC	HQ
One year treasury yield					
0	-243.54	NA	0.22	4.16	4.21
1	152.59	772.10	0.00	-2.48	**-2.34***
2	158.62	11.55	0.00	-2.52	-2.28
3	164.49	11.04	0.00	-2.55	-2.22
4	170.99	12.02	0.00	-2.59	-2.17
5	172.59	2.90	0.00	-2.55	-2.04
6	179.86	**12.94***	**0.0002***	**-2.61***	-2.00
7	180.82	1.68	0.00	-2.56	-1.85
8	181.18	0.62	0.00	-2.49	-1.70
9	183.11	3.24	0.00	-2.46	-1.57
10	187.78	7.67	0.00	-2.47	-1.48
11	188.23	0.73	0.00	-2.41	-1.33
Three month treasury yield					
0	-220.59	NA	0.15	3.77	3.82
1	158.62	739.13	0.00	-2.59	-2.45
2	171.56	24.79	0.00	-2.74	-2.50
3	181.73	19.13	**0.0002***	**-2.84***	**-2.51***
4	184.03	4.25	0.00	-2.81	-2.39
5	187.77	6.78	0.00	-2.81	-2.29
6	193.47	**10.14***	0.00	-2.84	-2.23
7	194.46	1.73	0.00	-2.79	-2.08
8	196.72	3.86	0.00	-2.76	-1.96
9	197.69	1.62	0.00	-2.71	-1.81
10	200.25	4.21	0.00	-2.68	-1.70
11	203.20	4.75	0.00	-2.66	-1.58

Table 8.20 VAR Model between Lending Rate and Bond Market Rate

One year treasury yield	MLR RATE	ONE YEAR YIELD
MLR RATE(-1)	**0.974**	**-0.098**
t-statistic	*[8.75]*	*[-0.47]*
MLR RATE(-2)	**-0.261**	**0.058**
t-statistic	*[-1.66]*	*[0.20]*

Table 8.20 (Continued)

One year treasury yield	MLR RATE	ONE YEAR YIELD
MLR RATE(-3)	**0.479**	**0.173**
t-statistic	*[3.05]*	*[0.59]*
MLR RATE(-4)	**-0.350**	**-0.306**
t-statistic	*[-2.22]*	*[-1.04]*
MLR RATE(-5)	**0.160**	**-0.062**
t-statistic	*[1.02]*	*[-0.21]*
MLR RATE(-6)	**-0.065**	**0.057**
t-statistic	*[-0.63]*	*[0.30]*
ONE YEAR YIELD(-1)	**0.202**	**1.145**
t-statistic	*[3.28]*	*[9.94]*
ONE YEAR YIELD(-2)	**0.066**	**0.052**
t-statistic	*[0.77]*	*[0.32]*
ONE YEAR YIELD(-3)	**-0.294**	**-0.263**
t-statistic	*[-3.39]*	*[-1.62]*
ONE YEAR YIELD(-4)	**0.041**	**-0.026**
t-statistic	*[0.46]*	*[-0.15]*
ONE YEAR YIELD(-5)	**0.144**	**0.132**
t-statistic	*[1.60]*	*[0.79]*
ONE YEAR YIELD(-6)	**-0.112**	**0.002**
t-statistic	*[-1.69]*	*[0.02]*
Constant	**0.284**	**1.050**
t-statistic	*[1.73]*	*[3.42]*
R-squared	0.979	0.975
Adj. R-squared	0.98	0.97
Sum sq. resids	1.12	3.93
S.E. equation	0.10	0.19
F-statistic	437.086	360.334
Log likelihood	114.52	37.26
Akaike AIC	-1.65	-0.39
Schwarz SC	-1.35	-0.10
Mean dependent	6.524	2.740
S.D. dependent	0.67	1.14
Determinant resid covariance (dof adj.)		0.00
Determinant resid covariance		0.000
Log likelihood		176.99
Akaike information criterion		-2.46
Schwarz criterion		-1.86

Table 8.20 (Continued)

Three month treasury yield	MLR RATE	three month yield
MLR RATE(-1)	**0.970**	**0.119**
t-statistic	*[9.02]*	*[0.74]*
MLR RATE(-2)	**-0.204**	**0.025**
t-statistic	*[-1.39]*	*[0.11]*
MLR RATE(-3)	**0.157**	**-0.268**
t-statistic	*[1.49]*	*[-1.71]*
three month yield(-1)	**0.238**	**1.182**
t-statistic	*[3.29]*	*[10.96]*
three month yield(-2)	**0.018**	**-0.071**
t-statistic	*[0.17]*	*[-0.45]*
three month yield(-3)	**-0.204**	**-0.089**
t-statistic	*[-2.73]*	*[-0.80]*
Constant	**0.367**	**0.759**
t-statistic	*[2.28]*	*[3.16]*
R-squared	0.976	0.982
Adj. R-squared	0.97	0.98
Sum sq. resids	1.35	2.99
S.E. equation	0.11	0.16
F-statistic	791.676	1,076.421
Log likelihood	106.86	56.88
Akaike AIC	-1.59	-0.79
Schwarz SC	-1.43	-0.63
Mean dependent	6.537	2.497
S.D. dependent	0.67	1.15
Determinant resid covariance (dof adj.)		0.00
Determinant resid covariance		0.000
Log likelihood		189.54
Akaike information criterion		-2.79
Schwarz criterion		-2.47

Table 8.21 Granger Causality Test between Lending Rate and Bond Market Rate

Dependent variable: One year treasury yield		
	Chi-sq	Prob.
MLR RATE	12.37**	0.05
Dependent variable: Three month treasury yield		
	Chi-sq	Prob.
MLR RATE	11.10*	0.01

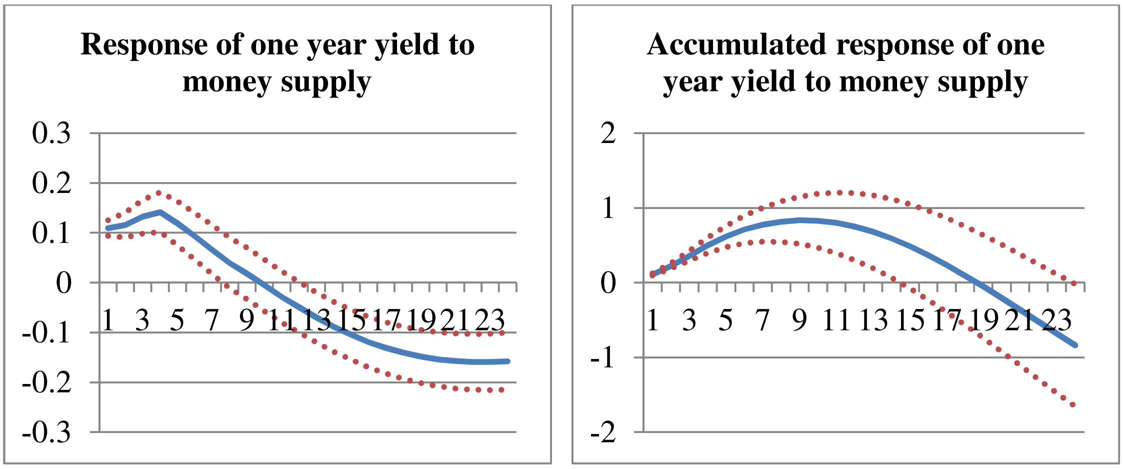

Figure 8.13 Generalized Impulse Response of Policy Rate and One Year Treasury Yield

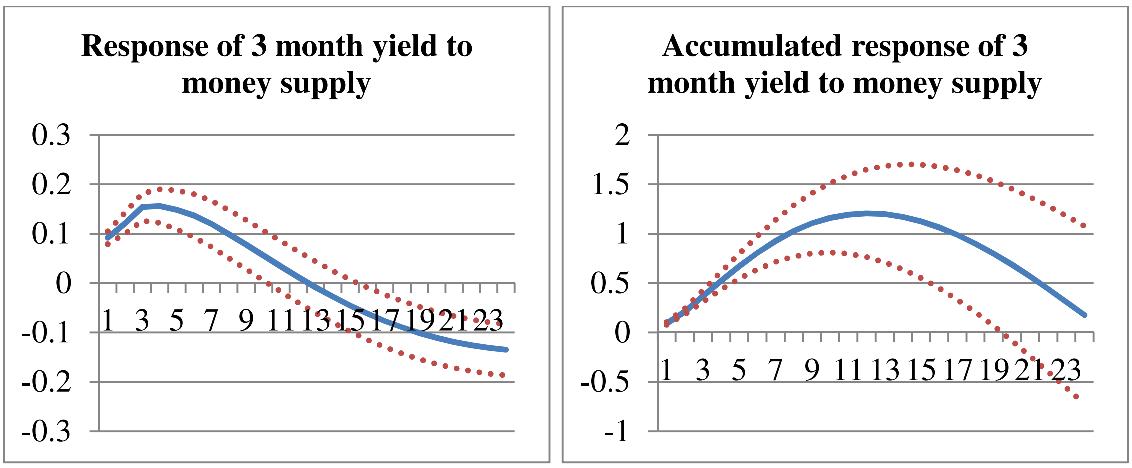

Figure 8.14 Generalized Impulse Response of Policy Rate and Three Month Treasury Yield

8.2 Study of RP Rate Effect on Asset Price Valuation

The study of the effect of RP rate on the Bank of Thailand policy rate is from the long term and short term relationships on asset price valuation. The error correction model under ARDL model is used for the study.

8.2.1 Engle-Granger Cointegration Test

For long term relationship between the asset price valuation and RP rate, the Engle-Granger Cointegration test is used for the study. The results of Engle-Granger Cointegration test are in Table 8.22. For the asset pricing valuation under all three models including CAPM, ICAPM and APT, the ADF test statistic for residuals of cointegration equations are -3.09, -3.79 and -4.74, respectively. They reject the unit root hypothesis.

The Engle-Granger Cointegration test found that ADF tests for the error term for the regression under the assumption of all three models including CAPM, ICAPM and APT rejected the hypothesis of unit root process. Therefore, under Engle-Granger cointegration test, there are cointegrations under all models and it is concluded that there is a long term relationship between asset price valuations and RP rates.

8.2.2 ARDL Bound Test

The lag length selection under the VAR model is used for the estimation of ARDL model is in Table 8.23. The results of ARDL Bound test are in Table 8.24-8.26. For CAPM, Table 8.24 shows that the Wald test is at 9.81 that is a 1% significance level. For ICAPM, Table 8.25 shows that the Wald test is at 3.63 that is a 5% significance level and, for APT model; Table 8.26 shows that the Wald test is at 4.29 that is a 1% significance level.

Therefore, the ARDL Bound test found that there were cointegrations under all three models including CAPM, ICAPM and APT models and it is concluded that there is the long term relationship between asset price valuations and RP rates.

Table 8.22 Engle-Granger Cointegration Test for RP Rate and Asset Price Valuation Cointegration

	CAPM	ICAPM	APT Model
Coefficient			
Constant	**3.243***	**3.356***	**3.606***
t-Statistic	*(60.73)*	*(57.56)*	*(47.40)*
P-Value	[0.00]	[0.00]	[0.00]
Sustainable Growth	**0.025***	**0.023***	**0.013***
t-Statistic	*(6.45)*	*(6.45)*	*(3.77)*
P-Value	[0.00]	[0.00]	[0.00]
RP Rate	**-0.092***	**-0.089***	**-0.091***
t-Statistic	*(-6.07)*	*(-6.48)*	*(-6.41)*
P-Value	[0.00]	[0.00]	[0.00]
Rate of Return-MSCI world	**0.006****		
t-Statistic	*(1.76)*		
P-Value	[0.08]		
Equity return Volatilities		**-0.003***	
t-Statistic		*(-3.66)*	
P-Value		[0.00]	
VIX			**-0.005****
t-Statistic			*(-1.98)*
P-Value			[0.05]
SPREAD			**-0.0002**
t-Statistic			*(-1.54)*
P-Value			[0.13]
Inflation Volatilities			**-2323.20***
t-Statistic			*(-4.68)*
P-Value			[0.00]
R-squared	0.36	0.43	0.66
Akaike info criterion	-0.46	-0.64	-1.20
Schwarz criterion	-0.37	-0.55	-1.06
Hannan-Quinn criter.	-0.42	-0.61	-1.14
Test			
LM Correlation test	227.63*	113.64*	58.69*
P-Value	*[0.00]*	*[0.00]*	*[0.00]*
Heteroskedastic test (BPG)	9.43*	4.53*	5.70*
P-Value	*[0.00]*	*[0.00]*	*[0.00]*
Residual Unit Root Test	**I(0)**	**I(0)**	**I(0)**
ADF Test	-3.09**	-3.79*	-4.74*
P-Value	*[0.03]*	*[0.00]*	*[0.00]*

Note: *1%, **5%, ***10% Significance level

Table 8.23 Lag Length Criteria for ARDL Bound Test and Error Correction Model of RP Rate Test

	Lag criteria	LR	FPE	AIC	SC	HQ
Log Price to Dividend	5	5	5	5	1	1
Sustainable Growth	5	5	5	5	1	1
RP Rate	2	2	5	5	2	2
Rate of Return-MSCI world	1	1	1	1	1	1
Equity return Volatility	2	2	2	2	2	2
VIX	1	1	2	2	1	1
SPREAD	2	2	2	2	1	2
Inflation Volatility	1	1	2	2	1	1
Rate of Return	4	4	4	4	1	1
10year Treasury Yield	1	4	6	6	1	1

8.2.3 Error Correction Model

The long term relationship between the log of price-to-dividend ratio and RP Rate are in Table 8.22. Error Correction Model under CAPM, ICAPM and APT model are in Table 8.24-8.26. For the long term relationship, the Engle-Granger cointegration test and ARDL bound test are used for the study and they found that there is cointegration between the actual log of price-to-dividend ratio and RP rate under CAPM, ICAPM and APT models.

For the short term relationship, the Wald tests for short term variables are used for the study and it is found that there was no significant effect of RP rate on all models.

Table 8.24 Error Correction Model of RP Rate Test under CAPM

Variable	Coefficient	t-Statistic	P-Value
Constant	**-0.002**	-0.26	0.80
Error Correction Term(t-1)	**-0.156***	-3.07	0.00
Δ Log Price-to-Dividend(t-1)	**0.087**	0.92	0.36
Δ Log Price-to-Dividend(t-2)	**0.213****	2.25	0.03
Δ Log Price-to-Dividend(t-3)	**0.053**	0.63	0.53
Δ Log Price-to-Dividend(t-4)	**0.209***	2.53	0.01
Δ Log Price-to-Dividend(t-5)	**0.066**	0.80	0.43
Δ Sustainable Growth(t)	**0.023***	4.42	0.00
Δ Sustainable Growth(t-1)	**0.001**	0.11	0.92
Δ Sustainable Growth(t-2)	**-0.001**	-0.18	0.85
Δ Sustainable Growth(t-3)	**-0.009**	-1.61	0.11
Δ Sustainable Growth(t-4)	**-0.008**	-1.43	0.16
Δ Sustainable Growth(t-5)	**0.004**	0.67	0.51
Δ RP Rate(t)	**-0.052**	-1.15	0.25
Δ RP Rate(t-1)	**0.003**	0.07	0.95
Δ RP Rate(t-2)	**-0.055**	-1.24	0.22
Δ World Rate of Return(t)	**0.007***	5.10	0.00
ΔWorldRate of Return (t-1)	**0.004***	2.88	0.00
R-squared	0.46		
Akaike info criterion	-2.22		
Schwarz criterion	-1.81		
Hannan-Quinn criter.	-2.05		
Test	**t/F-Statistic**	**P-Value**	
Wald Test (Long Term)	9.81*		
Wald Test (Short Term)	1.55	0.21	
LM Correlation test	5.04*	0.01	
Heteroskedastic test- Breusch-Pagan-Godfrey	0.86	0.62	
Residual Unit Root Test	I(0)		
Augmented Dickey-Fuller Test	-11.53*	0.00	

