Measuring Investors’ Behavioral Bias from the Movement of Currency Forward Rate

Miss Busakorn Wongwanit

A Thesis Submitted in Partial Fulfillment of the Requirements
for the Degree of Master of Science Program in Finance
Department of Banking and Finance
Faculty of Commerce and Accountancy
Chulalongkorn University
Academic Year 2015

การวัดการเบี่ยงเบนเชิงพฤติกรรมของนักลงทุนจากความเคลื่อนไหวของอัตราแลกเปลี่ยนล่วงหน้า

นางสาวบุษกร วงศ์วานิช

วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาวิทยาศาสตรมหาบัณฑิต
สาขาวิชาการเงิน ภาควิชาการธนาคารและการเงิน
คณะพาณิชยศาสตร์และการบัญชี จุฬาลงกรณ์มหาวิทยาลัย
ปีการศึกษา 2558

Thesis Title	Measuring Investors’ Behavioral Bias from the Movement of Currency Forward Rate
By	Miss Busakorn Wongwanit
Field of Study	Finance
Thesis Advisor	Roongkiat Ratanabanchuen, Ph.D.

Accepted by the Faculty of Commerce and Accountancy, Chulalongkorn University in Partial Fulfillment of the Requirements for the Master's Degree

................................Dean of the Faculty of Commerce and Accountancy
(Associate Professor Pasu Decharin, Ph.D.)

THESIS COMMITTEE

....Chairman
(Ruttachai Seelajaroen, Ph.D.)

....Thesis Advisor
(Roongkiat Ratanabanchuen, Ph.D.)

....Examiner
(Sira Suchintabandid, Ph.D.)

....External Examiner
(Piyapas Tharavanij, Ph.D.)

บุษกร วงศ์วานิช : การวัดการเบี่ยงเบนเชิงพฤติกรรมของนักลงทุนจากความเคลื่อนไหวของอัตราแลกเปลี่ยนล่วงหน้า (Measuring Investors’ Behavioral Bias from the Movement of Currency Forward Rate) อ.ที่ปรึกษาวิทยานิพนธ์หลัก: อ. ดร. รุ่งเกียรติ รัตนบานชื่น, 50 หน้า.

วิทยานิพนธ์ฉบับนี้จัดทำการศึกษาเรื่องอัตราแลกเปลี่ยนล่วงหน้าทำนายอัตราแลกเปลี่ยนในอนาคตได้หรือไม่ ซึ่งผลการทดสอบโดยสมการถดถอยปรากฏว่า อัตราแลกเปลี่ยนล่วงหน้าไม่สามารถคาดการณ์อัตราแลกเปลี่ยนในอนาคตได้ โดยเฉพาะอย่างยิ่งในระยะเวลายาว ดังนั้นการศึกษาครั้งนี้จึงมีจุดมุ่งหมายที่จะใช้การตีความทางพฤติกรรมในการอธิบายเบื้องหลังการคาดการณ์ที่ไม่มีประสิทธิภาพของอัตราแลกเปลี่ยนล่วงหน้า ผลของการศึกษานี้พบว่าการตีความทางพฤติกรรม มีประสิทธิภาพในการอธิบายปัญหาดังกล่าว ซึ่งแสดงให้เห็นว่า ทุกสกุลเงินมีรูปแบบที่คล้ายคลึงกันในกระบวนการการคาดการณ์ หลักฐานทางการวิจัยยังแสดงให้เห็นว่าอัตราแลกเปลี่ยนล่วงหน้าให้ข้อมูลสอดคล้องกับอัตราแลกเปลี่ยนในอนาคต ในระยะเวลาสั้น ตามทฤษฎี และในระยะเวลายาว การเบี่ยงเบนเชิงพฤติกรรมจะเกิดมากขึ้น นอกจากนี้หลังจากที่ได้ควบคุมส่วนชดเชยความเสี่ยงต่อช่วงเวลาที่แตกต่างกันในสมการถดถอย ตลาดสะท้อนถึงอารมณ์ที่มีความสมดุลมากขึ้นตลอดช่วงเวลา และสอดคล้องกับทฤษฎีที่ว่าอัตราแลกเปลี่ยนล่วงหน้าสามารถคาดการณ์อัตราแลกเปลี่ยนในอนาคตได้

ภาควิชา	การธนาคารและการเงิน	ลายมือชื่อนิสิต	....
สาขาวิชา	การเงิน	ลายมือชื่อ อ.ที่ปรึกษาหลัก	....
ปีการศึกษา	2558		

5782977726 : MAJOR FINANCE
KEYWORDS: FORWARD RATE BIAS / BEHAVIORAL BIAS / MARKET RATIONALITY / RISK PREMIUM

BUSAKORN WONGWANIT: Measuring Investors' Behavioral Bias from the Movement of Currency Forward Rate. ADVISOR: ROONGKIAT RATANABANCHUEN, Ph.D., 50 pp.

This study investigates whether the forward exchange rate is an unbiased predictor of future spot exchange rate. The empirical results by regression analysis show that the forward rate cannot predict the future spot exchange rate, particularly at longer periods. Therefore, this study aims to use behavioral interpretations explaining behind the inefficient forecasts of forward rates. The result clearly shows that behavioral interpretation is effective to explain such issues, indicating that all the examined currencies have similar patterns in the forecast revisions processes. Moreover, the evidences of this research also show that the FRUH do almost hold at shorter periods, and the longer periods, the more behavioral biases occur. Also, after controlling for time-varying risk premium in the regression, the markets reflect a more balanced mood over time and approach the FRUH.

Department:	Banking and Finance	Student's Signature	....
Field of Study:	Finance	Advisor's Signature	....
Academic Year:	2015		

ACKNOWLEDGEMENTS

This research would not be finished without the help of my kind advisor and classmates. I am heartily thankful them, especially my thesis advisor, whose encouragement, guidance and support from the initial to final level that enabled me to develop an understanding of the subject. Furthermore, I also thank all my thesis committees for giving valuable comments and suggestions. Lastly, I offer my regards and blessings to my family and special thanks to my MSF friends for their assistant, cheerfulness and friendship.

CONTENTS

CHAPTER 1

INTRODUCTION

1.1 Background and Problem Review

The relationship between spot and forward rates is significant for market participants for investing, hedging, speculating perspectives as well as policy making of the government. The forward exchange rate is negotiated today between a bank and a client in order to enter into a forward contract agreeing to buy or sell some amount of foreign currency in the future. Multinational corporations, banks and other financial institutions enter into forward contracts to take advantage of the forward rate for hedging purposes such as hedging future payables or receivables denominated in a foreign currency against foreign exchange risk.

The theory of "Rational Expectations" states that markets use all available information efficiently in forming expectations and such expectations are rational and unbiased; therefore, the forecast errors are uncorrelated and have zero means. The empirical results are contradicting to the theory since forward rates have found to be consistently biased forecasts of future spot rates as the changes in the future spot rates are generally negatively related to the forward discount. Froot and Thaler (1990) look at the coefficients on the forward premium (β) from lots of papers observed on major currencies and find that the coefficients are not only smaller than the theoretical standard value of 1, but their average value is in the negative sign, which means the forward rate actually points in the wrong direction. Forward rate forecasts of future spot rates clearly violate the rational expectations hypothesis, which is the failure of FRUH.

The currency market of forward and spot relationship remains an empirical and theoretical puzzle.[1]

[2] evidences have clearly shown the systematic deviations from rationality have also been documented in currency market, the recent models try to explain the sources of the irrationality forecasts of forward rate including systematic expectations theory, the presence of risk premium contained in forward rates, and statistical issues theory, which are occasionally promising, but they have also not resulted in any significant changes in the overall conclusions of significant non-rationality in forward rates (Engel, 1996). Also, such previous empirical studies generally test for the rationality of the forecasts on general properties such as bias or autocorrelation in errors, which provide limited insights into behavioral interpretations behind inefficient forecasts, and until now, there is only few researchers have explored on the behavioral biases in foreign exchange market to explain the failure of FRUH across currencies. Therefore, this paper aims to investigate if foreign exchange markets are characterized by the behavioral biases seen in other asset market by examining the ability of currency forward rates to forecast future spot exchange rates and to revise such forecasts with the availability of new information. This paper examines how forecast revisions reflect systematic behavioral biases of over-or-under reaction and optimism-or-pessimism, which are behavioral factors that could explain failures of rationality.

[3] results of the rejections of the unbiasedness hypothesis cause this paper to question the common assumptions of unbiasedness hypothesis. This paper believes that inefficient foreign exchange market and the bias in the forward rate may cause from both irrational expectations and a risk premium since the markets are not risk neutral (or no risk premium) and rational (or the speculators cannot make excess returns) as

assumed by the forward rate unbiasedness hypothesis. Most commonly, investors are risk- averse and they typically demand risk premium in order to hold purely speculative positions. Since there is no long or short data on the forward currency market at any given time as they are traded in the OTC market, this paper also aims to assess the possible behavioral explanations of the failure of the forward rates unbiasedness hypothesis while controlling for time- varying risk premium and assess possible behavioral explanations of the failure of the FRUH. Brenner and Kroner (1995) support that a no-arbitrage condition should be reasonable to control. The fundamental theorem of asset pricing states that the condition of no-arbitrage is equivalent to the existence of a risk neutral measure. Lewis (1989) examines the forward rates as forecasts of future spot rates and states that 50 percent of the errors come from learning issues or the anticipations of future shifts in fundamentals, and the remaining 50 percent of the errors come from a risk premium. Mohanram and Dan (2013) also find a strong linkage between a measure of risk; the cost of equity, and analysts forecast errors for stocks. Aggarwal, Lucey and Conner (2014) find that risk premium is clearly shown to be important in the gold forward market as after controlling for risk premium using the Chicago Board Options Exchange market volatility index (VIX) as the measurement, they see a decline in forecast errors when volatility increases. Thus, the risk premium might be the determinant of the failure of forward rate unbiasedness hypothesis in FX markets.

1.2 Objective of the Study

Hence, this study objective is to examine the ability of currency forward rates to forecast future spot rate and answer the research questions which are: How foreign exchange markets are characterized by the behavioral biases and does time-varying risk premium the determinant for there deviations from rationality? This paper aims to assess possible behavioral explanations of the failure of the FRUH while controlling for time-varying risk premium. Apart from that, this paper aims to examines whether the markets overlook is stable over time as the data set of this paper contains a wider range of horizons than the other previous studies.