Note: *1%, **5%, ***10% Significance level

Table 8.25 Error Correction Model of RP Rate Test under ICAPM

	Coefficient	t-Statistic	P-Value
Constant	**0.000**	0.02	0.98
Error Correction Term(t-1)	**-0.194***	-3.32	0.00
Δ Log Price-to-Dividend(t-1)	**0.045**	0.45	0.65
Δ Log Price-to-Dividend(t-2)	**0.053**	0.54	0.59
Δ Log Price-to-Dividend(t-3)	**0.070**	0.75	0.46
Δ Log Price-to-Dividend(t-4)	**0.239***	2.56	0.01
Δ Log Price-to-Dividend(t-5)	**0.035**	0.38	0.71
Δ Sustainable Growth(t)	**0.026***	4.21	0.00
Δ Sustainable Growth(t-1)	**-0.004**	-0.67	0.50
Δ Sustainable Growth(t-2)	**0.004**	0.69	0.49
Δ Sustainable Growth(t-3)	**-0.012****	-2.00	0.05
Δ Sustainable Growth(t-4)	**-0.009**	-1.56	0.12
Δ Sustainable Growth(t-5)	**-0.002**	-0.29	0.77
Δ RP Rate(t)	**-0.049**	-0.93	0.35
Δ RP Rate(t-1)	**-0.023**	-0.41	0.68
Δ RP Rate(t-2)	**-0.067**	-1.24	0.22
Δ Equities Volatility(t)	**-0.0003**	-0.60	0.55
Δ Equities Volatility(t-1)	**0.001*****	1.87	0.06
Δ Equities Volatility(t-2)	**0.000**	0.27	0.78
R-squared	0.34		
Akaike info criterion	-2.00		
Schwarz criterion	-1.57		
Hannan-Quinn criter.	-1.83		
Test	**t/F-Statistic**	**P-Value**	
Wald Test (Long Term)	3.63**		
Wald Test (Short Term)	1.85	0.14	
LM Correlation test	0.45	0.64	
Heteroskedastic test- Breusch-Pagan-Godfrey	0.81	0.69	
Residual Unit Root Test	I(0)		
Augmented Dickey-Fuller Test	-11.18*	0.00	

Note: *1%, **5%, ***10% Significance level

Table 8.26 Error Correction Model of RP Rate Test under APT

	Coefficient	t-Statistic	P-Value
Constant	**-0.001**	-0.20	0.84
Error Correction Term(t-1)	**-0.296***	-4.67	0.00
Δ Log Price-to-Dividend(t-1)	**-0.029**	-0.31	0.76
Δ Log Price-to-Dividend(t-2)	**0.067**	0.76	0.45
Δ Log Price-to-Dividend(t-3)	**0.021**	0.26	0.79
Δ Log Price-to-Dividend(t-4)	**0.237***	3.19	0.00
Δ Log Price-to-Dividend(t-5)	**0.035**	0.46	0.64
Δ Sustainable Growth(t)	**0.020***	4.22	0.00
Δ Sustainable Growth(t-1)	**-0.0001**	-0.03	0.98
Δ Sustainable Growth(t-2)	**-0.001**	-0.10	0.92
Δ Sustainable Growth(t-3)	**-0.007**	-1.45	0.15
Δ Sustainable Growth(t-4)	**-0.008*****	-1.70	0.09
Δ Sustainable Growth(t-5)	**0.001**	0.11	0.91
Δ RP Rate(t)	**-0.054**	-1.28	0.20
Δ RP Rate(t-1)	**0.009**	0.22	0.82
Δ RP Rate(t-2)	**-0.061**	-1.48	0.14
Δ VIX Index(t)	**-0.006***	-2.48	0.01
Δ VIX Index(t-1)	**-0.004**	-1.41	0.16
Δ Emerging Market Spread(t)	**-0.0001**	-0.28	0.78
Δ Emerging Market Spread(t-1)	**0.0003**	1.03	0.31
Δ Emerging Market Spread(t-2)	**-0.0001**	-0.27	0.79
Δ Inflation Volatility(t)	**-99.59**	-0.28	0.78
Δ Inflation Volatility(t-1)	**-219.77**	-0.59	0.55
R-squared	0.59		
Akaike info criterion	-2.40		
Schwarz criterion	-1.86		
Hannan-Quinn criter.	-2.18		
Test	**t/F-Statistic**	**P-Value**	
Wald Test (Long Term)	4.29*		
Wald Test (Short Term)	1.96	0.13	
LM Correlation test	0.97	0.38	
Heteroskedastic test- BPG	0.84	0.67	
Residual Unit Root Test	I(0)		
Augmented Dickey-Fuller Test	-10.21*	0.00	

Note: *1%, **5%, ***10% Significance level

Table 8.27 summarizes the result of the long term relationship between the log of price-to-dividend ratio and the role of monetary policy. The effect of RP rate on Log Price-to-Dividend on average is -0.0905. An increase of RP Rate by 1% will have a negative effect on Price-to-Dividend on average of 8.65%.

For the error correction model result on the short term relationship in Table 8.28, the Wald test on coefficients of differentials of RP rate found that the F-value statistics for CAPM, ICAPM and APT models were 1.55, 1.85 and 1.96 respectively. Therefore, there is no short term effect of RP rate on Log Price-to-Dividend ratio.

Table 8.27 Long Term Relationship of RP Rate on Equity Valuation

Y = Log Price-to-Dividend				
	CAPM	**ICAPM**	**APT**	**Average**
RP Rate	-0.092 *	-0.089**	-0.091*	**-0.0905**
% Price-to-Dividend				
	CAPM	**ICAPM**	**APT**	**Average**
Δ RP Rate =1%	-8.77%	-8.51%	-8.68%	**-8.65%**

Note: *1%, **5%, ***10% Significance level

Table 8.28 Short Term Relationship of RP Rate on Equity Valuation

	CAPM	**ICAPM**	**APT**
Wald Test Statistic	1.55	1.85	1.96

Note: *1%, **5%, ***10% Significance level

8.3 Study of Deposit Rate Effect on Asset Price Valuation

The study of the effect of deposit rates, part of Bank of Thailand‘s policy rate transmission, is from the long term and short term relationships on asset price valuation. The error correction model under ARDL model is used for the study.

8.3.1 Engle-Granger Cointegration Test

For the long term relationship between the asset price valuations and deposit rates, the Engle-Granger Cointegration test is used for the study. The results of Engle-Granger Cointegration test are in Table 8.29. For the asset pricing valuation under all three models including CAPM, ICAPM and APT, the ADF test statistic for residuals of cointegration equations are -3.00, -3.58 and -4.75, respectively. They reject the unit root hypothesis.

The Engle-Granger Cointegration test found that ADF tests for the error term for the regression under assumption of all three models including CAPM, ICAPM and APT rejected the hypothesis of unit root process. Therefore, under the Engle-Granger Cointegration test, there are cointegrations under all models and it is concluded that there is a long term relationship between asset price valuations and deposit rates.

8.3.2 ARDL Bound Test

The lag length selection under the VAR model is used for the estimation of ARDL model is in Table 8.30. The results of ARDL Bound test are in Table 8.31-8.33. For CAPM, Table 8.31 shows that the Wald test is at 8.62 that is a 1% significance level. For ICAPM, Table 8.32 shows that the Wald test is at 2.27 that is not significant and, for APT model; Table 8.33 shows that the Wald test is at 4.03 that is a 1% significance level.

Therefore, the ARDL Bound test found that there were cointegrations under all three models including CAPM, ICAPM and APT model and it is concluded that there is a long term relationship between asset price valuations and deposit rates.

Table 8.29 Engle-Granger Cointegration Test for Deposit Rate and Asset Price Valuation Cointegration

	CAPM	ICAPM	APT Model
Coefficient			
Constant	**3.154***	**3.297***	**3.475***
t-Statistic	*(53.30)*	*(51.79)*	*(45.15)*
P-Value	[0.00]	[0.00]	[0.00]
Sustainable Growth	**0.021***	**0.020***	**0.008****
t-Statistic	*(5.09)*	*(5.19)*	*(2.29)*
P-Value	[0.00]	[0.00]	[0.02]
Deposit Rate	**-0.055***	**-0.068***	**-0.063***
t-Statistic	*(-2.80)*	*(-3.84)*	*(-4.10)*
P-Value	[0.01]	[0.00]	[0.00]
Rate of Return-MSCI world	**0.007*****		
t-Statistic	*(1.75)*		
P-Value	[0.08]		
Equity return Volatilities		**-0.003***	
t-Statistic		*(-3.49)*	
P-Value		[0.00]	
VIX			**-0.007***
t-Statistic			*(-2.69)*
P-Value			[0.01]
SPREAD			**0.0002**
t-Statistic			*(0.81)*
P-Value			[0.42]
Inflation Volatilities			**-2952.6***
t-Statistic			*(-5.68)*
P-Value			[0.00]
R-squared	0.21	0.31	0.60
Akaike info criterion	-0.26	-0.46	-1.03
Schwarz criterion	-0.17	-0.37	-0.89
Hannan-Quinn criter.	-0.22	-0.43	-0.97
Test			
LM Correlation test	255.10*	138.06*	56.74*
P-Value	*[0.00]*	*[0.00]*	*[0.00]*
Heteroskedastic test (BPG)	7.67*	3.72*	8.95*
P-Value	*[0.00]*	*[0.01]*	*[0.00]*
Residual Unit Root Test	**I(0)**	**I(0)**	**I(0)**
ADF Test	-3.00**	-3.58*	-4.75*
P-Value	*[0.05]*	*[0.01]*	*[0.00]*

Note: *1%, **5%, ***10% Significance level

Table 8.30 Lag Length Criteria for ARDL Bound Test and Error Correction Model of Deposit Rate Test

	Lag criteria	LR	FPE	AIC	SC	HQ
Log Price to Dividend	5	5	5	5	1	1
Sustainable Growth	5	5	5	5	1	1
Deposit Rate	5	5	5	5	1	2
Rate of Return-MSCI world	1	1	1	1	1	1
Equity return Volatility	2	2	2	2	2	2
VIX	2	1	2	2	1	1
SPREAD	2	2	2	2	1	2
Inflation Volatility	1	1	2	2	1	1
Rate of Return	4	4	4	4	1	1
10year Treasury Yield	1	4	6	6	1	1

8.3.3 Error Correction Model

The long term relationship between the log of price-to-dividend ratio and deposit rate are in Table 8.29. Error Correction Model under CAPM, ICAPM and APT model are in Table 8.31-8.33. For the long term relationship, the Engle-Granger cointegration test and ARDL bound test are used for the study and they found that there is cointegration between the actual log of price-to-dividend ratio and deposit rate under CAPM and APT model but there is no significant cointegration for ICAPM.

For the short term relationship, the Wald tests for short term variables are used for the study and it is found that there was no significant effect of deposit rates on all models.

Table 8.34 summarizes the result of long term relationship between the log of price-to-dividend ratio and the role of monetary policy. The effect of deposit rate on Log Price-to-Dividend on average is -0.062. The increase of deposit rate by 1% will have a negative effect on Price-to-Dividend on average by 6.02% that is lower effect than RP Rate.

Table 8.31 Error Correction Model of Deposit Rate Test under CAPM

Variable	Coefficient	t-Statistic	P-Value
Constant	**-0.003**	-0.44	0.66
Error Correction Term(t-1)	**-0.153***	-3.05	0.00
Δ Log Price-to-Dividend(t-1)	**0.110**	1.13	0.26
Δ Log Price-to-Dividend(t-2)	**0.235****	2.37	0.02
Δ Log Price-to-Dividend(t-3)	**0.052**	0.60	0.55
Δ Log Price-to-Dividend(t-4)	**0.205****	2.35	0.02
Δ Log Price-to-Dividend(t-5)	**0.007**	0.08	0.93
Δ Sustainable Growth(t)	**0.024***	4.45	0.00
Δ Sustainable Growth(t-1)	**0.002**	0.29	0.78
Δ Sustainable Growth(t-2)	**-0.002**	-0.39	0.70
Δ Sustainable Growth(t-3)	**-0.009**	-1.61	0.11
Δ Sustainable Growth(t-4)	**-0.009**	-1.57	0.12
Δ Sustainable Growth(t-5)	**0.008**	1.38	0.17
Δ Deposit Rate(t)	**-0.070**	-1.64	0.10
Δ Deposit Rate(t-1)	**0.011**	0.25	0.81
Δ Deposit Rate(t-2)	**-0.016**	-0.38	0.71
Δ Deposit Rate(t-3)	**0.004**	0.09	0.93
Δ Deposit Rate(t-4)	**0.015**	0.34	0.73
Δ Deposit Rate(t-5)	**-0.062**	-1.46	0.15
ΔMSCI World Return(t)	**0.008***	5.04	0.00
ΔMSCI World Return(t-1)	**0.004***	2.85	0.01
R-squared	0.47		
Akaike info criterion	-2.18		
Schwarz criterion	-1.70		
Hannan-Quinn criter.	-1.99		
Test	**t/F-Statistic**	**P-Value**	
Wald Test (Long Term)	8.62*	0.00	
Wald Test (Short Term)	1.80	0.11	
LM Correlation test	4.50*	0.01	
Heteroskedastic test- Breusch-Pagan-Godfrey	0.87	0.62	
Residual Unit Root Test	**I(0)**		
Augmented Dickey-Fuller Test	-11.54*	0.00	

Note: *1%, **5%, ***10% Significance level

Table 8.32 Error Correction Model of Deposit Rate Test under ICAPM

	Coefficient	t-Statistic	P-Value
Constant	**-0.001**	-0.16	0.87
Error Correction Term(t-1)	**-0.157***	-2.84	0.01
Δ Log Price-to-Dividend(t-1)	**0.025**	0.24	0.81
Δ Log Price-to-Dividend(t-2)	**0.053**	0.52	0.60
Δ Log Price-to-Dividend(t-3)	**0.062**	0.64	0.53
Δ Log Price-to-Dividend(t-4)	**0.211**	2.10	0.04
Δ Log Price-to-Dividend(t-5)	**-0.047**	-0.48	0.63
Δ Sustainable Growth(t)	**0.026***	4.17	0.00
Δ Sustainable Growth(t-1)	**-0.004**	-0.58	0.56
Δ Sustainable Growth(t-2)	**0.003**	0.41	0.68
Δ Sustainable Growth(t-3)	**-0.013****	-2.23	0.03
Δ Sustainable Growth(t-4)	**-0.010**	-1.60	0.11
Δ Sustainable Growth(t-5)	**0.002**	0.24	0.81
Δ Deposit Rate(t)	**-0.084*****	-1.68	0.10
Δ Deposit Rate(t-1)	**-0.007**	-0.13	0.90
Δ Deposit Rate(t-2)	**0.017**	0.34	0.74
Δ Deposit Rate(t-3)	**-0.008**	-0.17	0.87
Δ Deposit Rate(t-4)	**-0.029**	-0.57	0.57
Δ Deposit Rate(t-5)	**-0.059**	-1.24	0.22
Δ Equities Volatility(t)	**-0.0005**	-1.10	0.27
Δ Equities Volatility(t-1)	**0.001**	1.07	0.29
Δ Equities Volatility(t-2)	**-0.0002**	-0.44	0.66
R-squared	0.34		
Akaike info criterion	-1.96		
Schwarz criterion	-1.46		
Hannan-Quinn criter.	-1.76		
Test	**t/F-Statistic**	**P-Value**	
Wald Test (Long Term)	2.27	0.07	
Wald Test (Short Term)	1.50	0.19	
LM Correlation test	0.49	0.61	
Heteroskedastic test- Breusch-Pagan-Godfrey	0.52	0.96	
Residual Unit Root Test	**I(0)**		
Augmented Dickey-Fuller Test	-11.12*	0.00	

Note: *1%, **5%, ***10% Significance level

Table 8.33 Error Correction Model of Deposit Rate Test under APT

	Coefficient	t-Statistic	P-Value
Constant	**-0.001**	-0.22	0.82
Error Correction Term(t-1)	**-0.274***	-4.34	0.00
Δ Log Price-to-Dividend(t-1)	**0.007**	0.07	0.94
Δ Log Price-to-Dividend(t-2)	**0.069**	0.75	0.45
Δ Log Price-to-Dividend(t-3)	**0.009**	0.11	0.91
Δ Log Price-to-Dividend(t-4)	**0.244***	3.06	0.00
Δ Log Price-to-Dividend(t-5)	**-0.018**	-0.23	0.82
Δ Sustainable Growth(t)	**0.021***	4.26	0.00
Δ Sustainable Growth(t-1)	**0.001**	0.10	0.92
Δ Sustainable Growth(t-2)	**-0.001**	-0.16	0.87
Δ Sustainable Growth(t-3)	**-0.007**	-1.36	0.18
Δ Sustainable Growth(t-4)	**-0.009*****	-1.83	0.07
Δ Sustainable Growth(t-5)	**0.004**	0.81	0.42
Δ Deposit Rate(t)	**-0.054**	-1.29	0.20
Δ Deposit Rate(t-1)	**0.019**	0.45	0.65
Δ Deposit Rate(t-2)	**-0.040**	-0.94	0.35
Δ Deposit Rate(t-3)	**0.004**	0.09	0.93
Δ Deposit Rate(t-4)	**0.022**	0.51	0.61
Δ Deposit Rate(t-5)	**-0.064**	-1.57	0.12
Δ VIX Index(t)	**-0.007***	-2.73	0.01
Δ VIX Index(t-1)	**-0.003**	-1.18	0.24
Δ Emerging Market Spread(t)	**0.00004**	0.12	0.90
Δ Emerging Market Spread(t-1)	**0.00030**	1.03	0.30
Δ Emerging Market Spread(t-2)	**-0.00009**	-0.42	0.68
Δ Inflation Volatility(t)	**-246.1**	-0.68	0.50
Δ Inflation Volatility(t-1)	**-324.1**	-0.85	0.40
R-squared	0.60		
Akaike info criterion	-2.35		
Schwarz criterion	-1.74		
Hannan-Quinn criter.	-2.10		
Test	**t/F-Statistic**	**P-Value**	
Wald Test (Long Term)	4.03*	0.00	
Wald Test (Short Term)	1.37	0.24	
LM Correlation test	0.79	0.46	
Heteroskedastic test- BPG	0.71	0.84	
Residual Unit Root Test	**I(0)**		
Augmented Dickey-Fuller Test	-10.44*	0.00	

Note: *1%, **5%, ***10% Significance level

For error correction model result on the short term relationship in Table 8.35, the Wald test on coefficients of differentials of deposit rate found that the F-value statistic for CAPM, ICAPM and APT model were 1.80, 1.50 and 1.37 respectively. Therefore, there is no short term effect of deposit rates on Log Price-to-Dividend ratio.

Table 8.34 Long term Relationship of Deposit Rate on Equity Valuation

Y = Log Price-to-Dividend				
	CAPM	**ICAPM**	**APT**	**Average**
Deposit Rate	-0.0553*	-0.0681	-0.0627*	**-0.0620**
% Price-to-Dividend				
	CAPM	**ICAPM**	**APT**	**Average**
ΔDeposit Rate =1%	-5.38%	-6.58%	-6.08%	**-6.02%**

Note: *1%, **5%, ***10% Significance level

Table 8.35 Short term Relationship of Deposit Rate on Equity Valuation

	CAPM	**ICAPM**	**APT**
Wald Test Statistic	1.80	1.50	1.37

Note: *1%, **5%, ***10% Significance level

8.4 Study of MLR Rate Effect on Asset Price Valuation

The study of the effect of MLR Rate, part of monetary policy transmission, is from the long term and short term relationships on asset price valuation. The error correction model under ARDL model is used for the study.

8.4.1 Engle-Granger Cointegration Test

For the long term relationship between the asset price valuation and MLR Rate, the Engle-Granger Cointegration test is used for the study. The results of Engle-Granger Cointegration test are in Table 8.36. For the asset pricing valuation under all three models including CAPM, ICAPM and APT, the ADF test statistic for residuals of cointegration equations are -2.92, -3.51 and -4.73, respectively. They reject the unit root hypothesis.

The Engle-Granger Cointegration test found that ADF tests for the error term for the regression under the assumption of all three models, including CAPM, ICAPM and APT rejected the hypothesis of unit root process. Therefore, under the Engle-Granger Cointegration test, there are cointegrations under all models and it is concluded that there is a long term relationship between asset price valuations and the MLR Rates.

8.4.2 ARDL Bound Test

The lag length selection under the VAR model is used for the estimation of the ARDL model is in Table 8.37. The results of ARDL Bound test are in Table 8.38-8.40. For CAPM, Table 8.38 shows that the Wald test is at 8.92 which is a 1% significance level. For ICAPM, Table 8.39 shows that the Wald test is at 2.38 which is not significant and, for APT model; Table 8.40 shows that the Wald test is at 4.53 that is a 1% significance level.

Therefore, the ARDL Bound test found that there are cointegrations under CAPM, and APT model but no cointegration on ICAPM and it is concluded that there is a long term relationship between asset price valuations and MLR Rates.

Table 8.36 Engle-Granger Cointegration Test for MLR Rate and Asset Price Valuation Cointegration

	CAPM	ICAPM	APT Model
Coefficient			
Constant	**3.509***	**3.761***	**3.807***
t-Statistic	*(17.54)*	*(21.11)*	*(22.63)*
P-Value	[0.00]	[0.00]	[0.00]
Sustainable Growth	**0.019***	**0.017***	**0.007*****
t-Statistic	*(4.53)*	*(4.46)*	*(1.79)*
P-Value	[0.00]	[0.00]	[0.08]
Deposit Rate	**-0.067****	**-0.087***	**-0.071***
t-Statistic	*(-2.31)*	*(-3.38)*	*(-3.15)*
P-Value	[0.02]	[0.00]	[0.00]
Rate of Return-MSCI world	**0.006**		
t-Statistic	*(1.62)*		
P-Value	[0.11]		
Equity return Volatilities		**-0.003***	
t-Statistic		*(-3.39)*	
P-Value		[0.00]	
VIX			**-0.007****
t-Statistic			*(-2.31)*
P-Value			[0.02]
SPREAD			**0.0002**
t-Statistic			*(1.07)*
P-Value			[0.29]
Inflation Volatilities			**-3139.0***
t-Statistic			*(-5.94)*
P-Value			[0.00]
R-squared	0.20	0.29	0.57
Akaike info criterion	-0.24	-0.44	-0.98
Schwarz criterion	-0.15	-0.35	-0.84
Hannan-Quinn criter.	-0.21	-0.40	-0.92
Test			
LM Correlation test	267.11*	144.35*	58.30*
P-Value	*[0.00]*	*[0.00]*	*[0.00]*
Heteroskedastic test (BPG)	7.59*	3.14**	10.04*
P-Value	*[0.00]*	*[0.03]*	*[0.00]*
Residual Unit Root Test			
ADF Test	-2.92**	-3.51*	-4.73*
P-Value	*[0.05]*	*[0.01]*	*[0.00]*

Note: *1%, **5%, ***10% Significance level

Table 8.37 Lag Length Criteria for ARDL Bound Test and Error Correction Model of MLR Rate Test

	Lag criteria	LR	FPE	AIC	SC	HQ
Log Price to Dividend	5	5	5	5	1	1
Sustainable Growth	5	5	5	5	1	1
MLR Rate	5	5	6	6	2	5
Rate of Return-MSCI world	1	1	1	1	1	1
Equity return Volatility	2	2	2	2	2	2
VIX	2	1	2	2	1	1
SPREAD	2	2	2	2	1	2
Inflation Volatility	1	1	2	2	1	1
Rate of Return	4	4	4	4	1	1
10year Treasury Yield	1	4	6	6	1	1

8.4.3 Error Correction Model

The long term relationship between the log of price-to-dividend ratio and MLR Rate are in Table 8.36. Error Correction Model under CAPM, ICAPM and APT model are in Table 8.38-8.40. For the long term relationship, the Engle-Granger cointegration test and ARDL bound test are used for the study and they found that there is a cointegration between the actual log of price-to-dividend ratio and MLR Rate under CAPM, ICAPM and APT model.

For the short term relationship, the Wald tests for short term variables are used for the study and it is found that there was no significant effect of the MLR Rate on all models.

Table 8.38 Error Correction Model of MLR Rate Test under CAPM

Variable	Coefficient	t-Statistic	P-Value
Constant	**-0.003**	-0.44	0.66
Error Correction Term(t-1)	**-0.150***	-3.01	0.00
Δ Log Price-to-Dividend(t-1)	**0.089**	0.92	0.36
Δ Log Price-to-Dividend(t-2)	**0.210****	2.11	0.04
Δ Log Price-to-Dividend(t-3)	**0.028**	0.32	0.75
Δ Log Price-to-Dividend(t-4)	**0.177****	1.97	0.05
Δ Log Price-to-Dividend(t-5)	**0.008**	0.09	0.93
Δ Sustainable Growth(t)	**0.024***	4.44	0.00
Δ Sustainable Growth(t-1)	**0.002**	0.38	0.70
Δ Sustainable Growth(t-2)	**-0.002**	-0.28	0.78
Δ Sustainable Growth(t-3)	**-0.008**	-1.40	0.17
Δ Sustainable Growth(t-4)	**-0.008**	-1.46	0.15
Δ Sustainable Growth(t-5)	**0.007**	1.24	0.22
Δ MLR Rate(t)	**-0.080**	-1.19	0.23
Δ MLR Rate(t-1)	**0.028**	0.42	0.67
Δ MLR Rate(t-2)	**0.001**	0.02	0.99
Δ MLR Rate(t-3)	**-0.070**	-1.07	0.29
Δ MLR Rate(t-4)	**0.007**	0.10	0.92
Δ MLR Rate(t-5)	**-0.084**	-1.29	0.20
ΔMSCI World Return(t)	**0.007***	4.88	0.00
ΔMSCI World Return(t-1)	**0.004***	2.86	0.01
R-squared	0.47		
Akaike info criterion	-2.19		
Schwarz criterion	-1.71		
Hannan-Quinn criter.	-1.99		
Test	**t/F-Statistic**	**P-Value**	
Wald Test (Long Term)	8.92*		
Wald Test (Short Term)	1.35	0.24	
LM Correlation test	4.88*	0.01	
Heteroskedastic test- Breusch-Pagan-Godfrey	0.83	0.67	
Residual Unit Root Test	I(0)		
Augmented Dickey-Fuller Test	**-11.56***	0.00	

Note: *1%, **5%, ***10% Significance level

Table 8.39 Error Correction Model of MLR Rate Test under ICAPM

	Coefficient	t-Statistic	P-Value
Constant	**-0.001**	-0.17	0.87
Error Correction Term(t-1)	**-0.157***	-2.90	0.00
Δ Log Price-to-Dividend(t-1)	**0.002**	0.02	0.99
Δ Log Price-to-Dividend(t-2)	**0.033**	0.33	0.74
Δ Log Price-to-Dividend(t-3)	**0.042**	0.43	0.67
Δ Log Price-to-Dividend(t-4)	**0.191****	1.86	0.07
Δ Log Price-to-Dividend(t-5)	**-0.048**	-0.49	0.63
Δ Sustainable Growth(t)	**0.026***	4.22	0.00
Δ Sustainable Growth(t-1)	**-0.003**	-0.46	0.64
Δ Sustainable Growth(t-2)	**0.003**	0.54	0.59
Δ Sustainable Growth(t-3)	**-0.012****	-2.05	0.04
Δ Sustainable Growth(t-4)	**-0.009**	-1.55	0.12
Δ Sustainable Growth(t-5)	**0.001**	0.16	0.87
Δ MLR Rate(t)	**-0.113**	-1.53	0.13
Δ MLR Rate(t-1)	**0.003**	0.03	0.97
Δ MLR Rate(t-2)	**0.029**	0.40	0.69
Δ MLR Rate(t-3)	**-0.073**	-0.97	0.33
Δ MLR Rate(t-4)	**-0.045**	-0.58	0.56
Δ MLR Rate(t-5)	**-0.086**	-1.21	0.23
Δ Equities Volatility(t)	**-0.0005**	-1.16	0.25
Δ Equities Volatility(t-1)	**0.0006**	1.39	0.17
Δ Equities Volatility(t-2)	**-0.0001**	-0.24	0.81
R-squared	0.36		
Akaike info criterion	-1.98		
Schwarz criterion	-1.48		
Hannan-Quinn criter.	-1.77		
Test	**t/F-Statistic**	**P-Value**	
Wald Test (Long Term)	2.38	0.06	
Wald Test (Short Term)	1.96	0.08	
LM Correlation test	0.17	0.84	
Heteroskedastic test- Breusch-Pagan-Godfrey	0.61	0.91	
Residual Unit Root Test	I(0)		
Augmented Dickey-Fuller Test	-11.05*	0.00	

Note: *1%, **5%, ***10% Significance level

Table 8.40 Error Correction Model of MLR Rate Test under APT

	Coefficient	t-Statistic	P-Value
Constant	**-0.001**	-0.15	0.88
Error Correction Term(t-1)	**-0.282***	-4.41	0.00
Δ Log Price-to-Dividend(t-1)	**0.010**	0.11	0.92
Δ Log Price-to-Dividend(t-2)	**0.063**	0.68	0.50
Δ Log Price-to-Dividend(t-3)	**-0.006**	-0.07	0.94
Δ Log Price-to-Dividend(t-4)	**0.217**	2.63	0.01
Δ Log Price-to-Dividend(t-5)	**-0.026**	-0.32	0.75
Δ Sustainable Growth(t)	**0.021***	4.31	0.00
Δ Sustainable Growth(t-1)	**0.002**	0.35	0.73
Δ Sustainable Growth(t-2)	**0.000**	0.02	0.99
Δ Sustainable Growth(t-3)	**-0.005**	-1.01	0.31
Δ Sustainable Growth(t-4)	**-0.009*****	-1.76	0.08
Δ Sustainable Growth(t-5)	**0.005**	0.91	0.36
Δ MLR Rate(t)	**-0.062**	-0.97	0.34
Δ MLR Rate(t-1)	**0.026**	0.40	0.69
Δ MLR Rate(t-2)	**-0.016**	-0.25	0.80
Δ MLR Rate(t-3)	**-0.058**	-0.87	0.39
Δ MLR Rate(t-4)	**0.042**	0.62	0.53
Δ MLR Rate(t-5)	**-0.130**	-1.98	0.05
Δ VIX Index(t)	**-0.007***	-2.81	0.01
Δ VIX Index(t-1)	**-0.003**	-0.99	0.32
Δ Emerging Market Spread(t)	**0.00012**	0.40	0.69
Δ Emerging Market Spread(t-1)	**0.00025**	0.86	0.39
Δ Emerging Market Spread(t-2)	**-0.00003**	-0.15	0.88
Δ Inflation Volatility(t)	**-172.8**	-0.46	0.64
Δ Inflation Volatility(t-1)	**-352.4**	-0.89	0.37
R-squared			
Akaike info criterion	-2.36		
Schwarz criterion	-1.75		
Hannan-Quinn criter.	-2.11		
Test	**t/F-Statistic**	**P-Value**	
Wald Test (Long Term)	4.53*		
Wald Test (Short Term)	1.79	0.11	
LM Correlation test	0.90	0.41	
Heteroskedastic test- Breusch-Pagan-	0.70	0.84	
Residual Unit Root Test	I(0)		
Augmented Dickey-Fuller Test	-10.38*	0.00	

Note: *1%, **5%, ***10% Significance level

Table 8.41 summarizes the results of the long term relationship between the log of price-to-dividend ratio and the role of monetary policy. The effect of the MLR Rate on Log Price-to-Dividend on average is -0.0752. An increase of the MLR Rate by 1% will have negative effect on Price-to-Dividend on an average of 7.24% that is lower effect than the RP Rate.

For the error correction model result on the short term relationship in Table 8.42, the Wald test on coefficients of differentials of the MLR Rate found that the F-value statistic for CAPM, ICAPM and APT model were 1.35, 1.96 and 1.79 respectively. There is only the ICAPM model which has a short term effect of differentials in the MLR rate on the differentials of asset price valuation at a 10% significance level. Therefore, there is no short term effect of the MLR Rate on Log Price-to-Dividend ratio.

Table 8.41 Long Term Relationship of MLR Rate on Equity Valuations

Y = Log Price-to-Dividend				
	CAPM	**ICAPM**	**APT**	**Average**
MLR Rate	-0.0672**	-0.0873	-0.0712*	**-0.0752**
% Price-to-Dividend				
	CAPM	**ICAPM**	**APT**	**Average**
ΔMLR Rate =1%	-6.50%	-8.36%	-6.87%	**-7.24%**

Note: *1%, **5%, ***10% Significance level

Table 8.42 Short Term Relationship of MLR Rate on Equity Valuations

	CAPM	**ICAPM**	**APT**
Wald Test Statistic	1.35	1.96***	1.79

Note: *1%, **5%, ***10% Significance level

8.5 Result Analysis and Summary

For monetary policy tools and transmission, there are the effects of policy rate (RP rate) on the money supply, deposit rates and lending rates in Table 8.43. The results show that there is Granger causality on the RP rate on all monetary transmission including deposit rates and lending rates and the impulse response function show the negative effect of policy rates on real money supply and the positive effects on deposit and lending rates. It is concluded that there are monetary transmissions from the implementation of the policy rate.