1.3 Contributions

[4]irical studies generally test for the rationality of the forecasts on general properties such as bias or autocorrelation in errors. One motivation behind this work is aiming to use behavioral interpretations behind inefficient forecasts of forward rates.

The organization of this thesis is as follows: Chapter 1 present the Introduction and motivation behind this thesis while Chapter 2 provide the literature reviews of past related researches in the efficient market hypothesis, a review of the literatures on the forward rate unbiasedness hypothesis, the theoretical bases and empirical evidences for behavioral biases in equity markets, and the empirical evidences for possible explanations of the forward exchange rate bias. Chapter 3 present the developed hypothesis. Chapter 4 shows details the data used and descriptive statistic of the sample. Chapter 5 shows the methodology and results to answer the research questions. Chapter 6 provides the conclusions of this thesis.

CHAPTER 2

LITERATURE REVIEWS

2.1 The Efficient Market Hypothesis

[5]Theres are thought to be rational and risk neutral under the efficient market hypothesis (EMH). They are assumed to be rational and therefore value securities rationally. EMH states that if economic agents are risk neutral, all available information is used rationally; therefore, the market is competitive. As risk neutral investors needs no compensation for risk, the future spot rate may not be differing from expectation. With no taxes and transaction costs, or other frictions, the foreign exchange market will be efficient in the sense that the expected rate of return to speculation in the forward exchange market will be zero. The EMH also states that since forward exchange rates fully reflect all available information concerning the expectations of investors for future spot rates, the forward rates should be an unbiased forecasts of future spot rates. The tests of market efficiency are comprised of joint tests of two null hypotheses which are the market efficiency hypothesis (MEH) and the unbiasedness or the rational expectation hypothesis. (UH or REH).

The efficient market hypothesis [6](EMH) was firstly introduced by Fama (1970). This theory consists of three types of market test with the market efficiency concepts based on various information sets (1) The Weak Form: Past information is already reflected on price, or the foreign exchange rate forecasting based on historical exchange rate as history tends to repeat itself. (2) The Semi-Strong Form: Public information is united in the asset price, or the prediction of foreign exchange rate based on the availability of public information and (3) The Strong-Form: All available information, together with the private information is reflected in the asset price, or forecasting of foreign exchange rates made by agents, such as the central bank, who may have more information than others. The results of De Nederlandsche Bank and the Bank of Canada also state that although the central bank own more information in term of monetary and exchange rate policy, they still cannot predict the future spot rate. Because the foreign exchange markets are large and liquid, they are believed to be the most efficient financial market; however, Grossman and Stiglitz (1976) contribute an important message that information is costly to collect and analyze, so not all information will be collected. Therefore, market will never be fully efficient or reach the strong-form.

In the foreign exchange market, lots of researchers support the weak-form tests, which show that the technical analysis model that observes on the basis of past realized spot rate is a technique for predicting changes in foreign exchange rate, does better than the fundamental analysis model at predicting foreign exchange rate in the short run. Fundamental factors that contribute to a change in exchange rate include monetary policy, political stability, interest rates and imports as well as exports. Many researchers conclude that fundamental analysis models using publicly available macroeconomic variables to estimate exchange rates, such as inflation and interest rates, are not successful in predicting foreign exchange rate in the short-run.

2.2 Forward Rate Unbiasedness Hypothesis (FRUH)

[7]e theoretical foundation of the FRUH forms in the Uncovered Interest Parity (UIP) condition and Covered Interest Parity (CIP) condition. If UIP holds the expected changes in spot exchange rate for a k-period horizon $(E_t(s_{t+k}) - s_t)$ should be indifference from the difference of the domestic and foreign nominal interest rate $(i_t - i_t^*)$. UIP is determined by a parity relationship among the spot exchange rate and differences in interest rates between two countries, which reflects an equilibrium in foreign exchange market whereby arbitrage opportunities are eliminated. As the equilibrium, when interest rates vary across two countries, the parity condition implies that the forward rate is a premium or discount indicating from interest rate differential. CIP states that the nominal interest rate differential between two countries $(i_t - i_t^*)$ must be indifferent to the countries' forward exchange rate premium or discount $(f_t^k - s_t)$. This means that the forward rate derives its value from the spot rate and the additional information in available interest rates, which investors eliminate exposure to foreign exchange risk or the unanticipated changes in exchange rates with the use of the forward contract; therefore, the exchange rate risk is effectively covered. Under this condition, a domestic investor will receive equal returns from investing in domestic assets or in foreign currency assets in other countries with different interest rate, and converting the foreign currency for domestic currency at the negotiated forward rate because they will be indifferent to the interest rates on deposits in these countries because of the forward rate equilibrium. CIP allows for no arbitrage opportunities since the return on domestic deposits is equal to the return on foreign deposits. If the returns are not equal by the use of the forward contract, there would be potential arbitrage

opportunities. For the equilibrium to hold under differences in interest rates between two countries, the forward rate must generally differ from the spot exchange rate; in other words, the forward rate premium or discount reflects the interest rates differential between two countries.

Using UIP and CIP condition, FRUH can be formulated by simply substituting the expected changes in the spot rate with the ex-post changes in the spot rate plus an error term. FRUH is the joint hypothesis of the conditions of UIP and rational expectations under the assumption of risk neutrality. Therefore, the future change in spot exchange rate for a k-period horizon should be equal to current forward premium. Isard (2008) state that if the ex-post spot exchange rate appreciation (depreciation) should be equal to the forward exchange rate premium (discount), respectively. To perform empirical tests of the FRUH, most of the research commonly use the "Fama Regression" (Fama, 1984) to test whether the current forward premium ($f_t^k - s_t$) is an unbiased predictor of the future spot exchange rate return($s_{t+k} - s_t$) by regressing current forward premium on the future spot exchange rate return. The main focus of FRUH is not on how accurate of the forward exchange rate forecast, but it is rather on whether the forecast errors are systematically biased.

If the rational expectations are true, the forward exchange rates fully reflect available information about the expectation of investors, so forward rate should be unbiased forecasts of future spot rates, so the null hypothesis of unbiasedness is $\beta = 1$, if the null hypothesis are rejected, it means that FRUH does not hold. The implication of the null hypothesis rejected is that market participants may make systematic time varying forecast errors or forward exchange rate does not correctly predict the future spot rate movement on average. Most empirical evidences show forward rates have been documented to be consistently biased forecasts of future spot rates as β is found to be closed to -1 rather than 1 (Froot and Thaler, 1990); (Gospodinov, 2009). It means that the forward bias puzzle is commonly accepted.

2.3 The Theoretical Bases and Empirical Evidences for Behavioral Biases in Equity Markets

This paper notes that markets and investors continuously revise their expectations with new information and such revisions may be influenced by behavioral pattern that deviate prices from market rationality and efficiency. General investors usually have limited ability to access and process information; therefore, sometimes they create many behavioral biases, and the common one is overconfidence. Barberis et al. (1998) state that overconfidence among general investors has two types, which are overweighting prior beliefs and underweighting new information. These lead to under-react to information as the adjustments are naturally insufficient as stated by Slovic and Lichtenstein (1971) because the different starting points lead to different estimates, which biased toward the initial values. During decision making, individuals tend to rely too heavily on an initial piece of information offered to make subsequent judgments. For example, in stock markets, Montier (2002) finds general investors tend to under-react to fundamental information, and the past prices are likely to influence the price today since investors are usually conservative and tend to judge the past price according to the historical prices, which result underreact to recent information. Amir and Ganzach (1998) find that security analysts under-react to new information. Jackson and Johnson (2006) also find a generalized under-reaction pattern in equity market.

Shiller (2002) states that the discovered negative beta would be consistent with the widely accepted bias of conservatism.

Another behavioral bias of investors is over-reaction, which occurs when investors place too much weight on new information in forming their expectations regarding future events. For example, investors may conclude earning growth from a consistent past histories earning growth of some companies too far into the future. Then, investors over- value and overprice these companies and become disappointed in the future when the forecasted earnings growth is not as expected because they use the representativeness heuristic without considering that a history of high earnings growth is unlikely to repeat itself. Such overreaction tends to drive prices to be above their fair or rational market value, only to have rational investors take opposite side of the trades and bring prices eventually back in line. With an inadequate quantity of similar information, investors will under- react to information. However, with large amounts of similar information, investors will over-react to information.

Abel (2002), Posteshman (2001) and Daniel et al. (1998) identify the evidences among investors that they are systematic pessimism in response to new information and over-react at long horizons and tend to under-react at short horizons. Ball and Croushore (2001) have found systematic pessimism in the equity market responses to new information. The empirical evidences show systematic deviations from rationality and efficiency and seem to reflect well-documented behavioral patterns among investors in the equity market.

Some literatures state that costly and asymmetric information as well as the limited arbitrage of investors can lead to systematic deviations from rational expectations. The recent literatures on equity markets explore the reasons for such deviation from rationality and efficiency. Schleifer and Vishny (1997) note that financial markets are not frictionless because it the reality, trading is always associated with certain transactions and information costs, such as commission and tax implication; therefore, investors face limitation on the nature of arbitrage as to arbitrage, it requires capital and is normally risky to do. Also, arbitrage may be limited by agency problems between skilled arbitragers and general arbitragers since they have different skills and more connections. Therefore, due to restrictions that are placed, rational traders who aim to arbitrage face pricing inefficiencies and prices may remain in a non-equilibrium as Schleifer and Vishny state that these systematic non-rational behavioral patterns may remain due to the limited arbitrage of investors.

2.4 The Empirical Evidences for Possible Explanations of the Forward Exchange Rate Bias

Many empirical evidences have proved that even though there are much higher trading volumes in foreign exchange markets than the equity markets, systematic deviation from rationality also happens in this market. Bekaert at al. (2001) conclude that there are three main possible reasons for the rejection of forward rates as an unbiased forecast of future spot rates, which are

1) The systematic expectations theory: The systematic expectations theory explains that market participants make systematic prediction errors. The main idea is that market participants make irrational expectations as they are not risk neutral and rational as assumed by FRUH. One subcategory under the systematic expectations theory that is commonly used to explain the failure is “The Carry Trade Effect”, which causes the short-term bias from fundamentals. A basis strategy for the carry trade in

currency is that selling forward currency at premium and buying forward currency at discount yields a positive excess returns, which generates high economic value to a risk averse investors. The recent studies suggested that the momentum inherent in carry trades may lead to worsen biasedness (Spronk et al, 2013; Verschoor, 2013).