Table 8.43 Effect of RP Rate on Monetary Tools and Transmission

Effect of Policy Rate	Money Supply	Deposit Rate	MLR Rate
Granger Causality Test	29.31*	9.36***	16.69**
P-Value	*[0.00]*	*[0.05]*	*[0.01]*
Impulse Response Function	Negative	Positive	Positive

Note: *1%, **5%, ***10% Significance level

Table 8.44 Effect of Monetary Policy Effects on Bond Market

Effect of Policy Rate	RP Rate	Real Money Supply	Deposit Rate	MLR Rate
One year bond yields ($R_{1y,t}$)				
Granger Causality Test	12.71*	0.97	9.79**	12.37**
P-Value	*[0.00]*	*[0.81]*	*[0.04]*	*[0.05]*
Impulse Response Function	Positive	Negative	Positive	Positive
Three months bond yields ($R_{3m,t}$)				
Granger Causality Test	3.47	4.46	9.80**	11.10*
P-Value	*[0.32]*	*[0.22]*	*[0.02]*	*[0.01]*
Impulse Response Function	Positive	Negative	Positive	Positive

Note: *1%, **5%, ***10% Significance level

Table 8.44 shows that policy rates, deposit rate and lending rates have the significant effects on the market interest rates but real money supply has no effect on the bond market rate, because the BOT uses liquidity management to support the effectiveness of policy rates to meet BOT objectives. Therefore, BOT's monetary policy is effective in using policy rates on money transmission effects and BOT also uses monetary tools to manage liquidity adjustment along with BOT policy rates. For the results of monetary policy transmission study, I can concluded that the policy rate, deposit rate and lending rate will have an effect on bond market rates and can be used as a proxy to study the effect of monetary policy on asset prices; however, the real money supply as liquidity effect has no effect on bond market rates Therefore, the real money supply should not be used as a proxy of risk free rates to study the effect of monetary policy on asset prices. For the long term relationship, Engle-Granger cointegration test and ARDL bound test are used for this study. Table 8.45 shows that, for RP rate, there is cointegration between the actual log of price-to-dividend and fundamental values for all three models from the Engle-Granger cointegration test and ARDL bound test. For deposit rates and MLR rates, there are cointegrations between the actual log of price-to-dividend and fundamental values for all three models from the Engle-Granger cointegration test but, for the ARDL bound test, there are cointegrations between the actual log of price-to-dividend and fundamental values for CAPM and APT and there are no cointegrations between the actual log of price-to-dividend and fundamental values for ICAPM.

For the long term effects of monetary policy on asset prices, I found significant effects from the RP rate, deposit rate and lending rates on asset prices. For sensitivity effect in Table 8.46, the effect of RP rate on Log Price-to-Dividend on average is -0.0905. The increase of RP Rate by 1% will have a negative effect on Price-to-Dividend by an average of 8.65%. The effect of deposit rates on Log Price-to-Dividend on average is -0.062. An increase of deposit rate by 1% will have a negative effect on Price-to-Dividend on average of 6.02% that is a lower effect than the RP Rate. The effect of the MLR Rate on Log Price-to-Dividend on average is -0.0752. The increase of MLR Rate by 1% will have a negative effect on Price-to-Dividend by an average of 7.24% that is a lower effect than the RP Rate.

Table 8.45 Summary of Cointegration Test

	CAPM	ICAPM	APT
RP Rate			
Engle-Granger Test	-3.09**	-3.79*	-4.74*
P-Value	*[0.03]*	*[0.00]*	*[0.00]*
ARDL Bound Test (F-Value)	9.81*	3.63**	4.29*
Deposit Rate			
Engle-Granger Test	-3.00**	-3.58*	-4.75*
P-Value	*[0.04]*	*[0.01]*	*[0.00]*
ARDL Bound Test (F-Value)	8.62*	2.27	4.03*
MLR Rate			
Engle-Granger Test	-2.92**	-3.51*	-4.73*
P-Value	*[0.05]*	*[0.01]*	*[0.00]*
ARDL Bound Test (F-Value)	8.92*	2.38	4.53*

Note: *1%, **5%, ***10% Significance level

Table 8.46 Long Term Relationship of Monetary Policy on Asset Price Valuations

Y = Log Price-to-Dividend				
	CAPM	**ICAPM**	**APT**	**Average**
RP Rate	-0.092*	-0.089**	-0.091*	**-0.0905***
t-statistic	*[-6.07]*	*[-6.48]*	*[-6.41]*	
Deposit Rate	-0.0553*	-0.0681	-0.0627*	**-0.0620***
t-statistic	*[-2.80]*	*[-3.84]*	*[-4.10]*	
MLR Rate	-0.0672**	-0.0873	-0.0712*	**-0.0752***
t-statistic	*[-2.31]*	*[-3.38]*	*[-3.15]*	
% Price-to-Dividend				
	CAPM	**ICAPM**	**APT**	**Average**
Δ RP Rate =1%	-8.77%*	-8.51%**	-8.68%*	**-8.65%***
$\Delta\ Deposit\ Rate\ = 1\%$	-5.38%*	-6.58%	-6.08%*	**-6.02%***
$\Delta\ MLR\ Rate\ = 1\%$	-6.50%*	-8.36%	-6.87%*	**-7.24%***

Note: *1%, **5%, ***10% Significance level

For the short term effect in Table 8.47, for RP rate effect, the Wald test on coefficients of differentials of RP rate found that the F-value statistic for CAPM, ICAPM and APT model were insignificant at 1.55, 1.85 and 1.96 respectively. Therefore, there is no short term effect of RP rates on Log Price-to-Dividend ratios.

For the deposit rate effect, the Wald test on coefficients of differentials in the deposit rate found that the F-value statistic for CAPM, ICAPM and APT model were insignificant at 1.80, 1.50 and 1.37 respectively. Therefore, there is no short term effect of Deposit Rate on Log Price-to-Dividend ratio.

For MLR, the F-value statistic for CAPM, ICAPM and APT model are 1.35, 1.96 and 1.79 respectively. Therefore, there is only the ICAPM model that has a short term effect of differentials of the MLR rate on differentials of asset price valuation at a 10% significance level. Therefore, there is no short term effect of MLR Rates on Log Price-to-Dividend ratios.

Table 8.47 Short Term Relationship of Monetary Policy on Asset Price Valuation

	CAPM	**ICAPM**	**APT**
RP Rate			
Wald Test Statistic	1.55	1.85	1.96
P-Value	*[0.21]*	*[0.14]*	*[0.13]*
Effect of ΔRP Rate	Negative	Negative	Negative
Deposit Rate			
Wald Test Statistic	1.80	1.50	1.37
P-Value	*[0.11]*	*[0.19]*	*[0.24]*
Effect of Δ Deposit Rate	Negative	Negative	Negative
MLR Rate			
Wald Test Statistic	1.35	1.96***	1.79
P-Value	*[0.24]*	*[0.08]*	*[0,11]*
Effect of Δ MLR Rate	Negative	Negative	Negative

Note: *1%, **5%, ***10% Significance level

8.6 Discussion

The Engle-Granger Cointegration test and ARDL bound test found the relationship between the Logs of Price-to-Dividend and monetary policy. Interest rate from RP rate, deposit rate and MLR rate negatively impact on asset price valuation. For the sensitivity effect, the RP rate has a higher impact on asset price valuation than deposit rates and lending rates because the deposit rate and lending rate are monetary transmission mechanisms that will have a second-round impact on the asset prices but the RP rate will directly affect asset prices from all other monetary transmission mechanisms including interest channels, expectation channels, asset price channels and credit channels.

The negative effects of monetary policy rate on asset prices conform with all three models, including CAPM, ICAPM and APT. For CAPM, some explanation is that if beta is less than one, the effect of interest rates will be negative on asset price valuations. For beta estimation in Table 8.48, I found that beta of market was 0.91, less than one; therefore, the interest rate will have a negative effect from the monetary policy rate under CAPM.

Table 8.48 Beta Estimation from CAPM Model

	Coefficient
Constant	1.00**
t-statistic	*[2.49]*
Risk Premium	0.91*
t-statistic	[11.02]
R-squared	0.49
Akaike info criterion	5.89
Schwarz criterion	5.94
Hannan-Quinn criter.	5.91

Note: *1%, **5%, ***10% Significance level

For further study of individual markets, sector indices and individual stocks, CAPM can explain that the lower risk assets will have a negative effect of interest rates and that higher risk assets will have a positive effect on interest rates. Further study will help explain more clearly picture of interest rate effects on individual asset prices than the overall market as a whole.

CHAPTER 9

CONCLUSION

The studies in this paper were threefold. They were

1) To detect asset price bubbles in Thailand Stock Exchange Market during 2002-2012 due to a significantly rising stock market during that period

2) To find the long term and short term effects of risk especially financial and macro variables volatilities on asset prices in Thailand

3) To find the long term and short term effect of monetary policy on asset prices in Thailand because there are many debates on the effect of monetary policy on asset prices, especially during the low interest rate with a rising stock market during 2002-2012.

The dividend discounted model using expected stock return from actual return, CAPM, ICAPM and APT Model. The cointegration test under Engle-Granger method and ARDL Bound test are used to detect bubbles and find a long term relationship between the actual log of price-to-dividend and its fundamental value. The error correction model is used to find long term and short term relationships between the investment risk factors including equity return volatility, inflation volatility, VIX index and JP Morgan Emerging Market spread, and asset price valuation. For monetary policy studies, VAR model is used to study the effect of policy rate for monetary transmissions on the real money supply, deposit rates and lending rates and their monetary transmissions on the bond market. The error correction model is also used to find long term and short term relationships between the monetary policy impacts including RP rate, deposit rate and lending rate, and asset price valuation.

For asset price bubble detection, the results show a cointegration between actual value of Log Price-to-Dividend ratio and fundamental values under all four models including perfect expectation Model, CAPM, ICAPM and APT model. I can conclude that there were no bubble signs for Thailand stock market during 2002-2012. The limitation of the study is from the requirement for dividend data. Because of the Asian financial crises during 1997; therefore, the dividend data dropped suddenly to unusual levels. An alternative study method is to use other relative valuation ratios, including the price-to-earnings and price-to-operating-cashflow that are more stable than dividends. For further study, although there is no sign of an asset bubble on the equity market indices, some individual stocks valuations increased aggressively after 2008; therefore, an individual stock bubble study should be considered for further study. Lastly, there are other factors that affect Log of Price-dividend ratio including the liquidity effects or the change of shareholders benefit payments like treasury stocks. Those factors could be affecting significantly the valuation and further study may help to clarify the possibility of asset bubbles.

For the relationship between investment risk factors and asset price valuation, there are the significant effects from equity return volatilities, inflation volatilities, VIX index and JP Morgan Emerging Market Spread for the long term effects on asset prices. For the short term effect, the differentials of equity return volatilities and VIX Index also have a significant effect on differentials of Log Price-to-Dividend ratio; however, differentials of other risk factors including JP Morgan Emerging Market Spread and inflation volatilities have no effects on differentials of Log Price-to-Dividend ratio. Therefore, the study shows that asset prices rely on their own equity return volatilities, other market volatilities and macroeconomic volatilities and the financial and macro volatilities play an important role on the asset price valuation. Further study should be on the mutual relationship between the volatilities and asset price valuation. Finally, under the high asset price valuation in a bubble situation, it is likely to cause high financial and macro volatilities and negative effects on the economy.

For the monetary policy study on monetary policy tools and transmission, there are the effects of policy rate (RP rate) on the money supply, deposit rates and lending rates and there are also the effect of policy rates, deposit rates and lending rates on bond market rates under the Granger causality test and impulse response function; but the real money supply has a temporary negative effect on bond market interest rates from the impulse response function but has no permanent effect from the Granger causality test, mainly because BOT uses liquidity management to support the effectiveness of policy rate to ensure that the policy rates play an important role on the monetary transmission. It can be concluded that the policy rate, deposit rate and lending rate will have an effect on bond market rates and can be used as a proxy to study the effect of monetary policy on the asset prices; however, the real money supply as a liquidity effect has no effect on bond market rates and the real money supply should not be used as a proxy of risk free rate to study the effect of monetary policy on asset prices.

For the long term relationship between monetary policies and asset prices, I found the significant effects from policy rates, deposit rates and lending rates on asset prices. For the short term effect, policy rates, deposit rates and lending rates have no short term effect on asset price valuation. For the magnitude of sensitivity effect, RP rates have higher impact on asset price valuation than deposit rates and lending rates because the deposit rate and lending rate are the monetary transmission mechanism that will have a second-round impact on asset prices but the RP rate will directly affect asset prices from all other monetary transmission mechanisms including interest channels, expectation channels, asset price channels and credit channels. The negative effects of monetary policy rate on asset prices conform with all three models including CAPM, ICAPM and APT. For CAPM, some explanation is that if beta which was estimated at 0.91 is less than one, the effect of interest rates will be negative on asset price valuations. For further study on individual markets, sector indices and individual stocks, CAPM can help explain that lower risk assets will have a negative effect from the interest rate and the higher risk assets will have a positive effect from the interest rate.

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APPENDIX

Appendix A Data

	Price	Dividend	Log Price	Log Dividend	Log Price-to-Dividend	Log Price-to-Dividend Seasonal
Apr-02	371.42	9.44	5.92	2.24	3.67	3.69
May-02	407.96	9.51	6.01	2.25	3.76	3.78
Jun-02	389.10	9.54	5.96	2.26	3.71	3.71
Jul-02	376.02	9.49	5.93	2.25	3.68	3.65
Aug-02	361.16	9.81	5.89	2.28	3.61	3.59
Sep-02	331.79	9.36	5.80	2.24	3.57	3.57
Oct-02	357.22	9.42	5.88	2.24	3.63	3.65
Nov-02	364.90	9.33	5.90	2.23	3.67	3.68
Dec-02	356.48	9.70	5.88	2.27	3.60	3.58
Jan-03	370.01	9.62	5.91	2.26	3.65	3.65
Feb-03	361.32	11.69	5.89	2.46	3.43	3.41
Mar-03	364.55	12.96	5.90	2.56	3.34	3.35
Apr-03	374.63	15.58	5.93	2.75	3.18	3.20
May-03	403.82	15.69	6.00	2.75	3.25	3.27
Jun-03	461.82	15.67	6.14	2.75	3.38	3.38
Jul-03	484.11	15.66	6.18	2.75	3.43	3.40
Aug-03	537.71	18.12	6.29	2.90	3.39	3.38
Sep-03	578.98	18.53	6.36	2.92	3.44	3.44
Oct-03	639.45	18.53	6.46	2.92	3.54	3.56
Nov-03	646.03	19.71	6.47	2.98	3.49	3.50
Dec-03	772.15	19.61	6.65	2.98	3.67	3.65
Jan-04	698.90	19.82	6.55	2.99	3.56	3.56
Feb-04	716.30	17.08	6.57	2.84	3.74	3.72
Mar-04	647.30	22.14	6.47	3.10	3.38	3.39
Apr-04	648.15	20.48	6.47	3.02	3.45	3.47
May-04	641.05	20.73	6.46	3.03	3.43	3.45
Jun-04	646.64	21.00	6.47	3.04	3.43	3.43
Jul-04	636.70	21.00	6.46	3.04	3.41	3.38
Aug-04	624.59	21.91	6.44	3.09	3.35	3.34
Sep-04	644.67	22.26	6.47	3.10	3.37	3.36
Oct-04	628.16	22.15	6.44	3.10	3.34	3.36
Nov-04	656.73	21.42	6.49	3.06	3.42	3.43
Dec-04	668.10	21.67	6.50	3.08	3.43	3.41
Jan-05	701.91	21.66	6.55	3.08	3.48	3.48

	Price	Dividend	Log Price	Log Dividend	Log Price-to-Dividend	Log Price-to-Dividend Seasonal
Feb-05	741.55	21.96	6.61	3.09	3.52	3.50
Mar-05	681.49	24.50	6.52	3.20	3.33	3.34
Apr-05	658.88	26.61	6.49	3.28	3.21	3.23
May-05	667.55	26.94	6.50	3.29	3.21	3.23
Jun-05	675.50	26.60	6.52	3.28	3.23	3.24
Jul-05	675.67	26.64	6.52	3.28	3.23	3.20
Aug-05	697.85	27.96	6.55	3.33	3.22	3.20
Sep-05	723.23	28.43	6.58	3.35	3.24	3.23
Oct-05	682.62	28.83	6.53	3.36	3.16	3.18
Nov-05	667.75	28.63	6.50	3.35	3.15	3.16
Dec-05	713.73	28.03	6.57	3.33	3.24	3.22
Jan-06	762.63	28.50	6.64	3.35	3.29	3.28
Feb-06	744.05	28.49	6.61	3.35	3.26	3.24
Mar-06	733.25	30.87	6.60	3.43	3.17	3.19
Apr-06	768.29	29.26	6.64	3.38	3.27	3.29
May-06	709.43	30.09	6.56	3.40	3.16	3.18
Jun-06	678.13	30.01	6.52	3.40	3.12	3.12
Jul-06	691.49	29.99	6.54	3.40	3.14	3.11
Aug-06	690.90	30.50	6.54	3.42	3.12	3.11
Sep-06	686.10	32.89	6.53	3.49	3.04	3.04
Oct-06	722.46	32.87	6.58	3.49	3.09	3.10
Nov-06	739.06	32.88	6.61	3.49	3.11	3.12
Dec-06	679.84	33.25	6.52	3.50	3.02	3.00
Jan-07	654.04	32.95	6.48	3.50	2.99	2.98
Feb-07	677.13	33.00	6.52	3.50	3.02	3.00
Mar-07	673.71	26.69	6.51	3.28	3.23	3.25
Apr-07	699.16	30.75	6.55	3.43	3.12	3.14
May-07	737.40	30.44	6.60	3.42	3.19	3.21
Jun-07	776.79	30.53	6.66	3.42	3.24	3.24
Jul-07	859.76	30.50	6.76	3.42	3.34	3.31
Aug-07	813.21	29.58	6.70	3.39	3.31	3.30
Sep-07	845.50	29.30	6.74	3.38	3.36	3.36
Oct-07	907.28	29.10	6.81	3.37	3.44	3.45
Nov-07	846.44	29.03	6.74	3.37	3.37	3.38
Dec-07	858.10	28.78	6.75	3.36	3.39	3.38
Jan-08	784.23	28.86	6.66	3.36	3.30	3.30
Feb-08	845.76	28.64	6.74	3.35	3.39	3.37
Mar-08	817.03	30.65	6.71	3.42	3.28	3.30
Apr-08	832.45	30.18	6.72	3.41	3.32	3.34

	Price	Dividend	Log Price	Log Dividend	Log Price-to-Dividend	Log Price-to-Dividend Seasonal
May-08	833.65	30.28	6.73	3.41	3.32	3.34
Jun-08	768.59	30.82	6.64	3.43	3.22	3.22
Jul-08	676.32	30.87	6.52	3.43	3.09	3.06
Aug-08	684.44	31.77	6.53	3.46	3.07	3.06
Sep-08	596.54	32.84	6.39	3.49	2.90	2.90
Oct-08	416.53	33.11	6.03	3.50	2.53	2.55
Nov-08	401.84	33.35	6.00	3.51	2.49	2.50
Dec-08	449.96	33.84	6.11	3.52	2.59	2.57
Jan-09	437.69	33.40	6.08	3.51	2.57	2.57
Feb-09	431.52	34.81	6.07	3.55	2.52	2.50
Mar-09	431.50	30.37	6.07	3.41	2.65	2.67
Apr-09	491.69	28.23	6.20	3.34	2.86	2.88
May-09	560.41	28.55	6.33	3.35	2.98	3.00
Jun-09	597.48	28.02	6.39	3.33	3.06	3.06
Jul-09	624.00	28.04	6.44	3.33	3.10	3.07
Aug-09	653.25	27.12	6.48	3.30	3.18	3.17
Sep-09	717.07	26.07	6.58	3.26	3.31	3.31
Oct-09	685.24	25.91	6.53	3.25	3.28	3.29
Nov-09	689.07	25.56	6.54	3.24	3.29	3.31
Dec-09	734.54	25.08	6.60	3.22	3.38	3.36
Jan-10	696.55	24.99	6.55	3.22	3.33	3.32
Feb-10	721.37	24.56	6.58	3.20	3.38	3.36
Mar-10	787.98	26.04	6.67	3.26	3.41	3.43
Apr-10	763.51	30.61	6.64	3.42	3.22	3.24
May-10	750.43	31.26	6.62	3.44	3.18	3.20
Jun-10	797.31	31.19	6.68	3.44	3.24	3.24
Jul-10	855.83	31.20	6.75	3.44	3.31	3.28
Aug-10	913.19	32.16	6.82	3.47	3.35	3.33
Sep-10	975.30	32.66	6.88	3.49	3.40	3.40
Oct-10	984.46	32.81	6.89	3.49	3.40	3.42
Nov-10	1,005.12	36.54	6.91	3.60	3.31	3.33
Dec-10	1,032.76	36.68	6.94	3.60	3.34	3.32
Jan-11	964.10	36.86	6.87	3.61	3.26	3.26
Feb-11	987.91	37.61	6.90	3.63	3.27	3.25
Mar-11	1,047.48	38.42	6.95	3.65	3.31	3.32
Apr-11	1,093.56	38.32	7.00	3.65	3.35	3.37
May-11	1,073.83	38.60	6.98	3.65	3.33	3.35
Jun-11	1,041.48	38.82	6.95	3.66	3.29	3.29
Jul-11	1,133.53	38.79	7.03	3.66	3.37	3.34

	Price	Dividend	Log Price	Log Dividend	Log Price-to-Dividend	Log Price-to-Dividend Seasonal
Aug-11	1,070.05	41.58	6.98	3.73	3.25	3.24
Sep-11	916.21	42.46	6.82	3.75	3.07	3.07
Oct-11	974.75	42.11	6.88	3.74	3.14	3.16
Nov-11	995.33	38.49	6.90	3.65	3.25	3.26
Dec-11	1,025.32	43.19	6.93	3.77	3.17	3.15
Jan-12	1,083.97	44.18	6.99	3.79	3.20	3.20
Feb-12	1,160.90	45.74	7.06	3.82	3.23	3.22
Mar-12	1,196.77	44.62	7.09	3.80	3.29	3.31
Apr-12	1,228.49	42.58	7.11	3.75	3.36	3.38
May-12	1,141.50	44.15	7.04	3.79	3.25	3.27
Jun-12	1,172.11	44.13	7.07	3.79	3.28	3.28
Jul-12	1,199.30	44.14	7.09	3.79	3.30	3.27
Aug-12	1,227.48	45.47	7.11	3.82	3.30	3.28
Sep-12	1,298.79	44.26	7.17	3.79	3.38	3.38
Oct-12	1,298.87	44.75	7.17	3.80	3.37	3.38
Nov-12	1,324.04	45.09	7.19	3.81	3.38	3.39
Dec-12	1,391.93	40.50	7.24	3.70	3.54	3.52

	Sustainable growth rate	Sustainable growth rate Seasonal	Rate of return	Rate of return Seasonal	3months Treasury Yield	3months Treasury Yield Seasonal
Apr-02	7.87	8.39	0.40	-1.81	1.97	2.05
May-02	9.09	9.64	9.94	10.49	1.97	2.07
Jun-02	12.12	12.16	-4.58	-5.06	1.97	2.06
Jul-02	11.92	11.58	-3.36	-4.43	1.90	1.86
Aug-02	12.05	12.01	-3.75	-4.33	1.84	1.75
Sep-02	12.19	11.62	-8.02	-7.48	1.95	1.83
Oct-02	12.33	12.01	7.75	9.80	1.84	1.70
Nov-02	12.56	12.19	2.22	3.43	1.70	1.60
Dec-02	13.98	14.05	-2.18	-5.10	1.71	1.69
Jan-03	13.81	13.78	3.82	6.87	1.56	1.59
Feb-03	12.49	12.55	-1.56	-2.78	1.43	1.52
Mar-03	12.68	13.13	1.77	2.86	1.60	1.70
Apr-03	11.05	11.57	4.59	2.37	1.60	1.68
May-03	11.09	11.63	7.93	8.47	1.54	1.64
Jun-03	12.66	12.70	14.40	13.93	1.29	1.38
Jul-03	12.40	12.06	4.83	3.76	1.16	1.12
Aug-03	11.18	11.14	11.74	11.15	1.18	1.10
Sep-03	13.44	12.87	7.83	8.37	1.12	1.00
Oct-03	11.64	11.32	10.49	12.54	1.21	1.07
Nov-03	11.26	10.89	1.25	2.47	1.17	1.07
Dec-03	12.11	12.18	19.58	16.66	1.06	1.04
Jan-04	12.07	12.03	-9.45	-6.40	1.09	1.13
Feb-04	13.74	13.80	2.51	1.30	1.06	1.15
Mar-04	12.23	12.68	-8.49	-7.40	1.03	1.13
Apr-04	13.35	13.87	0.90	-1.31	1.17	1.25
May-04	13.39	13.93	-0.98	-0.44	1.06	1.16
Jun-04	14.32	14.36	0.94	0.46	1.05	1.14
Jul-04	13.13	12.79	-1.54	-2.61	1.35	1.31
Aug-04	12.61	12.57	-1.25	-1.84	1.42	1.34
Sep-04	16.56	15.99	3.40	3.94	1.57	1.45
Oct-04	16.66	16.34	-2.54	-0.49	1.64	1.50
Nov-04	17.55	17.18	4.66	5.87	1.70	1.60
Dec-04	19.10	19.17	1.82	-1.09	1.85	1.83
Jan-05	19.18	19.15	5.10	8.15	1.96	2.00
Feb-05	19.43	19.49	5.72	4.50	2.04	2.14

	Sustainable growth rate	Sustainable growth rate Seasonal	Rate of return	Rate of return Seasonal	3months Treasury Yield	3months Treasury Yield Seasonal
Mar-05	18.20	18.65	-6.65	-5.56	2.11	2.21
Apr-05	17.66	18.18	-2.28	-4.49	2.33	2.41
May-05	17.39	17.93	1.48	2.02	2.44	2.54
Jun-05	18.13	18.17	1.20	0.73	2.36	2.45
Jul-05	18.32	17.98	0.03	-1.04	2.85	2.81
Aug-05	17.95	17.92	4.09	3.51	2.75	2.67
Sep-05	17.18	16.61	3.87	4.41	2.87	2.75
Oct-05	16.84	16.52	-5.54	-3.49	3.39	3.25
Nov-05	17.05	16.68	-2.10	-0.89	3.72	3.62
Dec-05	14.78	14.85	6.89	3.97	3.88	3.86
Jan-06	14.81	14.77	6.96	10.00	3.96	4.00
Feb-06	14.73	14.79	-2.38	-3.59	4.02	4.12
Mar-06	12.66	13.11	0.31	1.40	4.57	4.67
Apr-06	13.26	13.78	5.53	3.31	4.74	4.82
May-06	13.11	13.65	-7.41	-6.87	4.84	4.94
Jun-06	14.00	14.04	-4.41	-4.89	4.97	5.06
Jul-06	17.00	16.67	1.97	0.90	4.93	4.89
Aug-06	16.71	16.67	0.78	0.20	4.90	4.82
Sep-06	14.39	13.81	-0.11	0.43	4.97	4.85
Oct-06	14.27	13.95	5.38	7.43	4.94	4.80
Nov-06	14.24	13.87	2.37	3.58	4.80	4.70
Dec-06	9.41	9.47	-7.96	-10.88	4.93	4.91
Jan-07	9.48	9.45	-3.73	-0.68	4.64	4.68
Feb-07	9.43	9.49	3.61	2.39	4.47	4.57
Mar-07	9.81	10.26	0.50	1.59	3.97	4.07
Apr-07	8.53	9.05	5.19	2.98	3.53	3.61
May-07	8.55	9.09	5.70	6.24	3.11	3.21
Jun-07	8.20	8.24	5.35	4.88	2.98	3.07
Jul-07	8.09	7.75	10.68	9.61	3.06	3.02
Aug-07	8.48	8.45	-4.83	-5.41	3.04	2.96
Sep-07	8.31	7.74	4.43	4.97	3.08	2.96
Oct-07	7.75	7.43	7.35	9.40	3.12	2.98
Nov-07	7.30	6.93	-6.66	-5.44	3.16	3.06
Dec-07	8.71	8.78	1.39	-1.52	3.19	3.17
Jan-08	9.57	9.54	-8.54	-5.50	3.07	3.11

	Sustainable growth rate	Sustainable growth rate Seasonal	Rate of return	Rate of return Seasonal	3months Treasury Yield	3months Treasury Yield Seasonal
Feb-08	8.81	8.87	7.88	6.67	3.05	3.15
Mar-08	7.70	8.15	-2.35	-1.26	2.93	3.03
Apr-08	7.95	8.47	3.00	0.78	3.07	3.15
May-08	8.68	9.22	0.35	0.89	3.23	3.33
Jun-08	10.88	10.92	-7.73	-8.21	3.32	3.41
Jul-08	10.74	10.40	-12.00	-13.07	3.48	3.44
Aug-08	10.41	10.37	2.08	1.50	3.77	3.69
Sep-08	9.82	9.25	-12.14	-11.60	3.77	3.65
Oct-08	9.63	9.31	-30.07	-28.02	3.45	3.31
Nov-08	9.65	9.28	-3.36	-2.15	3.21	3.11
Dec-08	1.67	1.73	12.13	9.21	2.10	2.08
Jan-09	1.83	1.80	-2.70	0.34	1.84	1.88
Feb-09	1.27	1.33	-1.02	-2.24	1.42	1.52
Mar-09	-0.85	-0.40	1.02	2.11	1.13	1.23
Apr-09	0.10	0.62	15.56	13.34	1.02	1.10
May-09	-0.12	0.42	14.39	14.93	1.06	1.16
Jun-09	-1.15	-1.11	6.63	6.15	1.17	1.26
Jul-09	-0.71	-1.05	4.45	3.38	1.12	1.08
Aug-09	-0.32	-0.36	5.49	4.91	1.18	1.10
Sep-09	1.12	0.55	10.35	10.89	1.22	1.10
Oct-09	1.35	1.03	-4.37	-2.33	1.25	1.11
Nov-09	1.40	1.03	0.61	1.82	1.25	1.15
Dec-09	8.46	8.52	6.62	3.70	1.14	1.12
Jan-10	8.49	8.46	-5.17	-2.13	1.24	1.28
Feb-10	8.73	8.79	3.75	2.53	1.25	1.35
Mar-10	10.23	10.68	10.05	11.14	1.24	1.34
Apr-10	9.03	9.55	-1.65	-3.86	1.19	1.27
May-10	8.92	9.46	-1.36	-0.82	1.19	1.29
Jun-10	9.17	9.21	6.25	5.77	1.21	1.30
Jul-10	9.30	8.96	7.35	6.28	1.56	1.52
Aug-10	8.94	8.90	7.40	6.82	1.69	1.61
Sep-10	9.56	8.99	7.27	7.81	1.67	1.55
Oct-10	9.72	9.40	1.00	3.05	1.71	1.57
Nov-10	8.75	8.38	2.51	3.73	1.75	1.65
Dec-10	10.17	10.23	2.78	-0.14	1.97	1.95

	Sustainable growth rate	Sustainable growth rate Seasonal	Rate of return	Rate of return Seasonal	3months Treasury Yield	3months Treasury Yield Seasonal
Jan-11	10.04	10.01	-6.63	-3.59	2.11	2.15
Feb-11	9.82	9.88	2.68	1.46	2.25	2.35
Mar-11	11.61	12.06	6.71	7.80	2.50	2.60
Apr-11	11.82	12.34	5.49	3.27	2.63	2.71
May-11	11.66	12.20	-1.53	-0.99	2.74	2.84
Jun-11	12.61	12.65	-2.99	-3.47	3.06	3.15
Jul-11	12.38	12.04	8.85	7.77	3.28	3.24
Aug-11	11.65	11.61	-4.83	-5.41	3.40	3.32
Sep-11	11.75	11.17	-13.90	-13.35	3.50	3.38
Oct-11	11.86	11.54	6.42	8.47	3.42	3.28
Nov-11	12.88	12.51	2.16	3.37	3.25	3.15
Dec-11	9.72	9.79	3.51	0.59	3.14	3.12
Jan-12	9.49	9.46	5.84	8.88	3.03	3.07
Feb-12	9.02	9.08	7.43	6.21	3.02	3.12
Mar-12	9.03	9.48	3.57	4.66	3.02	3.12
Apr-12	9.62	10.14	3.43	1.22	3.06	3.14
May-12	9.28	9.82	-6.71	-6.17	3.04	3.14
Jun-12	7.95	7.99	2.70	2.22	3.03	3.12
Jul-12	7.95	7.61	2.33	1.25	3.01	2.97
Aug-12	7.61	7.58	3.19	2.61	3.00	2.92
Sep-12	9.69	9.12	6.13	6.67	3.02	2.90
Oct-12	9.63	9.31	0.06	2.11	2.77	2.63
Nov-12	10.17	9.80	2.00	3.21	2.75	2.65
Dec-12	11.67	11.74	5.16	2.24	2.76	2.74