2) The presence of risk premium: Froot and Frankel (1989) state that the bias in the forward rate causes from both irrational expectations and a risk premium. Waheed (2009) also finds that the risk premium might be the determinant of the failure of FRUH, and he finds that the external current account balance position, foreign portfolio investment, inflation as well as interest rate are determinants of the risk premium. However, Frankel and Poonawala (2010) find that forward rate biasedness is less pronounced for developing market currencies than for developed market currencies, so they suggested that a time-varying exchange rate risk premium may not be the explanation for bias since to invest in emerging market probably be riskier, but the finding shows that bias in their forward rate is smaller, which might be because high riskiness in emerging market currencies may not entirely incorporated in the exchange rate risk premium when considering the conditional bias to be an exogenous variables such as risk factors as well as changes in an economic conditions and policies. Bernoth et al. (2005) find that the time- varying approach leads to the failure of risk premium as risk premium is negatively correlated with expected spot exchange rates. The literature surveys of Engel (1996) and Burnside et al. (2010) conclude that the time-varying risk premium approach occasionally explain the forward rate bias.

3) The statistical issues theory: This means that the statistical tests themselves may lead to false rejections due to poor probabilities and finite sample. Some researchers find that the empirical failures of the hypothesis resulting from

contaminated data and even inappropriate selections of the time length of forward contracts. For example, sampling error (Breuer and Wohar, 1996), near co-integration (Maynard, 2003), small sample sizes and serial correlation in the forward premium (discount) (Baillie and Bollerslev, 2000), nonlinearities in the data (Clarida et al., 2001), and omitted variables (McBrady, 2005; Pippenger, 2011). Also, Barnhart and Szakmary (1991) state that conflicting results of FRUH may due to the different time period that examined and specific factors during the period. For example, forward exchange rates that predict future spot exchange rates are influenced by changes in interest and inflation rates differentials and monetary policy changes between countries, which implies that changes in expectations, during the time that forward rate prediction is made, can partly explain the forecast errors. Lothian and Wu (2011) identify that their sample data in 1980s resulted in the negative slope estimates due to the changes of monetary policy in US and UK. So far, Aggarwal et al. (2008) state that even though they have improved statistical methodologies that account for potential statistical problems of the forward rates biasedness, they reconfirm that the forward rates are the bias forecast of the future spot exchange rate.

It has been widely accepted that forward rates reflect systematic biases as forecasts of future spot rates. Until now, there is little empirical literature on behavioral biases in foreign exchange market. There is only the research of DeGrauwe et al. (2005) as well as Aggarwal and Zong (2008). DeGrauwe et al state that behavioral bubble or wave of optimism leads asset prices to be higher than its true value causes biasedness in forward exchange rates as investors stick on the trading strategies in the prior periods that have been profitable. Aggarwal and Zong observe market rationality at short-horizon and find that market overlook is pessimism, and forecast revisions in forward rates as forecast of future spot rates reflect systematic under-react to new information.

CHAPTER 3

HYPOTHESIS DEVELOPMENT

[8]s most empirical evidences show that forward rates have been documented to be consistently biased forecasts of future spot rates but the sources of such bias are still unclear; therefore, this paper does not only aim to examine the rationality of forward rates as forecast of future spot rates, but this paper also aims to examine on behavioral interpretations of such biases and deviations from rationality and efficiency by examining new available information that incorporated in the changes in the forward rate on how such forecast revisions of forward rates as forecast of the same future spot exchange rate are characterized by systematic behavioral biases of over-or-under reaction and optimism-or-pessimism. Moreover, to assess possible behavioral explanations of the failure of the FRUH, this paper examines whether time-varying risk premium is the the determinant for there deviations from rationality. In addition, this paper aims examines the evolution of the behavioral dynamics over time to assess whether the markets overlook is stable or not.

RESEARCH QUESTION I: How foreign exchange markets are characterized by systematic behavioral biases of over-or-under reaction and optimism-or-pessimism overtime?

As the rationality hypothesis is firmly rejected according to many theoretical results, this paper estimates that forecast revisions of forward rates as forecast of future spot rates have a high likelihood to reflect systematic pessimism and systematic under-reaction to new information overtime. This is because people are generally learning slowly and are usually conservative, so they difficultly shake off their initial value of memories and tend to underweight new available information. Therefore, when new available information is processed, investors under-react to this information.

Also, this study predicts systematic pessimism according to forecast revisions in forward rates as forecasts of future spot rates because the examined period was the period of the subprime mortgage crisis and the world economic recovery periods. Ever since the starting of the global financial crisis in 2007, financial investors have remained stressed as they experienced various shocks and uncertainties that caused by low oil prices, shifting in capital flows caused by the anticipated reversal of US monetary expansion, instability within Eurozone and the unstable situation in Greece (Chavdarov ,2015). These situations increase the level of uncertainty among financial market participants, which lead to the drop in confidence of investor. Investors would withdraw their money from risky assets and exchange rate is the most liquid asset of all, so it is normally very sensitive during the crisis. This might reflect systematic pessimism among investors due to uncertainty they face.

RESEARCH QUESTION II: Does time-varying risk premium the determinant for there deviations from rationality?

This research predicts that after controlling for time-varying risk premium, both forecast errors and forecast revisions are expected to decline because the markets are not risk neutral and rational as assumed by the forward rate unbiasedness hypothesis since most commonly, investors are risk- averse and they typically demand risk premium in order to hold purely speculative positions. The fundamental theorem of asset pricing states that the condition of no-arbitrage is equivalent to the existence of a risk neutral measure. Therefore, after controlling for time- varying risk premium, it seems to be a complete market with no arbitrage opportunity, so all relevant information will fully reflect into the forward rates. They would be no behavioral bias, and forward rates can be an unbiased forecast of future spot exchange rate.

CHAPTER 4

DATA AND DESCRIPTIVE STATISTIC

[9] data covers the foreign exchange rates of the eight major industrialized countries quoted against the U.S. Dollar (USD), which are Australian Dollar (AUD), Canadian Dollar (CAD), British Pound (GBP), Euro (EUR), Japanese Yen (JPY), Swiss Franc (CHF), New Zealand Dollar (NZD) and Mexican Peso (MXN). The research of Cochrane (2001) identifies risk as a concept in asset pricing model, which does not frequently change over day-to-day. Therefore, this research studies in weekly frequency. The data set for weekly spot and forward rate of 3,6,12 and 24-month as well as FX implied volatility for each currency pair during June, 2006 – December, 2014 are used in this studies. Yields to maturity for 3 months, 6 months,1 year, 2 years and 3 years are also required for each currency. All of which are obtained from ***Bloomberg Database***. **Table I** shows the descriptive statistics for the data set at the levels for the forecast error and forecast revision for each currency at 3,6 and 12-month horizons. One notice point is that the calculation of forecast errors is similar to forward premium (discount). Also, all the examined variables are in log-form.

Table I :Descriptive Statistics for Forecast Errors and Forecast Revisions (June, 2006 – December, 2014)

	AUD	CAD	GBP	EUR	JPY	CHF	NZD	MXN
A. FE,3M								
Mean	-.0063	-.0037	-.0076	-.0037	-.0005	.0098	-.0007	-.0181
S.D.	.0790	.0496	.0536	.0536	.0561	.0518	.0727	.0636
Min	-.4685	-.2364	-.2499	-.2290	-.1710	-.1583	-.3251	-.3192
Max	.2305	.1552	.1529	.1104	.1746	.1577	.2554	.1286
Obs	448	448	448	448	448	448	448	448
B. FE,6M								
Mean	-.0134	-.0074	-.0150	-.0080	-.0013	.0199	-.0007	-.0370
S.D.	.1180	.0756	.0830	.0806	.0816	.0736	.1120	.0915
Min	-.4481	-.2410	-.3536	-.2236	-.2475	-.1765	-.4034	-.4414
Max	.2733	.1774	.1773	.1362	.1909	.2386	.3094	.1085
Obs	448	448	448	448	448	448	448	448
C. FE,12M								
Mean	-.0262	-.0113	-.0310	-.0137	.0012	.0393	-.0038	-.0725
S.D.	.1485	.1017	.1015	.1017	.1202	.0935	.1422	.1120
Min	-.4406	-.2916	-.3758	-.2671	-.2578	-.2225	-.4993	-.4308
Max	.3434	.2224	.1596	.1852	.2341	.3335	.3047	.1351
Obs	428	428	428	428	428	428	428	428
D. FR,6m-3m								
Mean	.0071	.0037	.0074	.0042	.0008	-.0101	.0025	.0188
S.D.	.0776	.0492	.0528	.0535	.0553	-.0516	.0721	.0635
Min	-.2442	-.1687	-.1564	-.1172	-.1562	-.1470	-.2719	-.1454
Max	.4610	.2312	.2473	.2259	.1709	.1740	.3235	.3313
Obs	448	448	448	448	448	448	448	448
E. FR, 12m-6m								
Mean	.0183	.0082	.0176	.0115	.0011	-.0189	.0073	.0398
S.D.	.1148	.0748	.0807	.0784	.0831	.0736	.1095	.0934
Min	-.2737	-.1835	-.1706	-.1453	-.1909	-.2408	-.3229	-.1363
Max	.4383	.2392	.3413	.2152	.2474	.1920	.3878	.4405
Obs	428	428	428	428	428	428	428	428
F. FR,2y-12m								
Mean	.0405	.0286	.0360	.0255	.0064	-.0346	.0186	.0780
S.D.	.1401	.0899	.0978	.0902	.1231	.0912	.1366	.1182
Min	-.3304	-.2192	-.1389	-.1721	-.2581	-.3796	-.3024	-.1750
Max	.3479	.2465	-.1389	.2485	.2628	.2369	.4405	.4225
Obs	375	375	375	375	375	375	375	375

Note: This table reports descriptive statistics for forecast errors (FE) and forecast revisions (FR) of the eight major currency pairs, which are Australian Dollar (AUD), Canadian Dollar (CAD), Swiss Franc (CHF), Euro(EUR), British Pound (GBP), Japanese Yen(JPY), New Zealand Dollar(NZD) and Mexican Peso(MXN) at 3, 6, and 12-month horizons. Forecast errors represent forward premium (discount) for each currency quoted against US Dollars. All examined variables are in Log-Form. $FE_t = Ln\, F_{t-k}^t - Ln\, S_t$, and $FR_t = Ln\, F_{t-k}^t - Ln\, F_{t-2k}^t$; for example, $FE_{3m} = LnF_{t-3m}^t - LnS_t$ and $FR_{3m} = LnF_{t-3m}^t - LnF_{t-6m}^t$.

CHAPTER 5

METHODOLOGY

5.1 Primary Analysis for Testing Forward Rate Unbiasedness Hypothesis

Table II reports the results of the tests for unit roots for examining forward rate unbiasedness hypothesis (Equation 1) in each of the time series including the spot rate, 3-month forward rate, 6-month forward rate, 12-month forward rate and the 2-year forward rates. All examined variables are in Log-Form in order to overcome the Siegel paradox. To examine the non-stationary and unit roots associated in the spot and forward rates, an augmented Dickey-Fuller (ADF) test which allow for serial correlation in error term (ϵ_t) should be used. This is important because unit root tests of the spot and forward rates should take into account any seasonality in the generation of time-series data. The results clearly show that all variables at the level have unit roots as stochastic trends are prevalent in the spot and forward rates. The presence of stochastic trends (random walk) in the spot and forward rates restricts the statistical model that can be used. Therefore, the first differences are applied in order to turn it to be stationary.

Theoretically, forward rates can be priced using a no-arbitrage condition relationship between the spot and forward rate, which is known as covered interest rate parity as the relationship between interest rates and the spot and forward currency values of two counties are in equilibrium, so there are no interest rate arbitrage opportunities between those two countries. Brenner and Kroner (1995) show that the existence of co-integration between the spot rate and forward rates depend entirely on the time-series properties of the cost of carry, or

Table II: Unit Root Tests for Spot and Forward Rates

	AUD	CAD	GBP	EUR	JPY	CHF	NZD	MXN
Spot Rates	**-1.672**	**-0.847**	**-1.622**	**-1.577**	**-0.703**	**-1.978**	**-2.167**	**-0.972**
(First Difference)	-9.365***	-10.477***	-9.672***	-9.753***	-9.660***	-10.735***	-10.132***	-9.217***
3- Month Forward Rates	**-1.663**	**-0.842**	**-1.632**	**-1.566**	**-0.703**	**-1.971**	**-2.152**	**-1.031**
(First Difference)	-18.230***	-19.184***	-17.162***	-15.810***	-16.687***	-15.637***	-17.352***	-18.001***
6-Month Forward Rates	**-1.652**	**-0.822**	**-1.640**	**-1.553**	**-0.703**	**-1.955**	**-2.134**	**-1.067**
(First Difference)	-18.216***	-19.23***	-17.183***	-15.822***	-16.687***	-15.625***	-17.378***	-18.100***
12-Month Forward Rates	**-1.630**	**-0.795**	**-1.656**	**-1.538**	**-0.702**	**-1.922**	**-2.092**	**-1.124**
(First Difference)	-18.185***	-19.182***	-17.285***	-15.862***	-16.687***	-15.595***	-17.415***	-18.089***
2-Year Forward Rates	**-1.631**	**-0.855**	**-1.707**	**-1.566**	**-0.701**	**-1.841**	**-2.026**	**-1.242**
(First Difference)	-18.204***	-19.386***	-17.369***	-16.016***	-16.688***	-15.711***	-16.968***	-17.879***

Note: Augmented-Dickey-Fuller tests (ADF Tests) is applied to all time series used in this paper. All variables are in Log-Form. This reported results are statistic with 4 lags. The 1% (***) critical value is -3.9754, 5% (**) critical value is -3.4182, and 10% (*) critical value is -3.1312. The level series for all variables have unit root, so they are not stationary as shown in bold. The same test is applied to the first difference of the level series of each period, and this report shows that all tested variables are stationary.

"Differential" between domestic and foreign interest rates because under covered interest rate parity, the forward rate is simply a reflection of interest rates differentials between two countries. If the differential is stationary, then the spot and forward rate are tied together, and they would be co-integrated. However, if the differential has a stochastic trend, then the spot and forward rate tend to drift apart, and they would not be co-integrated. The cost of carry can be calculated by Ln $D_{t-k}^{t} = k(Dr_{t-k}^{t} - Fr_{t-k}^{t})$, where Dr_{t-k}^{t} (Fr_{t-k}^{t}) is the domestic and foreign interest rates k- period at time $t-k$, respectively. This paper examines on r_{t-3m}^{t}, r_{t-6m}^{t}, and r_{t-12m}^{t}, which are 3-month, 6-month and 12-month horizons, respectively. **Table III** clearly show that the differentials for all time horizons are stationary, which is similar to the finding of Brenner and Kroner, who state that the differential will not likely to have a stochastic trend considering the currency market because the similar underlying economic forces likely to drive interest rates in both countries, so the difference of domestic and foreign interest rates would eliminate the trend.

As the spot and forward rates are all I (1) series (integrated of order 1), a co-integrating vector should be estimated. The results of Johansen Co-integration tests of the spot rate and 3-month forward rate, the spot rate and 6-month forward rate, and the spot rate and 12-month forward rate in the levels for each currency are shown in **Table IV**. This paper shows that there are a co-integrating relationship exists between spot and forward rates for all horizons, but does not find the co-integrating vector of (1, -1) for any horizons for all tested currencies. This finding is not uncommon as if the spot and forward rate are co-integrated with a (1, -1) co-integrating vector, the evidence will be in favor of the FRUH. The result supports that the conditions for co-integration literally holds between the spot and forward rates and that co-integration can only exist follows three conditions, which are firstly, the spot rates and the

Table III : Unit Root Tests of Interest Rates Differences of Two Currencies

	AUD	CAD	GBP	EUR	JPY	CHF	NZD	MXN
3 Month	-4.984***	-4.428***	-7.336***	-3.563***	-7.265***	-	-7.328***	-3.867**
6 Month	-4.765***	-4.270***	-6.252***	-4.017**	-4.919***	-	-4.579***	-4.114**
1 Year	-2.994**	-4.001***	-2.889**	-4.698***	-8.640***	-5.877***	-3.021**	-18.106***
2 Year	-3.810***	-3.926***	-2.873**	-4.561***	-8.567***	-4.844***	-3.490**	-2.936**
3 Year	-3.016**	-3.461***	-2.622*	-3.020**	-6.644***	-4.153***	-2.970**	-4.781***

Note: For unit root testing, Augmented-Dickey-Fuller tests (ADF Tests) is applied. The cost of carry can be calculated by $Ln\ D_{t-k}^{t} = k(Dr_{t-k}^{t} - Fr_{t-k}^{t})$, where Dr_{t-k}^{t} (Fr_{t-k}^{t}) is the domestic and foreign interest rates k- period at time $t-k$,respectively. This paper examines on $Ln\ D_{t-3m}^{t}$, $Ln\ D_{t-6m}^{t}$, and $Ln\ D_{t-12m}^{t}$, which are 3-month, 6-month and 12-month horizons, respectively. This reported results are statistic with 4 lags. The 1% (***) critical value is -3.9754, 5% (**) critical value is -3.4182, and 10% (*) critical value is -3.1312. This report shows that all tested variables are stationary, I (0).

Table IV: Co-integration between Spot Rate and Forward Rate at Level

		Eigenvalue	Trace Statistic	5% Critical Value	Hypothesized No. of CE(s)	(1,-1)
AUD	S_t vs F_{t-3M}^t	0.1509	80.6240	20.2618	None *	No
		0.0107	4.9989	9.1645	At most 1	
	S_t vs F_{t-6M}^t	0.0603	32.9811	20.2618	None *	No
		0.0111	5.0342	9.1645	At most 1	
	S_t vs F_{t-12M}^t	0.0130	27.2515	20.26184	None *	No
		0.0040	1.7119	9.1645	At most 1	
CAD	S_t vs F_{t-3M}^t	0.1414	72.9213	20.2618	None *	No
		0.0052	2.4544	9.1645	At most 1	
	S_t vs F_{t-6M}^t	0.0663	36.1506	20.2618	None *	No
		0.0117	5.3173	9.1645	At most 1	
	S_t vs F_{t-12M}^t	0.0141	27.4340	20.2618	None *	No
		0.0032	1.3908	9.1645	At most 1	
GBP	S_t vs F_{t-3M}^t	0.1249	67.4931	20.2618	None *	No
		0.0124	5.8057	9.1645	At most 1	
	S_t vs F_{t-6M}^t	0.0591	32.6471	20.2618	None *	No
		0.0116	5.2752	9.1645	At most 1	
	S_t vs F_{t-12M}^t	0.0181	21.8691	20.2618	None *	No
		0.0097	4.1454	9.1645	At most 1	
EUR	S_t vs F_{t-3M}^t	0.0120	43.4049	20.2618	None *	No
		0.0011	3.7723	9.1645	At most 1	
	S_t vs F_{t-6M}^t	0.0068	30.1888	20.2618	None *	No
		0.0026	8.5458	9.1645	At most 1	
	S_t vs F_{t-12M}^t	0.0024	29.2468	20.2618	None *	No
		0.0005	1.7740	9.1645	At most 1	
JPY	S_t vs F_{t-3M}^t	0.1459	74.2320	20.2618	None *	No
		0.0029	1.3609	9.1645	At most 1	
	S_t vs F_{t-6M}^t	0.0454	21.6647	20.2618	None *	No
		0.0017	0.8011	9.1645	At most 1	
	S_t vs F_{t-12M}^t	0.0338	28.1369	20.2618	None *	No
		0.0083	3.5491	6.1645	At most 1	
CHF	S_t vs F_{t-3M}^t	0.0824	44.7156	20.2618	None *	No
		0.0106	4.9412	9.1645	At most 1	

	S_t vs F_{t-6M}^t	0.0399	22.6849	20.2618	None *	No
		0.0097	4.3899	9.1645	At most 1	
	S_t vs F_{t-12M}^t	0.0215	24.2064	20.2618	None *	No
		0.0117	5.0065	9.1645	At most 1	
NZD	S_t vs F_{t-3M}^t	0.1206	62.2378	20.2618	None *	No
		0.0160	6.9370	9.1645	At most 1	
	S_t vs F_{t-6M}^t	0.0534	28.9222	20.2618	None *	No
		0.0143	6.0127	9.1645	At most 1	
	S_t vs F_{t-12M}^t	0.0150	28.1262	20.2618	None *	No
		0.0056	2.2167	9.1645	At most 1	
MXN	S_t vs F_{t-3M}^t	0.1491	77.9605	20.2618	None *	No
		0.0071	3.3229	9.1645	At most 1	
	S_t vs F_{t-6M}^t	0.0528	27.3632	20.2618	None *	No
		0.0065	2.9708	9.1645	At most 1	
	S_t vs F_{t-12M}^t	0.0120	28.9407	20.2618	None *	No
		0.0089	3.8018	9.1645	At most 1	

Note: Johansen co-integration test is applied to each currency pair between the spot rate and 3-month forward rate, the spot rate and 6-month forward rate , and the spot rate and 12-month forward rate with the assumptions that the variables are in constant term and have no trend. (*) denotes the rejection of hypothesis at 5% significant level. First state is that $H_o: r = 0$, $H_1: 0 < r \leq g$. If the null hypothesis of the first state is not rejected, there is no co-integration. The second state is that $H_o: r = 1$, $H_1: 1 < r \leq g$. If the null hypothesis of the second state is not rejected, the conclusion would be that there is one co-integrating vector, while if this is rejected, it can be concluded that there is more than one co-integrating vector.

forward rates are non-stationary in the levels. Secondly, both spot and forward rate series are stationary in first difference. Thirdly, there exists a linear combination of levels, where $\mu_{t+k} = S_{t+k} + \beta F_t$. Also, in the context of spot and forward rates, the fact that these are essentially rates of the same currency but with different delivery and payment dates, means that financial theory would suggest that they should be co-integrated. Since this paper finds that both spot and forward rates at all time horizons are co-integrated, it can be implied that they have a long term equilibrium relationship that they may deviate from the short run. Therefore, the error correction term should be formed into the equation. Error correct terms would results better long run forecast than traditional time-series models.