	10year treasury yield	10year treasury yield Seasonal	Inflation	Inflation Seasonal	R/P	R/P Seasonal
Apr-02	5.65	5.80	0.01	0.00	2.00	2.06
May-02	5.58	5.65	0.00	0.00	2.00	2.12
Jun-02	5.35	5.35	0.00	0.00	2.00	2.10
Jul-02	5.06	5.01	0.00	0.00	2.00	2.05
Aug-02	4.50	4.58	0.00	0.00	2.00	1.95
Sep-02	4.03	4.02	0.00	0.01	2.00	1.91
Oct-02	3.88	3.73	0.01	0.01	2.00	1.84
Nov-02	3.67	3.49	0.00	0.00	1.75	1.65
Dec-02	3.64	3.57	0.00	0.00	1.75	1.68
Jan-03	3.18	3.25	0.01	0.01	1.75	1.76
Feb-03	3.26	3.29	0.00	0.00	1.75	1.85
Mar-03	3.35	3.42	0.00	0.00	1.75	1.78
Apr-03	3.25	3.40	0.00	0.00	1.75	1.81
May-03	2.78	2.85	0.00	0.00	1.75	1.87
Jun-03	2.38	2.38	0.00	0.00	1.25	1.35
Jul-03	2.81	2.76	0.00	0.00	1.25	1.30
Aug-03	3.17	3.25	0.01	0.01	1.25	1.20
Sep-03	3.41	3.40	0.00	0.00	1.25	1.16
Oct-03	4.17	4.02	0.00	0.00	1.25	1.09
Nov-03	4.79	4.61	0.00	0.01	1.25	1.15
Dec-03	4.94	4.87	0.00	0.00	1.25	1.18
Jan-04	4.72	4.79	0.00	0.00	1.25	1.26
Feb-04	4.50	4.53	0.01	0.01	1.25	1.35
Mar-04	4.06	4.13	0.00	0.00	1.25	1.28
Apr-04	4.83	4.98	0.00	0.00	1.25	1.31
May-04	4.93	5.00	0.00	0.00	1.25	1.37
Jun-04	5.17	5.17	0.00	0.00	1.25	1.35
Jul-04	5.14	5.09	0.00	0.00	1.25	1.30
Aug-04	4.96	5.04	0.00	0.01	1.50	1.45
Sep-04	4.80	4.79	0.00	0.01	1.50	1.41
Oct-04	4.93	4.78	0.00	0.00	1.75	1.59
Nov-04	4.99	4.81	0.00	0.00	1.75	1.65
Dec-04	4.85	4.78	0.00	0.00	2.00	1.93
Jan-05	4.91	4.98	0.00	0.00	2.00	2.01
Feb-05	4.78	4.81	0.00	0.00	2.00	2.10

	10year treasury yield	10year treasury yield Seasonal	Inflation	Inflation Seasonal	R/P	R/P Seasonal
Mar-05	4.55	4.62	0.01	0.01	2.25	2.28
Apr-05	4.24	4.39	0.01	0.00	2.25	2.31
May-05	4.23	4.30	0.01	0.00	2.25	2.37
Jun-05	4.01	4.01	0.00	0.00	2.50	2.60
Jul-05	4.66	4.61	0.02	0.02	2.75	2.80
Aug-05	4.94	5.02	0.01	0.01	2.75	2.70
Sep-05	5.32	5.31	0.01	0.01	3.25	3.16
Oct-05	6.58	6.43	0.00	0.00	3.75	3.59
Nov-05	6.07	5.89	-0.01	0.00	3.75	3.65
Dec-05	5.47	5.40	0.00	0.00	4.00	3.93
Jan-06	5.52	5.59	0.00	0.00	4.25	4.26
Feb-06	5.31	5.34	0.00	0.00	4.25	4.35
Mar-06	5.59	5.66	0.01	0.01	4.50	4.53
Apr-06	5.50	5.65	0.01	0.01	4.75	4.81
May-06	5.45	5.52	0.01	0.00	4.75	4.87
Jun-06	5.67	5.67	0.00	0.00	5.00	5.10
Jul-06	5.49	5.44	0.00	0.00	5.00	5.05
Aug-06	5.29	5.37	0.00	0.00	5.00	4.95
Sep-06	5.13	5.12	0.00	0.00	5.00	4.91
Oct-06	5.16	5.01	0.00	0.01	5.00	4.84
Nov-06	4.77	4.59	0.00	0.00	5.00	4.90
Dec-06	5.44	5.37	0.00	0.00	5.00	4.93
Jan-07	4.74	4.81	0.00	0.00	4.75	4.76
Feb-07	4.49	4.52	0.00	0.00	4.50	4.60
Mar-07	4.31	4.38	0.01	0.00	4.50	4.53
Apr-07	3.87	4.02	0.01	0.00	4.00	4.06
May-07	3.87	3.94	0.01	0.00	3.50	3.62
Jun-07	4.51	4.51	0.00	0.00	3.50	3.60
Jul-07	4.67	4.62	0.00	0.00	3.25	3.30
Aug-07	4.80	4.88	-0.01	0.00	3.25	3.20
Sep-07	4.77	4.76	0.01	0.01	3.25	3.16
Oct-07	4.88	4.73	0.01	0.01	3.25	3.09
Nov-07	5.16	4.98	0.00	0.01	3.25	3.15
Dec-07	4.94	4.87	0.00	0.00	3.25	3.18
Jan-08	4.12	4.19	0.01	0.01	3.25	3.26

	10year treasury yield	10year treasury yield Seasonal	Inflation	Inflation Seasonal	R/P	R/P Seasonal
Feb-08	4.47	4.50	0.01	0.01	3.25	3.35
Mar-08	4.62	4.69	0.01	0.00	3.25	3.28
Apr-08	4.77	4.92	0.02	0.01	3.25	3.31
May-08	5.29	5.36	0.02	0.02	3.25	3.37
Jun-08	6.01	6.01	0.01	0.01	3.25	3.35
Jul-08	5.19	5.14	0.00	0.00	3.50	3.55
Aug-08	4.49	4.57	-0.03	-0.03	3.75	3.70
Sep-08	4.49	4.48	0.00	0.00	3.75	3.66
Oct-08	3.94	3.79	-0.01	-0.01	3.75	3.59
Nov-08	3.84	3.66	-0.01	-0.01	3.75	3.65
Dec-08	2.69	2.62	-0.02	-0.01	2.75	2.68
Jan-09	3.54	3.61	0.00	0.00	2.00	2.01
Feb-09	3.88	3.91	0.01	0.01	1.50	1.60
Mar-09	3.60	3.67	0.00	0.00	1.50	1.53
Apr-09	3.16	3.31	0.01	0.00	1.25	1.31
May-09	4.12	4.19	0.00	-0.01	1.25	1.37
Jun-09	3.80	3.80	0.00	0.00	1.25	1.35
Jul-09	3.78	3.73	0.00	0.00	1.25	1.30
Aug-09	3.93	4.01	0.00	0.01	1.25	1.20
Sep-09	4.18	4.17	0.00	0.00	1.25	1.16
Oct-09	4.44	4.29	0.00	0.00	1.25	1.09
Nov-09	4.41	4.23	0.00	0.01	1.25	1.15
Dec-09	4.34	4.27	0.00	0.00	1.25	1.18
Jan-10	4.12	4.19	0.01	0.00	1.25	1.26
Feb-10	4.01	4.04	0.01	0.00	1.25	1.35
Mar-10	4.05	4.12	0.00	0.00	1.25	1.28
Apr-10	3.67	3.82	0.00	0.00	1.25	1.31
May-10	3.49	3.56	0.00	0.00	1.25	1.37
Jun-10	3.33	3.33	0.00	0.00	1.25	1.35
Jul-10	3.44	3.39	0.00	0.00	1.50	1.55
Aug-10	3.01	3.09	0.00	0.01	1.75	1.70
Sep-10	3.12	3.11	0.00	0.00	1.75	1.66
Oct-10	3.18	3.03	0.00	0.00	1.75	1.59
Nov-10	3.59	3.41	0.00	0.01	1.75	1.65
Dec-10	3.77	3.70	0.00	0.01	2.00	1.93

	10year treasury yield	10year treasury yield Seasonal	Inflation	Inflation Seasonal	R/P	R/P Seasonal
Jan-11	3.85	3.92	0.01	0.00	2.25	2.26
Feb-11	3.89	3.92	0.00	0.00	2.25	2.35
Mar-11	3.75	3.82	0.00	0.00	2.50	2.53
Apr-11	3.70	3.85	0.01	0.01	2.75	2.81
May-11	3.79	3.86	0.00	0.00	2.75	2.87
Jun-11	3.91	3.91	0.00	0.00	3.00	3.10
Jul-11	4.02	3.97	0.00	0.00	3.25	3.30
Aug-11	3.51	3.59	0.00	0.01	3.50	3.45
Sep-11	3.75	3.74	0.00	0.00	3.50	3.41
Oct-11	3.38	3.23	0.00	0.00	3.50	3.34
Nov-11	3.42	3.24	0.00	0.01	3.25	3.15
Dec-11	3.35	3.28	0.00	0.00	3.25	3.18
Jan-12	3.21	3.28	0.00	0.00	3.00	3.01
Feb-12	3.58	3.61	0.00	0.00	3.00	3.10
Mar-12	3.83	3.90	0.01	0.00	3.00	3.03
Apr-12	3.83	3.98	0.00	0.00	3.00	3.06
May-12	3.74	3.81	0.00	0.00	3.00	3.12
Jun-12	3.57	3.57	0.00	0.00	3.00	3.10
Jul-12	3.33	3.28	0.00	0.00	3.00	3.05
Aug-12	3.43	3.51	0.00	0.01	3.00	2.95
Sep-12	3.59	3.58	0.00	0.00	3.00	2.91
Oct-12	3.37	3.22	0.00	0.00	2.75	2.59
Nov-12	3.55	3.37	0.00	0.00	2.75	2.65
Dec-12	3.52	3.45	0.00	0.01	2.75	2.68

	Deposit Rate	Deposit Rate Seasonal	MLR Rate	MLR Rate Seasonal	World Market Return	World Market Return Seasonal
Apr-02	2.63	2.65	7.06	7.05	-2.81	-5.23
May-02	2.63	2.72	7.06	7.09	0.19	1.11
Jun-02	2.63	2.70	7.06	7.09	-6.18	-4.98
Jul-02	2.63	2.64	7.06	7.10	-8.44	-9.21
Aug-02	2.63	2.61	7.06	7.08	0.19	1.44
Sep-02	2.63	2.54	7.06	7.05	-10.96	-10.51
Oct-02	2.00	1.94	6.69	6.67	7.36	6.65
Nov-02	2.00	1.96	6.69	6.67	5.46	5.39
Dec-02	2.00	1.99	6.69	6.68	-4.75	-6.30
Jan-03	2.00	1.98	6.69	6.66	-2.92	-1.08
Feb-03	2.00	2.01	6.69	6.68	-1.70	-1.21
Mar-03	1.81	1.83	6.50	6.48	-0.43	-1.08
Apr-03	1.81	1.84	6.50	6.49	8.91	6.50
May-03	1.81	1.90	6.50	6.53	5.82	6.75
Jun-03	1.25	1.32	6.00	6.03	1.93	3.13
Jul-03	1.06	1.08	5.69	5.73	2.21	1.44
Aug-03	1.06	1.05	5.69	5.70	2.38	3.64
Sep-03	1.06	0.98	5.69	5.67	0.64	1.09
Oct-03	1.00	0.94	5.69	5.67	6.06	5.35
Nov-03	1.00	0.96	5.69	5.67	1.52	1.45
Dec-03	1.00	0.99	5.69	5.68	6.34	4.79
Jan-04	1.00	0.98	5.69	5.66	1.70	3.54
Feb-04	1.00	1.01	5.69	5.68	1.85	2.34
Mar-04	1.00	1.02	5.69	5.67	-0.54	-1.18
Apr-04	1.00	1.02	5.69	5.67	-2.28	-4.70
May-04	1.00	1.09	5.69	5.72	0.81	1.74
Jun-04	1.00	1.07	5.69	5.72	2.02	3.22
Jul-04	1.00	1.02	5.69	5.73	-3.18	-3.95
Aug-04	1.00	0.98	5.69	5.70	0.66	1.92
Sep-04	1.00	0.92	5.69	5.67	2.11	2.56
Oct-04	1.00	0.94	5.69	5.67	2.47	1.76
Nov-04	1.00	0.96	5.69	5.67	5.48	5.40
Dec-04	1.00	0.99	5.69	5.68	3.90	2.35
Jan-05	1.00	0.98	5.69	5.66	-2.11	-0.27
Feb-05	1.00	1.01	5.69	5.68	3.50	4.00

	Deposit Rate	Deposit Rate Seasonal	MLR Rate	MLR Rate Seasonal	World Market Return	World Market Return Seasonal
Mar-05	1.00	1.02	5.69	5.67	-2.16	-2.81
Apr-05	1.00	1.02	5.69	5.67	-2.15	-4.56
May-05	1.00	1.09	5.69	5.72	1.94	2.87
Jun-05	1.00	1.07	5.69	5.72	1.06	2.27
Jul-05	1.19	1.21	5.75	5.79	3.72	2.94
Aug-05	1.38	1.36	5.75	5.77	0.82	2.08
Sep-05	2.00	1.92	6.00	5.99	3.03	3.48
Oct-05	2.25	2.19	6.25	6.23	-2.67	-3.38
Nov-05	2.20	2.16	6.25	6.23	3.70	3.62
Dec-05	2.50	2.49	6.50	6.50	2.49	0.94
Jan-06	3.00	2.98	6.75	6.72	4.94	6.78
Feb-06	3.00	3.01	6.75	6.75	-0.11	0.39
Mar-06	3.69	3.70	7.25	7.23	2.15	1.50
Apr-06	4.00	4.02	7.50	7.49	3.38	0.97
May-06	4.00	4.09	7.50	7.53	-3.84	-2.92
Jun-06	4.00	4.07	7.50	7.53	0.00	1.21
Jul-06	4.00	4.02	7.50	7.54	0.70	-0.08
Aug-06	4.00	3.98	7.69	7.70	2.65	3.90
Sep-06	4.00	3.92	7.69	7.67	1.19	1.64
Oct-06	4.00	3.94	7.69	7.67	3.77	3.07
Nov-06	4.00	3.96	7.69	7.67	2.89	2.81
Dec-06	4.00	3.99	7.69	7.68	2.26	0.71
Jan-07	3.81	3.79	7.69	7.66	1.13	2.96
Feb-07	3.56	3.58	7.69	7.68	-0.48	0.02
Mar-07	3.25	3.27	7.50	7.48	2.04	1.40
Apr-07	2.75	2.77	7.19	7.17	4.49	2.07
May-07	2.25	2.34	7.00	7.03	3.08	4.00
Jun-07	2.25	2.32	7.00	7.03	-0.25	0.96
Jul-07	2.31	2.33	6.87	6.91	-1.51	-2.28
Aug-07	2.31	2.30	6.87	6.88	-0.22	1.04
Sep-07	2.31	2.23	6.87	6.85	5.39	5.84
Oct-07	2.31	2.25	6.87	6.85	3.92	3.21
Nov-07	2.31	2.27	6.87	6.85	-4.34	-4.42
Dec-07	2.31	2.31	6.87	6.86	-1.06	-2.61
Jan-08	2.31	2.29	6.87	6.84	-8.16	-6.33
Feb-08	2.31	2.33	6.87	6.87	0.33	0.82
Mar-08	2.31	2.33	6.87	6.85	-1.40	-2.04

	Deposit Rate	Deposit Rate Seasonal	MLR Rate	MLR Rate Seasonal	World Market Return	World Market Return Seasonal
Apr-08	2.31	2.34	6.87	6.85	5.64	3.22
May-08	2.31	2.40	6.87	6.90	1.67	2.60
Jun-08	2.75	2.82	7.25	7.28	-8.17	-6.97
Jul-08	2.75	2.77	7.25	7.29	-2.57	-3.34
Aug-08	2.75	2.73	7.25	7.27	-2.10	-0.84
Sep-08	2.75	2.67	7.25	7.24	-12.46	-12.01
Oct-08	2.75	2.69	7.25	7.23	-19.79	-20.50
Nov-08	2.75	2.71	7.25	7.23	-6.48	-6.56
Dec-08	1.75	1.74	6.75	6.75	3.67	2.13
Jan-09	1.44	1.41	6.50	6.47	-8.52	-6.68
Feb-09	1.31	1.33	6.38	6.37	-9.70	-9.21
Mar-09	0.98	0.99	6.13	6.11	8.37	7.73
Apr-09	0.91	0.94	6.06	6.05	11.88	9.47
May-09	0.79	0.88	5.86	5.88	9.98	10.90
Jun-09	0.94	1.01	5.86	5.89	-0.51	0.69
Jul-09	0.94	0.96	5.86	5.90	8.82	8.05
Aug-09	1.00	0.98	5.86	5.87	3.63	4.88
Sep-09	0.83	0.74	5.86	5.84	4.61	5.06
Oct-09	0.83	0.76	5.86	5.84	-1.52	-2.23
Nov-09	0.70	0.66	5.86	5.84	4.17	4.09
Dec-09	0.70	0.69	5.86	5.85	2.10	0.55
Jan-10	0.70	0.68	5.86	5.83	-4.31	-2.47
Feb-10	0.70	0.71	5.86	5.85	1.32	1.81
Mar-10	0.68	0.69	5.86	5.85	6.48	5.83
Apr-10	0.68	0.70	5.86	5.85	0.22	-2.19
May-10	0.68	0.77	5.86	5.89	-9.37	-8.44
Jun-10	0.68	0.75	5.86	5.89	-3.02	-1.82
Jul-10	1.06	1.08	6.00	6.04	8.16	7.38
Aug-10	1.06	1.05	6.00	6.02	-3.44	-2.18
Sep-10	1.16	1.08	6.00	5.99	9.60	10.05
Oct-10	1.16	1.10	6.00	5.98	3.63	2.92
Nov-10	1.16	1.12	6.00	5.98	-2.16	-2.24
Dec-10	1.49	1.49	6.12	6.12	7.36	5.81
Jan-11	1.70	1.68	6.37	6.35	1.58	3.42
Feb-11	1.70	1.71	6.37	6.37	2.96	3.46
Mar-11	1.87	1.88	6.62	6.61	-0.07	-0.72
Apr-11	2.07	2.09	6.75	6.74	4.12	1.70