5.2 Testing for Forward Rate Unbiasedness Hypothesis

According to Engel (1996), he constructs a comprehensive review of the literature on forward and spot rates relationship with the assumptions that if rational expectations hold and investors are risk neutral, the forward rate is an unbiased predictor of the expected future spot rate, or the forward rate is a conglomeration of all investors' expectations, which can be expressed as:

$$E_t(S_{t+k}) = F_t^{t+k}$$

where the expected spot rate at $t + k$ conditional on the information available at time t should be equal to the forward rate at time t. The above hypothesis is usually constructed at the levels relationship as:

$$S_{t+k} = F_t^{t+k} + \varepsilon_t$$

where ε_t is the rational expectation forecast error. Forward exchange rates have important theoretical implications for forecasting future spot exchange rates as the forward rate should be an unbiased predictor of the future spot exchange rate. Markets use all available information efficiently in forming expectations and such expectations are rational and unbiased, so that the rational expectation forecast errors are expected to be zero. This leads to a regression at the levels which has generally been used to test for the unbiasedness hypothesis of forward exchange rates, which is expressed as:

$$S_{t+k} = \alpha + \beta F_t^{t+k} + \mu_{t+k}$$

where the null hypothesis is that $\beta = 1, \alpha = 0$ and $E_t(\mu_{t+k})$ = 0.

Spot and forward rates are generally found to have unit root. Also, the hypothesis of unbiased forward exchange rates requires that not only that S_{t+k} and F_t to be co-integrated, but also the co-integrating vector must be equal to (1, -1). This paper investigates the co-integration between $S_{t+k}$and F_t, and finds that they are co-integrated for all horizons of every examined exchange rates, but the co-integrating vectors are not equal to (1, -1) as there are more than one co-integrating vectors which means they have long run relationship; therefore, the traditional time-series models are not appropriate for modeling the co-integrating vector of (S_{t+k}, F_t) and the use of such equation can lead to wrong interpretations since the traditional time-series models are misspecified considering the co-integration of spot rate and forward rate, and error correction terms needs to be added.

Brenner and Kroner (1995) develop the appropriate test for unbiasedness as follows in order to overcome statistical issues, such as a stochastic trend of the input variables and an omitted repressors bias, which occurs when the model incorrectly leaves one or more important casual factors, and the model may be bias when it compensates for the missing factors by over-or-underestimating the effect of one of the other factors.

$$\boldsymbol{\Delta\, Ln\, S_t = \alpha + \beta \Delta Ln\, f_{t-k}^{t} + \delta\left(Ln\, f_{t-2k}^{t-k} - Ln\, S_{t-k}\right) + \epsilon_t} \quad \textbf{(1)}$$

$$Ln\, S_t - Ln\, S_{t-k} = \alpha + \beta(Ln\, f_{t-k}^{t} - Ln\, f_{t-2k}^{t-k}) + \delta\left(Ln\, f_{t-2k}^{t-k} - Ln\, S_{t-k}\right) + \epsilon_t$$

where the unbiasedness hypothesis is satisfied if (α, β, δ) = $(0, 1, 1)$ and the residual are serially uncorrelated. Market efficiency hypothesis is forward exchange markets states that traders have rational expectations. If the rational expectation holds true, the forward market provides an unbiased estimate of the future spot rate, these two variables would be perfectly positively correlated. The rational expectations hypothesis (REH) also states that economic agents should have make use of all available information in forming expectations, so there should be no systematic patterns in forecast errors. The error correction term implies that the model controls for forecast error of the previous period in order to get the clear result of the current period. This involves regressing the change in the spot rate over 3-, 6-,12- and 24- month periods predicted by the change in the forward rates and the change in previous period forecast error. The dependent variable can therefore suffer from serious autocorrelation inherent in the data, and such issue can be dealt by regressing OLS with Newey-West heteroskedasticity and autocorrelation consistent (HAC) standard errors.

The empirical results based on the differencing equations with the error correction term shown in **Table V** strongly reject the hypothesis of unbiased forward exchange rates forecast of future spot rate, which confirm other previous researches as $\alpha \neq 0$ and there are on the basis of serial correlation in the residuals. As the null hypothesis are rejected, it means that FRUH does not hold. The implication of the null hypothesis rejected is that market participants

Table V : The Test for Unbiasedness

	AUD	CAD	GBP	EUR	JPY	CHF	NZD	MXN
A. 3M								
α	.0071***	.0007***	.0010***	.0002***	.00003***	.0023***	.0074***	.0077***
	(.0002)	(.0001)	(.0001)	(.0001)	(.0000)	(.0001)	(.0001)	(.0003)
β	.9912***	.9964***	1.0024***	.9878***	1.0001***	.9694***	1.0020***	.9361***
	(.0089)	(.0060)	(.0091)	(.0068)	(.0001)	(.0064)	(.0069)	(.0235)
δ	.9600***	.9832***	.9939***	.9686***	1.0003***	.9423***	1.0004***	.8901***
	(.0129)	(.0108)	(.0144)	(.0112)	(.0002)	(.0107)	(.0100)	(.0309)
Obs	477	477	477	477	477	477	445	477
R^2	0.9780	.9854	0.9815	0.9768	1.0000	0.9768	0.9857	0.9470
B. 6M								
α	.0125***	.0015***	.0021***	.0003***	.0001***	.0043***	.0140***	.0127***
	(.0006)	(.0002)	(.0002)	(.0002)	(.0000)	(.0002)	(.0003)	(.0009)
β	.9533***	.9712***	.9722***	.9486***	1.0003***	.9208***	.9827***	.8449***
	(.0255)	(.0108)	(.0191)	(.0144)	(.0002)	(.0150)	(.0139)	(.0411)
δ	.8538***	.9229***	.9215***	.8760***	1.0006***	.8419***	.9485***	.7188***
	(.0343)	(.0183)	(.0328)	(.0241)	(.0003)	(.0261)	(.0235)	(.0562)
Obs	477	477	477	477	477	477	445	477
R^2	0.9217	0.9468	0.9310	1.694	1.0000	0.9296	0.9474	0.8628
C. 12M								
α	.0170***	.0025***	.0033***	.0005***	.0001***	.0066***	.0226***	.0172***
	(.0019)	(.0004)	(.0003)	(.0004)	(.0000)	(.0005)	(.0014)	(.0021)
β	.8370***	.8826***	.8679***	.8446***	1.0005***	.8217***	.8949***	.7197***
	(.0476)	(.0227)	(.0326)	(.0245)	(.0003)	(.0287)	(.0295)	(.0477)
δ	.5834***	.7207***	.6927***	.6426***	1.0009***	.6375***	.7551***	.4771***
	(.0595)	(.0380)	(.0555)	(.0390)	(.0006)	(.0466)	(.0503)	(.0575)
Obs	477	477	477	477	477	477	445	477
R^2	0.7850	0.8335	0.8046	0.7912	0.9999	0.8318	0.8351	0.7450
D. 2Y								
α	.0161***	.0030***	.0036***	.0010*	.0003***	.0090***	.0260***	.0187***
	(.0031)	(.0006)	(.0005)	(.0005)	(.0000)	(.0011)	(.0034)	(.0031)
β	.6797***	.7111***	.7168***	.7060***	1.0012***	.7062***	.6957***	.5699***
	(.0487)	(.0298)	(.0345)	(.0274)	(.0006)	(.0399)	(.0437)	(.0504)
δ	.2784***	.3857***	.3781***	.3337***	1.0014***	.3911***	.4281***	.2544***
	(.0477)	(.0453)	(.0491)	(.0330)	(.0010)	(.0472)	(.0543)	(.0428)
Obs	477	477	477	477	477	477	445	477
R^2	0.6340	0.6569	0.6465	0.6236	0.9997	0.7115	0.6355	0.6155

Note: This table reports the regression results of $\Delta\ Ln\ S_t = \alpha + \beta \Delta Ln\ f_{t-k}^{t} + \delta\left(Ln\ f_{t-2k}^{t-k} - Ln\ S_{t-k}\right) + \epsilon_t$ for each currency pair using OLS with Newey-West HAC standard errors. The unbiasedness hypothesis is satisfied if $(\alpha, \beta, \delta) = (0,1,1)$ and the residual are serially uncorrelated. All variables are reported with SEs below them in parenthesis. Also, number of observations and the R-squared are described. This table reports the results of 3- month (Panel A), 6-month (Panel B), 12-month (Panel C) and 2-Year periods (Panel D) for the eight currencies. *p<0.05, ** p<0.01, *** p<0.001

may make systemaatic time varying forecast errors or forward exchange rate does not correctly predict the future spot rate movement on average. Two obvious results are that there is more predictive power at shorter periods for every foreign exchange rates, and at longer horizons, the forecast of forward rates obviously does not follow the rational expectations. This result may consist to some evidences that FRUH does hold at short horizons. According to the theory of "Normal Backwardation", when the expected spot rates are above the forward rates, this leads to the desirable of speculators to net long their positions to gain profits as risk premium is required in order to hold purely speculative positions, so forward rates tend to approach the expected spot rates overtime as new information brings them into line with the expected future spot rates. Keynes (1930) claims that forward price will be either above or below the expected future spot depending on whether speculators hold short or long positions, respectively. Backwardation states that as the contract approaches the expiration, or the shorter the contracts, the forward rate will trade at a higher price compared to when the contract was far away from the expiration; therefore, this might lead to smaller forecast errors of the forward rates and the forecast of future spot exchanges rate in the shorter-horizon.

5.3 Primary Test Analysis for Testing Behavioral Biases

Before examining the idea of forecast revision process, this paper checks for the stationary for both FE_t and FR_t for every time horizons. All examined variables are in Log-Form. **Table VI** results that for 3-month and 6-month horizons, all of FE_t and FR_t are found to be stationary. For 12-month horizon, FE_t and FR_t generally have unit root; therefore, this paper takes the first difference for both FE_t and FR_t in order to turn it to be stationary.

As the variables FE_t and FR_trates are I(1) series (integrated of order 1) at 12-month horizon, a co-integrating vector should be estimated. This paper investigates the co-integration between FE_t and FR_t for 12-month horizon. If there two or more series are co-integrated, it means they have long- run relationship, so error correction term is needed to be added into the model. For 12-month horizon, as shown in **Table VII**, both variables are not co-integrated for every examined exchange rates, and the co-integrating vectors are not equal to (1, -1). Also, $FE_{12m}$and FR_{12m} tend to drift apart as they are not co-integrated. Thus, there is no need to correct the bias in the co-integrating vector following the error correction term.

[10]changes in FX implied volatility for each currency against USD is used as the proxy for risk for all time horizons, including 3-month horizon, 6-month horizon, and 12-month horizon, which are formed as $Ln\left[\frac{Vol_{t-3m}}{Vol_{t-6m}}\right]$, $Ln\left[\frac{Vol_{t-6m}}{Vol_{t-12m}}\right]$ and $Ln\left[\frac{Vol_{t-12m}}{Vol_{t-2y}}\right]$, respectively. They are considered to be exogenous variables, so this paper examines for unit roots using Augmented-Dickey-Fuller tests, and the results presented in **Table VIII** shows that they are all stationary time serie

Table VI: Unit Root Tests- Forecast Errors and Forecast Revisions

	AUD	CAD	GBP	EUR	JPY	CHF	NZD	MXN
Unit Root Tests- Forecast Errors								
FE, 3M	-4.067**	-3.593**	-3.592**	-4.242***	-4.022**	-4.653***	-3.655**	-4.446***
FE, 6M	-2.723*	-2.461***	-2.993**	-3.000**	-2.929**	-3.411**	-2.532***	-3.249**
FE, 12M	**-2.117**	**-1.527**	**-2.337**	**-2.180**	**-1.185**	**-2.751**	**-2.304**	**-2.087**
Δ FE, 12M	-6.706***	-6.420***	-7.725***	-6.749***	-5.756***	-10.242***	-9.388***	-7.765***
Unit Root Tests- Forecast Revisions								
FR,3 M	-4.168***	-3.972**	-3.562**	-4.404***	-3.914**	-4.423***	-3.618**	-4.534***
FR,6 M	-2.704*	-2.533***	-2.978**	-2.983**	-2.820*	-3.301**	-2.423***	-3.110**
FR,12 M	**-1.949**	**-1.694**	**-2.078**	**-2.361**	**-1.214**	**-2.896**	**-1.793**	**-1.872**
Δ FR,12 M	-8.834***	-8.821***	-8.222***	-8.045***	-8.944***	-9.225***	-8.991***	-9.523***

Note: Augmented-Dickey-Fuller tests (ADF Tests) is applied to all time series used in this paper and all variables are in Log-Form. This reported results are statistic with 4 lags. The 1% (***) critical value is -3.9754, 5% (**) critical value is -3.4182, and 10% (*) critical value is -3.1312. At 3-month and 6-month horizons, this report discovers that both the forecast errors and forecast revisions are stationary, except for 12-month horizon. At 12-month horizon, the same test is applied to their first difference, then this paper finds that they turn to be non-stochastic.

Table VII: Co-integration between Spot Rate and Forward Rate at Level

		Eigenvalue	Trace Statistic	5% Critical Value	Hypothesized No. of CE(s)	(1,-1)
AUD	FE_{12m} vs FR_{12m}	0.014	8.706	15.494	**None**	No
		0.008	3.164	3.841	**At most 1**	
CAD	FE_{12m} vs FR_{12m}	0.012	6.066	15.494	**None**	No
		0.003	1.374	3.841	**At most 1**	
GBP	FE_{12m} vs FR_{12m}	0.013	8.188	15.494	**None**	No
		0.008	3.333	3.841	**At most 1**	
EUR	FE_{12m} vs FR_{12m}	0.026	13.042	15.494	**None**	No
		0.016	3.046	3.841	**At most 1**	
JPY	FE_{12m} vs FR_{12m}	0.030	12.046	15.494	**None**	No
		0.001	0.555	3.841	**At most 1**	
CHF	FE_{12m} vs FR_{12m}	0.023	14.937	15.494	**None**	No
		0.016	3.093	3.841	**At most 1**	
NZD	FE_{12m} vs FR_{12m}	0.013	7.389	15.494	**None**	No
		0.008	2.784	3.841	**At most 1**	
MXN	FE_{12m} vs FR_{12m}	0.014	9.211	15.494	**None**	No
		0.010	3.721	3.841	**At most 1**	

Note: Johansen co-integration test is applied to each currency pair between the forecast errors and forecast revisions at 12-month horizon, where (*) denotes the rejection of hypothesis at 5% significant level. First state is that $\boldsymbol{H_o}: \boldsymbol{r} = \boldsymbol{0}$, $\boldsymbol{H_1}: \boldsymbol{0} < \boldsymbol{r} \leq \boldsymbol{g}$. If the null hypothesis of the first state is not rejected, there is no co-integration. The results for all examined currencies have shown that there is no co-integration between the forecast errors and forecast revisions at 12-month horizon.

Table VIII: Unit Root Tests for the Percentage Changes in Implied Volatility ($\%Vol_t$)

	AUD	CAD	GBP	EUR	JPY	CHF	NZD	MXN
3- Month Horizon	-4.101***	-3.940**	-5.109***	-2.921**	-4.302***	-6.248***	-5.089***	-4.248***
6-Month Horizon	-3.390**	-4.139***	-5.194***	-3.329**	-3.661***	-4.478***	-4.225***	-3.044**
12-Month Horizon	-3.415**	-2.568**	-2.994***	-3.563**	-3.273**	-3.683**	-5.252***	-3.472**

Note: Augmented-Dickey-Fuller tests (ADF Tests) is applied. This paper uses the percentage changes in implied volatility of the current forecast period and 3-month lag of that forecast period, $\%Vol_{t-6m}^{t-3m} = Ln\left[\frac{Vol_{t-3m}}{Vol_{t-6m}}\right]$, the current forecast period and 6-month lag of that forecast period, $\%Vol_{t-12m}^{t-6m} = Ln\left[\frac{Vol_{t-6m}}{Vol_{t-6m}}\right]$, and the current forecast period and 12-month lag of that forecast period, $\%Vol_{t-2y}^{t-12m} = Ln\left[\frac{Vol_{t-12m}}{Vol_{t-2y}}\right]$ for 3-,6- and 12-month horizon, respectively. This is considered to be the most appropriate proxy for the time-varying risk premium. This reported results are statistic with 4 lags. The 1% (***) critical value is -3.9754, 5% (**) critical value is -3.4182, and 10% (*) critical value is -3.1312. This paper finds that they are all stationary time series.

5.4 Testing for Behavioral Biases

[11]This paper aims to distinguish between the markets general overlook and the market response to new information by examining the relationship between the market mistakes (FEs) on a particular day and the forecast revisions (FRs) to the same expected future spot rate on that day. Two possible factors that could affect the market participants forecast from behavioral interpretations are that the market processes of new information on general outlooks (optimism-and-pessimism) and its response to that information (under-and-over reactions), which are independent of whether the received information is good or bad.

Forecast Error is formulated as $Ln\ F_t^{t+k} - Ln\ S_{t+k}$ to investigate the error of forward rates for forecasting spot rates. Forecast revisions is formulated by assuming that at time $t-k$, market participants form the forecast of the future spot rate at times t and $t+k$, which are F_{t-k}^{t} and F_{t-k}^{t+k} forward rates, respectively. At time t, market participants realize that the prior expectation formed at $t-k$ is not accurate, so they use the forecast error as a part of new information to revise their forecast at time $t+k$. Market participants revise their forecast of the future spot rate formed at time $t-k$ for time $t+k$, which reflects in the forward rate as F_{t-k}^{t+k}, and today, they form a new expectation with the arrival of new information for the future spot rate at $t+k$, which will be different from the original expectation and reflects in the forward rate as F_t^{t+k} as market participants have a tendency to adjust their beliefs to the most recent data and to make decision based on information they have at the present time. The forecast revision is then formed as $Ln\ F_t^{t+k} - Ln\ F_{t-k}^{t+k}$. It is the process reflected in how the changes in the prediction of the forward exchange rate as a forecast of the same future spot rate. Forecast revisions support the statement of Kozlova (2013) who states that economists and market participants revise their forecasting strategies as the new information becomes available and such revisions may incorporate changes in a country's institution, political, policy and economic situations as well as shocks to technology. Also, the statement of Amir and Ganzach (1998) who state that analysts usually base their forecasts on the previous information set and combined with new information to predict future company earnings.