	Deposit Rate	Deposit Rate Seasonal	MLR Rate	MLR Rate Seasonal	World Market Return	World Market Return Seasonal
May-11	2.07	2.16	6.75	6.78	-2.06	-1.13
Jun-11	2.24	2.31	6.87	6.90	-1.54	-0.33
Jul-11	2.49	2.51	7.13	7.16	-1.60	-2.37
Aug-11	2.61	2.60	7.19	7.20	-7.25	-6.00
Sep-11	2.74	2.65	7.25	7.24	-9.40	-8.95
Oct-11	2.74	2.68	7.25	7.23	10.72	10.01
Nov-11	2.74	2.69	7.25	7.23	-2.92	-2.99
Dec-11	2.74	2.73	7.25	7.25	-0.17	-1.72
Jan-12	2.74	2.71	7.22	7.19	5.82	7.66
Feb-12	2.73	2.74	7.13	7.12	5.09	5.59
Mar-12	2.73	2.74	7.13	7.11	0.71	0.06
Apr-12	2.73	2.75	7.13	7.11	-1.11	-3.52
May-12	2.73	2.82	7.13	7.15	-8.86	-7.94
Jun-12	2.73	2.80	7.13	7.16	5.01	6.22
Jul-12	2.73	2.74	7.13	7.17	1.39	0.62
Aug-12	2.73	2.71	7.13	7.14	2.24	3.50
Sep-12	2.73	2.64	7.13	7.11	3.19	3.64
Oct-12	2.54	2.48	7.03	7.01	-0.64	-1.35
Nov-12	2.43	2.38	7.00	6.98	1.34	1.26
Dec-12	2.43	2.42	7.00	7.00	2.33	0.79

	VIX	VIX seasonal	JP Emerging Market Spread	JP Emerging Market Spread seasonal	Equities Return Volatility	Inflation Volatility
Apr-02	21.91	23.96	594.00	606.94		
May-02	19.98	21.40	623.00	625.09		
Jun-02	25.40	26.97	756.00	763.90		
Jul-02	32.03	32.91	910.00	930.70	37.99	
Aug-02	32.64	32.96	812.00	825.07	32.22	
Sep-02	39.69	37.33	932.00	933.69	36.26	
Oct-02	31.14	27.79	806.00	790.26	40.14	
Nov-02	27.50	25.77	727.00	703.27	60.86	
Dec-02	28.62	29.35	725.00	716.72	33.82	0.000019
Jan-03	31.17	30.87	687.00	680.21	35.85	0.000016
Feb-03	29.63	29.76	659.00	654.95	34.17	0.000018
Mar-03	29.15	29.78	626.00	626.20	36.47	0.000024
Apr-03	21.21	23.26	534.00	546.94	29.29	0.000027
May-03	19.47	20.89	520.00	522.09	24.81	0.000025
Jun-03	19.52	21.09	515.00	522.90	37.45	0.000020
Jul-03	19.49	20.37	506.00	526.70	56.49	0.000023
Aug-03	18.63	18.95	482.00	495.07	32.75	0.000021
Sep-03	22.72	20.36	486.00	487.69	42.25	0.000026
Oct-03	16.10	12.75	455.00	439.26	30.03	0.000020
Nov-03	16.32	14.59	437.00	413.27	46.42	0.000016
Dec-03	18.31	19.04	403.00	394.72	32.72	0.000014
Jan-04	16.63	16.33	414.00	407.21	76.51	0.000012
Feb-04	14.55	14.68	431.00	426.95	87.75	0.000011
Mar-04	16.74	17.37	414.00	414.20	41.71	0.000012
Apr-04	17.19	19.24	468.00	480.94	65.15	0.000013
May-04	15.50	16.92	494.00	496.09	34.94	0.000016
Jun-04	14.34	15.91	482.00	489.90	27.02	0.000015
Jul-04	15.32	16.20	453.00	473.70	24.12	0.000012
Aug-04	15.29	15.61	425.00	438.07	27.16	0.000011
Sep-04	13.34	10.98	409.00	410.69	25.74	0.000016
Oct-04	16.27	12.92	399.00	383.26	26.25	0.000015
Nov-04	13.24	11.51	363.00	339.27	25.22	0.000013
Dec-04	13.29	14.02	347.00	338.72	30.52	0.000013
Jan-05	12.82	12.52	356.00	349.21	30.16	0.000012
Feb-05	12.08	12.21	333.00	328.95	39.39	0.000013

	VIX	VIX seasonal	JP Emerging Market Spread	JP Emerging Market Spread seasonal	Equities Return Volatility	Inflation Volatility
Mar-05	14.02	14.65	373.00	373.20	27.65	0.000011
Apr-05	15.31	17.36	384.00	396.94	40.50	0.000015
May-05	13.29	14.71	364.00	366.09	37.10	0.000013
Jun-05	12.04	13.61	297.00	304.90	27.26	0.000011
Jul-05	11.57	12.45	276.00	296.70	24.14	0.000010
Aug-05	12.60	12.92	281.00	294.07	24.10	0.000047
Sep-05	11.92	9.56	235.00	236.69	24.54	0.000050
Oct-05	15.32	11.97	242.00	226.26	24.76	0.000041
Nov-05	12.06	10.33	237.00	213.27	32.04	0.000030
Dec-05	12.07	12.80	237.00	228.72	26.50	0.000031
Jan-06	12.95	12.65	210.00	203.21	25.29	0.000022
Feb-06	12.34	12.47	187.00	182.95	43.09	0.000018
Mar-06	11.39	12.02	191.00	191.20	42.09	0.000015
Apr-06	11.59	13.64	179.00	191.94	28.39	0.000026
May-06	16.44	17.86	210.00	212.09	24.46	0.000024
Jun-06	13.08	14.65	218.00	225.90	42.47	0.000019
Jul-06	14.95	15.83	197.00	217.70	34.88	0.000016
Aug-06	12.31	12.63	196.94	210.01	26.32	0.000014
Sep-06	11.98	9.62	207.75	209.44	23.87	0.000012
Oct-06	11.10	7.75	194.00	178.26	23.17	0.000017
Nov-06	10.91	9.18	200.29	176.56	32.73	0.000015
Dec-06	11.56	12.29	171.00	162.72	25.80	0.000013
Jan-07	10.42	10.12	173.72	166.93	70.61	0.000013
Feb-07	15.42	15.55	186.62	182.57	36.60	0.000024
Mar-07	14.64	15.27	169.87	170.07	26.94	0.000034
Apr-07	14.22	16.27	167.25	180.19	24.66	0.000024
May-07	13.05	14.47	154.86	156.95	23.99	0.000019
Jun-07	16.23	17.80	181.06	188.96	27.51	0.000015
Jul-07	23.52	24.40	225.22	245.92	25.27	0.000013
Aug-07	23.38	23.70	246.00	259.07	36.33	0.000014
Sep-07	18.00	15.64	213.91	215.60	53.37	0.000017
Oct-07	18.53	15.18	201.05	185.31	36.42	0.000016
Nov-07	22.87	21.14	260.96	237.23	35.19	0.000022
Dec-07	22.50	23.23	254.60	246.32	44.02	0.000026
Jan-08	26.20	25.90	287.53	280.74	30.41	0.000021

	VIX	VIX seasonal	JP Emerging Market Spread	JP Emerging Market Spread seasonal	Equities Return Volatility	Inflation Volatility
Feb-08	26.54	26.67	305.59	301.54	42.21	0.000023
Mar-08	25.61	26.24	324.46	324.66	44.00	0.000019
Apr-08	20.79	22.84	283.30	296.24	32.87	0.000015
May-08	17.83	19.25	261.11	263.20	25.86	0.000027
Jun-08	23.95	25.52	308.42	316.32	24.42	0.000094
Jul-08	22.94	23.82	308.26	328.96	48.15	0.000084
Aug-08	20.65	20.97	322.73	335.80	74.02	0.000056
Sep-08	39.39	37.03	442.39	444.08	40.05	0.000246
Oct-08	59.89	56.54	683.77	668.03	67.07	0.000155
Nov-08	55.28	53.55	747.74	724.01	203.38	0.000141
Dec-08	40.00	40.73	724.44	716.16	76.34	0.000123
Jan-09	44.84	44.54	655.64	648.85	67.22	0.000121
Feb-09	46.35	46.48	671.92	667.87	36.05	0.000078
Mar-09	44.14	44.77	656.62	656.82	29.53	0.000064
Apr-09	36.50	38.55	542.38	555.32	24.78	0.000043
May-09	28.92	30.34	463.69	465.78	60.43	0.000034
Jun-09	26.35	27.92	432.98	440.88	67.18	0.000041
Jul-09	25.92	26.80	398.19	418.89	35.91	0.000029
Aug-09	26.01	26.33	389.28	402.35	27.10	0.000027
Sep-09	25.61	23.25	337.04	338.73	24.17	0.000022
Oct-09	30.69	27.34	333.29	317.55	39.10	0.000017
Nov-09	24.51	22.78	341.92	318.19	39.45	0.000014
Dec-09	21.68	22.41	294.43	286.15	27.64	0.000017
Jan-10	24.62	24.32	322.57	315.78	24.27	0.000014
Feb-10	19.50	19.63	310.88	306.83	27.39	0.000012
Mar-10	17.59	18.22	261.33	261.53	24.77	0.000011
Apr-10	22.05	24.10	274.40	287.34	44.57	0.000013
May-10	32.07	33.49	342.54	344.63	43.83	0.000014
Jun-10	34.54	36.11	358.23	366.13	29.56	0.000016
Jul-10	23.50	24.38	312.88	333.58	27.23	0.000013
Aug-10	26.05	26.37	325.64	338.71	29.29	0.000011
Sep-10	23.70	21.34	304.52	306.21	29.77	0.000013
Oct-10	21.20	17.85	282.50	266.76	29.54	0.000012
Nov-10	23.54	21.81	321.67	297.94	25.03	0.000011
Dec-10	17.75	18.48	288.52	280.24	23.64	0.000013

	VIX	VIX seasonal	JP Emerging Market Spread	JP Emerging Market Spread seasonal	Equities Return Volatility	Inflation Volatility
Jan-11	19.53	19.23	298.20	291.41	26.41	0.000013
Feb-11	18.35	18.48	303.70	299.65	31.62	0.000012
Mar-11	17.74	18.37	298.81	299.01	25.43	0.000011
Apr-11	14.75	16.80	301.68	314.62	34.38	0.000010
May-11	15.45	16.87	311.74	313.83	26.35	0.000017
Jun-11	16.52	18.09	288.45	296.35	26.73	0.000016
Jul-11	25.25	26.13	301.42	322.12	33.02	0.000013
Aug-11	31.62	31.94	353.99	367.06	38.55	0.000012
Sep-11	42.96	40.60	464.96	466.65	46.28	0.000019
Oct-11	29.96	26.61	391.73	375.99	75.26	0.000020
Nov-11	27.80	26.07	413.25	389.52	60.34	0.000016
Dec-11	23.40	24.13	426.34	418.06	33.86	0.000016
Jan-12	19.44	19.14	412.23	405.44	26.14	0.000014
Feb-12	18.43	18.56	356.77	352.72	34.36	0.000012
Mar-12	15.50	16.13	341.58	341.78	27.79	0.000011
Apr-12	17.15	19.20	348.00	360.94	25.29	0.000010
May-12	24.06	25.48	428.98	431.07	25.27	0.000013
Jun-12	17.08	18.65	374.17	382.07	44.37	0.000013
Jul-12	18.93	19.81	341.37	362.07	29.75	0.000012
Aug-12	17.47	17.79	325.45	338.52	24.98	0.000011
Sep-12	15.73	13.37	307.67	309.36	24.63	0.000014
Oct-12	18.60	15.25	295.76	280.02	28.95	0.000013
Nov-12	15.87	14.14	286.64	262.91	24.81	0.000011
Dec-12	18.02	18.75	265.78	257.50	23.75	0.000011

	Industrial Production Index	Industrial Production Index adjusted	Money Supply M1	Money Supply M1 adjusted	Money Supply M1 Seasonal	Log Money Supply M1 seasonal
Apr-02	108.51	62.44	586.30	43.31	42.01	3.74
May-02	110.80	63.76	580.24	42.86	41.07	3.72
Jun-02	110.76	63.73	575.34	42.50	43.77	3.78
Jul-02	108.73	62.56	570.03	42.11	44.53	3.80
Aug-02	113.86	65.52	582.69	43.04	44.70	3.80
Sep-02	112.69	64.84	590.27	43.60	45.77	3.82
Oct-02	114.04	65.62	590.63	43.63	45.57	3.82
Nov-02	118.27	68.05	607.46	44.87	44.89	3.80
Dec-02	110.91	63.82	656.31	48.48	46.13	3.83
Jan-03	118.43	68.15	656.58	48.50	47.53	3.86
Feb-03	117.51	67.62	654.11	48.32	46.51	3.84
Mar-03	122.11	70.26	660.75	48.81	47.52	3.86
Apr-03	123.06	70.81	654.34	48.33	47.03	3.85
May-03	118.79	68.35	650.36	48.04	46.24	3.83
Jun-03	122.41	70.44	648.52	47.90	49.17	3.90
Jul-03	122.82	70.67	646.07	47.72	50.15	3.92
Aug-03	121.08	69.67	661.03	48.83	50.49	3.92
Sep-03	126.63	72.86	666.02	49.20	51.37	3.94
Oct-03	128.98	74.22	693.34	51.21	53.16	3.97
Nov-03	127.40	73.31	774.22	57.19	57.20	4.05
Dec-03	136.53	78.56	750.20	55.41	53.07	3.97
Jan-04	133.33	76.72	742.61	54.85	53.89	3.99
Feb-04	135.59	78.02	766.25	56.60	54.80	4.00
Mar-04	126.79	72.96	751.88	55.54	54.25	3.99
Apr-04	133.04	76.55	766.69	56.63	55.33	4.01
May-04	134.85	77.59	752.43	55.58	53.78	3.98
Jun-04	135.73	78.10	742.52	54.85	56.12	4.03
Jul-04	136.93	78.79	751.84	55.53	57.96	4.06
Aug-04	137.25	78.98	744.44	54.99	56.65	4.04
Sep-04	139.15	80.07	766.65	56.63	58.80	4.07
Oct-04	144.41	83.09	780.03	57.62	59.56	4.09
Nov-04	145.12	83.50	788.76	58.26	58.28	4.07
Dec-04	146.44	84.26	829.88	61.30	58.95	4.08
Jan-05	147.11	84.65	820.70	60.62	59.66	4.09
Feb-05	139.92	80.51	842.47	62.23	60.43	4.10

	Industrial Production Index	Industrial Production Index adjusted	Money Supply M1	Money Supply M1 adjusted	Money Supply M1 Seasonal	Log Money Supply M1 seasonal
Mar-05	147.59	84.92	832.61	61.50	60.22	4.10
Apr-05	148.26	85.31	833.84	61.59	60.29	4.10
May-05	149.16	85.83	825.63	60.99	59.19	4.08
Jun-05	151.15	86.97	808.73	59.74	61.01	4.11
Jul-05	151.21	87.01	815.67	60.25	62.68	4.14
Aug-05	152.60	87.81	823.04	60.79	62.45	4.13
Sep-05	152.28	87.62	833.40	61.56	63.73	4.15
Oct-05	153.34	88.23	818.63	60.47	62.41	4.13
Nov-05	152.67	87.85	854.41	63.11	63.13	4.15
Dec-05	151.96	87.44	890.22	65.76	63.41	4.15
Jan-06	156.10	89.82	886.81	65.50	64.54	4.17
Feb-06	157.98	90.90	883.73	65.28	63.47	4.15
Mar-06	158.78	91.36	883.72	65.28	63.99	4.16
Apr-06	158.22	91.04	889.65	65.71	64.41	4.17
May-06	160.25	92.21	867.80	64.10	62.31	4.13
Jun-06	156.22	89.89	853.04	63.01	64.28	4.16
Jul-06	160.09	92.12	826.41	61.04	63.47	4.15
Aug-06	161.48	92.92	851.43	62.89	64.55	4.17
Sep-06	159.69	91.89	848.45	62.67	64.84	4.17
Oct-06	161.39	92.87	835.92	61.75	63.69	4.15
Nov-06	160.57	92.39	875.52	64.67	64.69	4.17
Dec-06	163.26	93.94	911.47	67.33	64.98	4.17
Jan-07	166.53	95.82	866.09	63.97	63.01	4.14
Feb-07	167.76	96.53	908.56	67.11	65.31	4.18
Mar-07	164.30	94.54	916.64	67.71	66.42	4.20
Apr-07	165.93	95.48	931.67	68.82	67.52	4.21
May-07	166.95	96.06	923.84	68.24	66.45	4.20
Jun-07	165.81	95.41	888.21	65.61	66.88	4.20
Jul-07	170.69	98.22	883.31	65.25	67.67	4.21
Aug-07	176.50	101.56	904.21	66.79	68.45	4.23
Sep-07	176.89	101.78	919.14	67.89	70.07	4.25
Oct-07	177.25	101.99	904.50	66.81	68.76	4.23
Nov-07	182.05	104.75	953.68	70.44	70.46	4.26
Dec-07	185.34	106.65	999.90	73.86	71.51	4.27
Jan-08	190.62	109.68	971.37	71.75	70.78	4.26