As this paper aims to examines the markets overlook over time; the 3-month horizon represents short horizon, the 6-month horizon represents medium horizon, and the 12-month horizon represents long horizon. Forecast errors are regressed on forecast revisions. This leads to the regression for behavioral biases testing, which is expressed as:

$$\boldsymbol{FE_t = \alpha + \beta FR_t + \mu_t} \quad \textbf{(2)}$$

[12]of 3 and 6-month horizon are stationary. The equations are then expressed as above base Equation (2).

$$(LnF_{t-3m}^{t} - LnS_t) = \alpha + \beta\ (LnF_{t-3m}^{t} - LnF_{t-6m}^{t}) + \mu_t$$

$$(LnF_{t-6m}^{t} - LnS_t) = \alpha + \beta\ (LnF_{t-6m}^{t} - LnF_{t-12m}^{t}) + \mu_t$$

However, for 12-month horizon, the forecast errors and forecast revisions are not stationary, but after taking the first differences, they turn to be stationary. Therefore, this paper has to examine for the co-integration between FE_{12m} and FR_{12m} . The result in **Table VII** finds that FE_{12m} and FR_{12m} are not co-integrated for any currency pairs since a stationary combination of the non-stationary variables has not been found and there is no co-integration, so obviously there would be no sense in forming an error correction term as these two variables do not have a long run equilibrium relationship and that do not deviate from in the short run. Therefore, the equation for 12-month horizon is formed by taking the first differences for both FE_{12m} and FR_{12m} as follow:

$$\boldsymbol{\Delta FE_t = \alpha + \beta\ \Delta FR_t + \mu_t} \quad \textbf{(3)}$$

$$(LnF_{t-12m}^{t} - LnS_t) - (LnF_{t-12m}^{t-1} - LnS_{t-1}) = \alpha + \beta\ \{(LnF_{t-12m}^{t} - LnF_{t-24m}^{t}) - (LnF_{t-12m}^{t-1} - LnF_{t-24m}^{t-1})\}. + \mu_t$$

[11]. Similarly, if α is negative, it reflects general pessimism in the market. The slope (β) is a measure of market participants' propensity to over- or under-reaction. A positive β implies overreaction. Over-reaction occurs when FE and FR have same signs. i.e. Forecast revisions revise upward, [13]he forward rates tend to rise above the expected future spot exchange rates, causing a positive forecast error. However, a negative β implies under- reaction. Under-reaction occurs when forecast error (FE) and forecast revisions (FR) happen to have the different sign or they have a reverse trend. i.e. Forecast revisions revise downward, but the expected spot rate tends to rise above the forward rates, resulting a negative forecast error.

[14]ndent variables are expected to suffer from autocorrelation inherent in the data due to the overlapping value of regressing a long horizon dependent variables as for regressing the FRUH, OLS with Newey-West HAC standard errors are regressed

for all time horizons: 3-Month, 6-month and 12-month with four lags in order to control for autocorrelation.

[15]This finding is similar to Aggarwal and Zong (2008), who find that the forward exchange rates are characterized by systematic pessimism under-reaction to new information during short- horizon, and Daniel et al. (1998) who discover the evidences among investors in equity markets that they are systematic pessimism in response to new information and over-react at long horizons and tend to under-react at short horizons. Therefore, such deviations from rationality and efficiency indicates well- documented behavioral patterns among market participants.

[16]*R* seems to have greatest explanatory power at 12-month horizon, and at 3-month horizon, the explanatory powers are almost close to zero. This evidence clearly shows that the FRUH almost holds at the short horizon, which supports to the previous evidence that at short horizon the F[17]does almost hold, and the longer the horizons, the more behavioral biases occur and the larger forecast error as it is more difficult to predict, the forecast of future spot exchange rate stays farther from the realized value of future spot rate as there is more time for economic and political conditions to change. This reflecting decreasing overtime of systematic pessimism among investors due to uncertainty [18]

Table IX : Testing for Behavioral Biases

	AUD	CAD	GBP	EUR	JPY	CHF	NZD	MXN
A. FE, 3-month Horizon								
α	-.0051	-.0005	-.0054	-.0227	-.0007	-.0096	-.0022	-.0165
	(.0051)	(.0040)	(.0034)	(.0035)	(.0035)	(.0036)	(.0047)	(.0038)
β(FR, 3M-6M)	-.1495**	-.2546**	-.2237**	-.1427**	-.0796*	-.0513**	-.2063**	-.0461***
	(.0584)	(.0658)	(.0778)	(.0557)	(.0685)	(.0809)	(.0820)	(.0845)
Obs	448	448	448	448	448	448	448	448
R^2	0.0210	0.0291	0.0478	0.0198	0.0063	0.0022	0.0415	0.0021
B. FE, 6-month Horizon								
α	-.0310	-.0031	-.0572**	-.0310	-.0025	-.0244***	-.0219	-.0419***
	(.0087)	(.0063)	(.0063)	(.0054)	(.0054)	(.0052)	(.0080)	(.0076)
β(FR, 6M-12M)	.2841**	.3225***	.2583**	.1475**	.0762*	.2155**	.1974*	.2541***
	(.0820)	(.0848)	(.1021)	(.0663)	(.0414)	(.0861)	(.1036)	(.0596)
Obs	427	427	427	427	427	427	427	427
R^2	0.0352	0.0916	0.0608	0.0223	0.0061	0.0441	0.0361	0.0681
C. ΔFE, 12-month Horizon								
A	-.0003	-.00007	-.00005*	-.00005	-.0004	-.0001	-.0003	-.0001
	(.0006)	(.0005)	(.0003)	(.0004)	(.0004)	(.0005)	(.0006)	(.0004)
β(Δ FR, 12M-2Y)	.5289***	.6891***	.4457***	.3712***	.5564***	.4609***	.4921***	.5466***
	(.0791)	(.0693)	(.0546)	(.0548)	(.0571)	(.0660)	(.0672)	(.0762)
Obs	375	375	375	375	375	375	375	375
R^2	0.2593	0.3215	0.2065	0.1687	0.2882	0.1790	0.2462	0.2973

Note: This table reports the regression results of $FE_t = \alpha + \beta FR_t + \mu_t$ for 3-month and 6-month horizons, while the regression results for 12-month horizon is regressed on $\Delta FE_t = \alpha + \beta \Delta FR_t + \mu_t$ using OLS with Newey-West HAC standard errors. FE is the forecast error, and FR is the forecast revisions. The null hypothesis of market rationality requires that both α and β are zero. Coefficients and intercepts are reported with SEs below them in parenthesis. Also, number of observations and the R-squared are described. This table reports the relationship between forecast error and forecast revision for different time horizons, which are 3-month (Panel A), 6-month (Panel B) and 12-month horizon (Panel C) of the eight currencies pairs. *p<0.05, ** p<0.01, *** p<0.001.

5.5 Testing for Behavioral Biases with Controlling of Time-Varying Risk Premium

[19]is paper aims to assess the possible behavioral explanations of the failure of the forward rates unbiasedness hypothesis while controlling for time-varying risk premium as an explanatory factor in no behavioral biases hypothesis, this paper adds a proxy for risk into the regressions with the results shown in **Table X**.

[20] other asset markets, the concept of risk [21]markets is as a currency value is denominated in terms of another currency, so what would be a risk premium of one currency would be a risk discount for the holder of other currency in the foreign exchange. Therefore, this paper uses the FX implied volatility for each currency against USD as the proxy for market risk. Implied volatility is the estimated volatility of an asset price, which is derived from an option price. Since most option trading volume usually occurs in at-the-money (ATM) options, these are the contract generally used to calculate implied volatility. In general, implied volatility increases when the market is bearish. In contrast, implied volatility decreases when the market is bullish. This is because of the common belief that bearish markets are riskier than bullish markets, and the higher the implied volatility, the higher the risk [22]

[23]This paper uses the percentage changes in implied volatility of the current forecast period and 3-month lag of that forecast period; $\%Vol_{t-6m}^{t-3m} = Ln\left[\frac{Vol_{t-3m}}{Vol_{t-6m}}\right]$, the current forecast period and 6-month lag of that forecast period; $\%Vol_{t-12m}^{t-6m} = Ln\left[\frac{Vol_{t-6m}}{Vol_{t-6m}}\right]$, and the current forecast period and 12-month lag of that forecast period;

$\%Vol_{t-2y}^{t-12m} = Ln\left[\frac{Vol_{t-12m}}{Vol_{t-2y}}\right]$ for 3-,6- and 12-month horizon, respectively. The equations are formed for 3-month and 6-month horizons as follow:

$$\boldsymbol{FE_t = \alpha + \beta_1 FR_t + \beta_2 \% Vol_t + \mu_t} \quad \textbf{(4)}$$

$$(LnF_{t-3m}^{t} - LnS_t) = \alpha + \beta_1(LnF_{t-3m}^{t} - LnF_{t-6m}^{t}) + \beta_2 Ln\left[\frac{Vol_{t-3m}}{Vol_{t-6m}}\right] + \mu_t$$

$$(LnF_{t-6m}^{t} - LnS_t) = \alpha + \beta_1(LnF_{t-6m}^{t} - LnF_{t-12m}^{t}) + \beta_2 Ln\left[\frac{Vol_{t-6m}}{Vol_{t-12m}}\right] + \mu_t$$

For 12-month horizon, the equation is expressed as:

$$\boldsymbol{\Delta FE_t = \alpha + \beta_1 \Delta FR_t + \beta_2 \% Vol_t + \mu_t} \quad \textbf{(3)}$$

$$(LnF_{t-12m}^{t} - LnS_t) - (LnF_{t-12m}^{t-1} - LnS_{t-1}) = \alpha + \beta_1 \{(LnF_{t-12m}^{t} - LnF_{t-24m}^{t}) - (LnF_{t-12m}^{t-1} - LnF_{t-24m}^{t-1})\} + \beta_2 \, Ln\left[\frac{Vol_{t-12m}}{Vol_{t-2y}}\right] + \mu_t$$

[24]hypothesis of no behavioral biases requires that both α and β are zero. After controlling for the time-varying risk premium, the results have changed significantly as both alphas and betas fall, which reflect a more balanced mood of the FX market over time and approach no behavioral bias hypothesis, which means that the time-varying risk premium is the determinant of the deviations from rationality. This result conforms to the research of Holden et al. (1990) as they discover that the forward rate is the sum of risk premium plus the expected spot rate; therefore, with the existence of a time

varying risk premium, the forward rate would be a poor predictor of future spot exchange rate. Still, the evidence reconfirms the finding of the regression without controlling of time-varying risk premium as the market mood is still found to be consistently pessimism overtime, and the markets under-react to new information in the short-horizon, while in the medium- till long- horizons, the markets generally over-react to new [25]

O[26] the explanatory power increases by almost double; however, the predictive powers are still lowest at shorter horizons. The results are reconfirmed the previous results that the FRUH do sometimes hold or almost hold at short horizons, and systematic behavioral biases clearly occur at longer horizons. Forecast accuracy decreases as the time horizon increases. Shorter- range forecasts must contend with fewer uncertainties than longer-range forecasts, therefore, they tend to be more accurate.

Moreover, the general results show that the percentage changes in implied volatility are statistically significantly negative correlated with FEs at all maturities for all tested currency pairs. The negative coefficient can be implied that as implied volatility of domestic currency increases, risk of that currency would increase, so many investors tend to hold more USD as USD has been seen as a safe, secure and strong currency. Most commodities such as gold and oil are priced in [27]so this gives an additional reason to hold currency in USD in order to minimizing transaction costs of using dollars to buy commodities. This leads to an appreciation of USD. Furthermore, as risk increases, uncertainties affect on the confidence of the forecast of forward rate. The confidence of the forecast of forward rate would be lower, so forward rates would not likely to be board, resulting the decreasing in degree of over-and-under reactions.

Therefore, the realized future spot rates tend to rise even more above the forward rates, and consequently, forecast errors tend to decline even more.

Table X : Testing for Behavioral Biases with Controlling of Time-Varying Risk Premium

	AUD	CAD	GBP	EUR	JPY	CHF	NZD	MXN
A. FE,3-month Horizon								
α	-.0030	-.0002	-.0021***	-.0152***	-.0003	-.0036	-.0017	-.0143
	(.0055)	(.0039)	(.0034)	(.0033)	(.0052)	(.0040)	(.0051)	(.0039)
β(FR, 3M-6M)	-.1201**	-.1709**	-.2005**	-.0786*	-.0275*	-.0215*	-.1985**	-.0001***
	(.0543)	(.0764)	(.0767)	(.0594)	(.0863)	(.0853)	(.0840)	(.0870)
$\%Vol_{t-6m}^{t-3m}$	-.0406***	-.0445***	-.0285***	-.0255***	-.0134**	-.0074**	-.0199**	-.0217***
	(.0081)	(.0090)	(.0065)	(.0042)	(.0066)	(.0065)	(.0074)	(.0041)
Obs	409	409	409	409	409	409	409	409
R^2	0.0700	0.1035	0.1011	0.0703	0.0135	0.0396	0.0550	0.0432
B. FE,6-month Horizon								
α	-.0132***	-.0069	-.0395***	-.0241**	-.0015	-.0139***	-.0197**	-.0373***
	(.0075)	(.0060)	(.0103)	(.0078)	(.0061)	(.0056)	(.0073)	(.0049)
β(FR, 6M-12M)	.1935***	.2733**	.2405**	.1058***	.0314*	.1032**	.1218**	.2154***
	(.0884)	(.0863)	(.0976)	(.0630)	(.0525)	(.0956)	(.1040)	(.0494)
$\%Vol_{t-12m}^{t-6m}$	-.0706***	-.0396**	-.0480***	-.0677***	-.0290**	-.0497***	-.0379***	-.0278***
	(.0108)	(.0125)	(.0127)	(.0111)	(.0118)	(.0102)	(.0097)	(.0066)
Obs	372	372	372	372	372	372	372	372
R^2	0.1640	0.1308	0.0848	0.2009	0.0311	0.1330	0.0698	0.1220
C. ΔFE 12-month Horizon								
A	-.0001	-.00001	-.00002	-.00004	-.0002	-.00005	-.0002	-.00004
	(.0008)	(.0005)	(.0004)	(.0004)	(.0005)	(.0005)	(.0007)	(.0005)
β(Δ FR, 12M-2Y)	.5092***	.6259***	.4078***	.3237***	.5004***	.4133***	.4819***	.2566***
	(.0873)	(.0716)	(.0678)	(.0613)	(.0656)	(.0747)	(.0800)	(.0966)
$\%Vol_{t-2y}^{t-12m}$	-.0013**	-.0017*	-.0011*	-.0006*	-.00002*	-.0012*	-.0002*	-.00016*
	(.0013)	(.0009)	(.0006)	(.0008)	(.0009)	(.0016)	(.0016)	(.0006)
Obs	299	299	299	299	299	299	299	299
R^2	0.2990	0.3305	0.2021	0.2087	0.2941	0.1964	0.2962	0.2998

Note: This table reports the regression results of $FE_t = \alpha + \beta FR_t + \%Vol_t + \mu_t$ for 3-month and 6-month horizons, while the regression results for 12-month horizon is regressed on $\Delta FE_t = \alpha + \beta \Delta FR_t + \%Vol_t + \mu_t$ using OLS with Newey-West HAC standard errors. FE is the forecast error, while FR is the forecast revision. This paper uses the percentage changes in implied volatility ($\%Vol_t$) as the most appropriate proxy for the time-varying risk premium. The null hypothesis of market rationality requires that both α and β are zero. Coefficients and intercepts are reported with SEs below them in parenthesis. Also, number of observations and the R-squared are described. This table reports the relationship between forecast error and forecast revision for different time horizons, which are 3-month (Panel A), 6-month (Panel B) and 12-month horizon (Panel C) of the eight currencies pairs. *p<0.05, ** p<0.01, *** p<0.001.

CHAPTER 7

CONCLUSION

[28]Behavioral interpretation is clearly shown to be important to explain the non-rationality of forward rates forecast of the future spot exchange rate. The FX market's forecast errors are generally found to be systematic pessimism in response to new information overtime for every currency. They tend to be over-react at long horizons and under-react at short horizons similar to the equity market, which indicate well- documented behavioral patterns among market participants in asset markets. The paper finds that all the examined[29] share similar patterns in the forecast revisions processes. [30], after controlling for time-varying risk premium using the percentage changes in FX implied volatility, the results have changed significantly as both alphas and betas fall, which reflect a more balanced mood of the FX market over time and approach no behavioral bias hypothesis.

[31]s significantly show that the FRUH do almost hold at short horizons, and the longer horizons, the more behavioral biases occur. Thus, the deviations from rationality can be partly explained by behavioral factors and the risk premium.

REFERENCES

1. Abel, B., *An Exploration of the Effects of Pessimism and Doubt on Asset Returns.* Journal of Economic Dynamics and Control, 2002. **26(7–8)**: p. 1075–1092.
2. Shiller, R., *Irrational Exuberance.* 2000.
3. Frankel, J.a.P., J. , *The Forward Market in Emerging Currencies: Less Biased than in Major Currencies.* Journal of International Money and Finance, 2010. **29**: p. 585–598.
4. Fama, E., *Efficient Capital Markets: A Review of Theory and Empirical Work.* Journal of Finance, 1970. **25**: p. 383–417.
5. Froot, K.a.T., R. , *Anomalies: Foreign Exchange.* Journal of Economic Perspect, 1990. **4** p. 179–192.
6. Verschoor, Z., *Carry Trade and Foreign Exchange Rate Puzzles.* European Economic Review, 2013. **60**: p. 17-31.
7. DeGrauwe, P., Dieci, R., and Grimaldi, M., *Fundamental and Non-Fundamental Equilibrium in the Foreign Exchange Market: A Behavioral Finance Framework.* 2005(CESifo Working Paper, No. 1431).
8. Barberis, N., Schleifer, A.and Vishny, R. , *A model of Investor Sentiment.* Journalof Financial Economics, 1998. **49(3)**: p. 307–343.
9. Holden, K., Peel, D., and Thompson, J. , *Economic Forecasting: An Introduction.* Cambridge University Press, 1990.
10. Bekaert, G., Hodrick, R., and Marshall, D. , *The Implications of First Order Risk Aversion for Asset Market Risk Premiums.* Journal of Monetary Economics, 1997. **40(1)**: p. 3–39.
11. Aggarwal, R., Lin, W.and Mohanty, S., *Are Forward Exchange Rates Rational Forecasts of Future Spot Rates?: An Improved Econometric Analysis for the Major Currencies.* Multinational Finance Journal, 2008. **12**(1(2)): p. 1-20.
12. Engel, C., *The Forward Discount Anomaly and the Risk Premium: A Survey of Recent Evidence.* Journal of Empirical Finance, 1996. **3**: p. 123-192.
13. Shleifer, A., and Vishny, W. , *The Limits of Arbitrage.* Journal of Finance, 1997. **52**: p. 35–55.
14. Gospodinov, N., *A New Look at the Forward Premium Puzzle.* Journal of Financial Econometrics, 2009. **7**: p. 312-338.
15. Baillie, R.a.B., T. , *The Forward Premium Anomaly is not as Bad as You Think.* Journal of International Money and Finance, 2000. **19**: p. 471-488.
16. Chavdarov, P., *Rising Pessimism among Financial Investors.* 2015(CEIC World Trend Data Talk).
17. McBrady, M., *Carry Traders, Dealers, and the Forward Discount Anomaly.* SSRN Electronic Journal., 2005.
18. Lothian, J.a.W., L. , *Uncovered Interest Rate Parity over the Past Two Centuries.* Journal of International Money and Finance, 2011: p. 448-473.
19. Burnside, C., Eichenbaum, M., Kleshchelski, I., and Rebelo, S. , *Do Peso Problems Explain the Returns to the Carry Trade?* NBER Working Paper, 2010.

20. Jackson, A., and Johnson, T., *Unifying Underreaction Anomalies.* Journal of Business, 2006. **79**: p. 75–114.
21. Ball, L., and Croushore, D. , *Expectations and the Effects of Monetary Policy.* 2001(Federal Reserve Bank of Philadelphia): p. 01–12.
22. Kozlova, O., *The Forward Discount Anomaly: Imperfect Knowledge, Conditional Rationality, and Risk.* ournal of Economic Methodology, Politics, Psychology, and Economics., 2013.
23. Keynes, J., *A Treatise on Money.* 1930.
24. Clarida, R., Sarno, L., Taylor, M., and Giorgio, V. , *The Out-of Sample Success of Term Structure Models as Exchange Rate Predictors: A Step Beyond.* 2001(NBER Working Paper Series No. 8601).
25. Waheed, M., *Forward Rate Unbiased Hypothesis, Risk Premium and Exchange Rate Expectations: Estimates on Pakistan Rupee-US Dollar.* 2009.
26. Breuer, J.a.W., M., *The Road Less Travelled: Institutional Aspects of Data and the Influence on Empirical Estimates with an Application to Tests of Forward Rate Unbiasedness.* The Economic Journal, 1996. **106**: p. 26-38.
27. Grossman, S.a.J., E. , *Information and Competitive Price Systems.* American Economic Review, 1976. **66**: p. 246-53.
28. Aggarwal, R.a.Z., S. , *Behavioral Biases in Forward Rates as Forecasts of Future Exchange Rates: Evidence of Systematic Pessimism and Under-Reaction.* Journal of Multinational Finance, 2008. **12**: p. 241–277.
29. Pippenger, J., *A Complete Solution to the Forward-Bias Puzzle.* 2011.
30. Montier, J., *Behavioral Finance: Insights into Irrational Minds and Markets.* Wiley Finance., 2002.
31. Daniel, D., Hirshleifer, D., and Subrahmanyam, A. , *Investor Psychology and Security Market Under- and Over-Reactions.* Journal of Finance, 1998. **53**: p. 1839-1886.

VITA

I do everything all my best, including this thesis. Wish it would be helpful for someone who needs it.