	Industrial Production Index	Industrial Production Index adjusted	Money Supply M1	Money Supply M1 adjusted	Money Supply M1 Seasonal	Log Money Supply M1 seasonal
Feb-08	183.44	105.55	990.10	73.13	71.33	4.27
Mar-08	181.59	104.49	1,000.86	73.93	72.64	4.29
Apr-08	183.97	105.86	1,014.47	74.93	73.63	4.30
May-08	182.84	105.21	1,024.83	75.70	73.90	4.30
Jun-08	180.06	103.61	987.00	72.90	74.18	4.31
Jul-08	185.47	106.72	962.02	71.06	73.49	4.30
Aug-08	189.57	109.08	992.98	73.35	75.01	4.32
Sep-08	176.53	101.58	977.10	72.17	74.35	4.31
Oct-08	176.69	101.67	977.53	72.21	74.15	4.31
Nov-08	170.46	98.08	1,010.45	74.64	74.65	4.31
Dec-08	146.20	84.12	1,041.22	76.91	74.56	4.31
Jan-09	141.12	81.20	1,036.44	76.56	75.59	4.33
Feb-09	144.67	83.24	1,039.78	76.80	75.00	4.32
Mar-09	148.72	85.57	1,033.00	76.30	75.02	4.32
Apr-09	157.80	90.80	1,060.41	78.33	77.03	4.34
May-09	163.11	93.86	1,103.52	81.51	79.72	4.38
Jun-09	165.96	95.50	1,025.57	75.75	77.02	4.34
Jul-09	168.40	96.90	1,013.26	74.84	77.27	4.35
Aug-09	172.56	99.29	1,061.01	78.37	80.03	4.38
Sep-09	177.20	101.96	1,052.10	77.71	79.89	4.38
Oct-09	177.87	102.35	1,079.55	79.74	81.69	4.40
Nov-09	182.33	104.91	1,115.18	82.37	82.39	4.41
Dec-09	191.65	110.28	1,174.55	86.76	84.41	4.44
Jan-10	187.21	107.72	1,148.10	84.80	83.84	4.43
Feb-10	190.06	109.36	1,187.47	87.71	85.91	4.45
Mar-10	195.46	112.47	1,182.41	87.34	86.05	4.45
Apr-10	196.25	112.92	1,182.47	87.34	86.04	4.45
May-10	188.39	108.40	1,261.88	93.21	91.41	4.52
Jun-10	189.11	108.82	1,180.18	87.17	88.44	4.48
Jul-10	190.96	109.88	1,173.02	86.65	89.07	4.49
Aug-10	186.15	107.11	1,181.41	87.26	88.92	4.49
Sep-10	191.22	110.03	1,175.47	86.83	89.00	4.49
Oct-10	191.44	110.16	1,202.29	88.81	90.75	4.51
Nov-10	191.32	110.09	1,235.40	91.25	91.27	4.51
Dec-10	187.84	108.08	1,302.44	96.20	93.86	4.54

	Industrial Production Index	Industrial Production Index adjusted	Money Supply M1	Money Supply M1 adjusted	Money Supply M1 Seasonal	Log Money Supply M1 seasonal
Jan-11	194.81	112.10	1,326.16	97.96	96.99	4.57
Feb-11	185.04	106.47	1,346.29	99.44	97.64	4.58
Mar-11	182.99	105.29	1,345.61	99.39	98.11	4.59
Apr-11	180.63	103.94	1,346.97	99.49	98.19	4.59
May-11	180.54	103.88	1,395.80	103.10	101.31	4.62
Jun-11	196.17	112.88	1,336.64	98.73	100.00	4.61
Jul-11	193.08	111.10	1,336.28	98.70	101.13	4.62
Aug-11	197.38	113.57	1,345.15	99.36	101.02	4.62
Sep-11	196.56	113.10	1,328.02	98.09	100.27	4.61
Oct-11	129.16	74.32	1,361.93	100.60	102.55	4.63
Nov-11	105.41	60.65	1,362.72	100.66	100.67	4.61
Dec-11	143.70	82.69	1,414.27	104.47	102.12	4.63
Jan-12	163.99	94.36	1,400.49	103.45	102.48	4.63
Feb-12	173.63	99.91	1,421.54	105.00	103.20	4.64
Mar-12	178.51	102.72	1,436.62	106.12	104.83	4.65
Apr-12	182.00	104.72	1,439.81	106.35	105.05	4.65
May-12	188.21	108.30	1,455.23	107.49	105.70	4.66
Jun-12	179.81	103.46	1,452.79	107.31	108.58	4.69
Jul-12	181.11	104.21	1,413.36	104.40	106.83	4.67
Aug-12	175.62	101.05	1,461.67	107.97	109.63	4.70
Sep-12	172.01	98.98	1,483.55	109.58	111.76	4.72
Oct-12	171.15	98.48	1,472.23	108.75	110.69	4.71
Nov-12	188.36	108.38	1,508.25	111.41	111.42	4.71
Dec-12	180.01	103.58	1,598.26	118.06	115.71	4.75

	CPI	CPI Seasonal	Log CPI seasonal	Log Real Money Supply	1Year Treasury Yield	1Year Treasury Yield Seasonal
Apr-02	76.30	76.02	4.33	-0.59	2.16	2.27
May-02	76.40	75.83	4.33	-0.61	2.14	2.22
Jun-02	76.20	75.66	4.33	-0.55	2.15	2.11
Jul-02	76.10	75.48	4.32	-0.53	2.14	2.06
Aug-02	76.20	75.91	4.33	-0.53	1.98	1.90
Sep-02	76.50	76.34	4.34	-0.51	1.99	1.88
Oct-02	76.90	76.86	4.34	-0.52	2.01	1.88
Nov-02	76.60	76.92	4.34	-0.54	1.79	1.67
Dec-02	76.60	77.34	4.35	-0.52	1.77	1.76
Jan-03	77.30	77.94	4.36	-0.49	1.61	1.70
Feb-03	77.20	77.71	4.35	-0.51	1.49	1.63
Mar-03	77.20	77.48	4.35	-0.49	1.63	1.77
Apr-03	77.50	77.22	4.35	-0.50	1.67	1.78
May-03	77.80	77.23	4.35	-0.51	1.62	1.70
Jun-03	77.50	76.96	4.34	-0.45	1.34	1.30
Jul-03	77.50	76.88	4.34	-0.43	1.22	1.14
Aug-03	77.90	77.61	4.35	-0.43	1.24	1.16
Sep-03	77.80	77.64	4.35	-0.41	1.23	1.12
Oct-03	77.90	77.86	4.35	-0.38	1.36	1.23
Nov-03	78.00	78.32	4.36	-0.31	1.41	1.29
Dec-03	78.00	78.74	4.37	-0.39	1.26	1.25
Jan-04	78.30	78.94	4.37	-0.38	1.36	1.45
Feb-04	78.90	79.41	4.37	-0.37	1.36	1.50
Mar-04	79.10	79.38	4.37	-0.38	1.24	1.38
Apr-04	79.40	79.12	4.37	-0.36	1.41	1.52
May-04	79.70	79.13	4.37	-0.39	1.45	1.53
Jun-04	79.90	79.36	4.37	-0.35	1.59	1.55
Jul-04	80.00	79.38	4.37	-0.31	1.77	1.69
Aug-04	80.30	80.01	4.38	-0.35	1.86	1.78
Sep-04	80.60	80.44	4.39	-0.31	1.91	1.80
Oct-04	80.60	80.56	4.39	-0.30	2.09	1.96
Nov-04	80.30	80.62	4.39	-0.32	2.38	2.26
Dec-04	80.30	81.04	4.39	-0.32	2.37	2.36
Jan-05	80.40	81.04	4.39	-0.31	2.47	2.56
Feb-05	80.80	81.31	4.40	-0.30	2.47	2.61

	CPI	CPI Seasonal	Log CPI seasonal	Log Real Money Supply	1Year Treasury Yield	1Year Treasury Yield Seasonal
Mar-05	81.60	81.88	4.41	-0.31	2.53	2.67
Apr-05	82.20	81.92	4.41	-0.31	2.67	2.78
May-05	82.70	82.13	4.41	-0.33	2.91	2.99
Jun-05	82.90	82.36	4.41	-0.30	2.81	2.77
Jul-05	84.20	83.58	4.43	-0.29	3.31	3.23
Aug-05	84.80	84.51	4.44	-0.30	3.32	3.24
Sep-05	85.40	85.24	4.45	-0.29	3.54	3.43
Oct-05	85.70	85.66	4.45	-0.32	4.09	3.96
Nov-05	85.00	85.32	4.45	-0.30	4.36	4.24
Dec-05	84.90	85.64	4.45	-0.30	4.38	4.37
Jan-06	85.10	85.74	4.45	-0.28	4.49	4.58
Feb-06	85.30	85.81	4.45	-0.30	4.48	4.62
Mar-06	86.20	86.48	4.46	-0.30	4.97	5.11
Apr-06	87.20	86.92	4.47	-0.30	5.05	5.16
May-06	87.80	87.23	4.47	-0.34	5.08	5.16
Jun-06	87.80	87.26	4.47	-0.31	5.22	5.18
Jul-06	88.00	87.38	4.47	-0.32	5.19	5.11
Aug-06	88.00	87.71	4.47	-0.31	5.09	5.01
Sep-06	87.70	87.54	4.47	-0.30	4.94	4.83
Oct-06	88.10	88.06	4.48	-0.32	4.91	4.78
Nov-06	88.00	88.32	4.48	-0.31	4.74	4.62
Dec-06	88.00	88.74	4.49	-0.31	4.91	4.90
Jan-07	87.70	88.34	4.48	-0.34	4.55	4.64
Feb-07	87.40	87.91	4.48	-0.30	4.37	4.51
Mar-07	87.90	88.18	4.48	-0.28	3.88	4.02
Apr-07	88.80	88.52	4.48	-0.27	3.48	3.59
May-07	89.50	88.93	4.49	-0.29	3.10	3.18
Jun-07	89.50	88.96	4.49	-0.29	3.26	3.22
Jul-07	89.50	88.88	4.49	-0.27	3.24	3.16
Aug-07	89.00	88.71	4.49	-0.26	3.31	3.23
Sep-07	89.50	89.34	4.49	-0.24	3.38	3.27
Oct-07	90.30	90.26	4.50	-0.27	3.47	3.34
Nov-07	90.70	91.02	4.51	-0.26	3.64	3.52
Dec-07	90.70	91.44	4.52	-0.25	3.55	3.54
Jan-08	91.50	92.14	4.52	-0.26	3.03	3.12

	CPI	CPI Seasonal	Log CPI seasonal	Log Real Money Supply	1Year Treasury Yield	1Year Treasury Yield Seasonal
Feb-08	92.10	92.61	4.53	-0.26	3.02	3.16
Mar-08	92.60	92.88	4.53	-0.25	2.94	3.08
Apr-08	94.20	93.92	4.54	-0.24	3.24	3.35
May-08	96.30	95.73	4.56	-0.26	3.54	3.62
Jun-08	97.30	96.76	4.57	-0.27	4.11	4.07
Jul-08	97.70	97.08	4.58	-0.28	3.77	3.69
Aug-08	94.80	94.51	4.55	-0.23	3.79	3.71
Sep-08	94.90	94.74	4.55	-0.24	3.79	3.68
Oct-08	93.80	93.76	4.54	-0.23	3.41	3.28
Nov-08	92.60	92.92	4.53	-0.22	3.12	3.00
Dec-08	91.10	91.84	4.52	-0.21	1.98	1.97
Jan-09	91.10	91.74	4.52	-0.19	1.75	1.84
Feb-09	92.00	92.51	4.53	-0.21	1.42	1.56
Mar-09	92.40	92.68	4.53	-0.21	1.15	1.29
Apr-09	93.30	93.02	4.53	-0.19	1.07	1.18
May-09	93.10	92.53	4.53	-0.15	1.18	1.26
Jun-09	93.40	92.86	4.53	-0.19	1.47	1.43
Jul-09	93.40	92.78	4.53	-0.18	1.38	1.30
Aug-09	93.80	93.51	4.54	-0.16	1.44	1.36
Sep-09	94.00	93.84	4.54	-0.16	1.58	1.47
Oct-09	94.10	94.06	4.54	-0.14	1.61	1.48
Nov-09	94.40	94.72	4.55	-0.14	1.50	1.38
Dec-09	94.30	95.04	4.55	-0.12	1.52	1.51
Jan-10	94.84	95.48	4.56	-0.13	1.49	1.58
Feb-10	95.37	95.88	4.56	-0.11	1.58	1.72
Mar-10	95.59	95.87	4.56	-0.11	1.65	1.79
Apr-10	96.06	95.78	4.56	-0.11	1.60	1.71
May-10	96.25	95.68	4.56	-0.05	1.52	1.60
Jun-10	96.50	95.96	4.56	-0.08	1.56	1.52
Jul-10	96.65	96.03	4.56	-0.08	1.91	1.83
Aug-10	96.88	96.59	4.57	-0.08	1.99	1.91
Sep-10	96.81	96.65	4.57	-0.08	2.01	1.90
Oct-10	96.83	96.79	4.57	-0.06	1.98	1.85
Nov-10	97.04	97.36	4.58	-0.06	2.11	1.99
Dec-10	97.19	97.93	4.58	-0.04	2.38	2.37

	CPI	CPI Seasonal	Log CPI seasonal	Log Real Money Supply	1Year Treasury Yield	1Year Treasury Yield Seasonal
Jan-11	97.72	98.36	4.59	-0.01	2.54	2.63
Feb-11	98.11	98.62	4.59	-0.01	2.68	2.82
Mar-11	98.59	98.87	4.59	-0.01	2.83	2.97
Apr-11	99.95	99.67	4.60	-0.01	3.00	3.11
May-11	100.29	99.72	4.60	0.02	3.15	3.23
Jun-11	100.42	99.88	4.60	0.00	3.50	3.46
Jul-11	100.60	99.98	4.60	0.01	3.64	3.56
Aug-11	101.04	100.75	4.61	0.00	3.48	3.40
Sep-11	100.70	100.54	4.61	0.00	3.57	3.46
Oct-11	100.89	100.85	4.61	0.02	3.32	3.19
Nov-11	101.11	101.43	4.62	-0.01	3.20	3.08
Dec-11	100.62	101.36	4.62	0.01	3.10	3.09
Jan-12	101.02	101.66	4.62	0.01	3.04	3.13
Feb-12	101.39	101.90	4.62	0.01	3.08	3.22
Mar-12	101.99	102.27	4.63	0.02	3.13	3.27
Apr-12	102.42	102.14	4.63	0.03	3.21	3.32
May-12	102.82	102.25	4.63	0.03	3.16	3.24
Jun-12	102.99	102.45	4.63	0.06	3.14	3.10
Jul-12	103.35	102.73	4.63	0.04	3.01	2.93
Aug-12	103.76	103.47	4.64	0.06	3.00	2.92
Sep-12	104.10	103.94	4.64	0.07	3.02	2.91
Oct-12	104.24	104.20	4.65	0.06	2.80	2.67
Nov-12	103.87	104.19	4.65	0.07	2.75	2.63
Dec-12	104.27	105.01	4.65	0.10	2.76	2.75

BIOGRAPHY

Name	Surakiat Kahaboonsirihansa
ACADEMIC BACKGROUND	Bachelor of Art, Accounting, Chulalongkorn University
	Master of Science, Economics and Finance, University of York
PRESENT POSITION	Senior Financial Advisor KASIKORNBANK
EXPERIENCES	Fund Manager, UOB Asset Management Co., LTD.
	Fund Manager, TISCO Asset Management Co., LTD.