THE PERFORMANCE OF IMPLIED VOLATILITY AND HISTORICAL VOLATILITY IN FORECASTING FUTURE REALIZED VOLATILITY: AN ANALYSIS FROM MALAYSIA, SINGAPORE AND THAILAND STRUCTURED CALL WARRANTS

BY

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ABSTRACT

Volatility is a most critical concept in both the theory and practice of finance. Two mainly known volatility estimator are historical volatility or past realized volatility and Implied volatility. Implied volatility is widely seen as the market's estimates of future volatility, and if markets are efficient, it should thus reflect all the information given at that particular time, including that contained in historical volatility. On the other hand, historical volatility is an unconditional predictor that ignores the most recent publicly available data. Contrasting views from past researches on which volatility estimator is superior in forecasting future realized volatility has prompted this study. The objectives of this study to examine the information content and predictive power of the implied volatility of structured call warrants from three ASEAN countries, namely Malaysia, Singapore and Thailand, in the period of August 2014 to July 2015. Specifically, the aim of the study is to investigate the ability of the structured call warrants explanatory variables to forecast (1) 1 day volatility and (2) volatility over the remaining days of the structured warrants contract. Two empirical models, time series historical and implied volatility, were estimated from the structured call warrants. All samples were then sorted by the volatility, time to maturity and moneyness, thus creating 50 subsamples for each country. Next, these volatilities are assessed through Ordinary Least Squares (OLS) assumptions - this methodology enables the addressing of the informational content, the biasness and efficiency of the forecast predictor. Additionally, an in-sample forecasting accuracy test is employed to identify the most efficient forecasting model. This study found that for Malaysia, Singapore and Thailand, both implied and historical volatility were biased and inefficient predictors of future realized volatility. Implied volatility does not incorporate all the information on future realized volatility, so does historical volatility. However, historical volatility had more predictive power than implied volatility when forecasting future realized volatility. Finally, the in-samples forecast accuracy also showed that the forecasting capabilities were poor for all the three ASEAN countries. This study adds to the growing literature of implied volatility. It also contributes new evidence to the academician and practitioner on forecasting capabilities of implied volatility from the emerging market, especially the ASEAN region. In addition, this study can be the impetus for new research on different model of implied volatility forecasting competing against more sophisticated historical volatility model.

Keywords: Implied volatility; historical volatility; options; forecasting

خلاصة البحث

تبحث هذه الدراسة المحتوى المعلوماتي والقوة التنبؤية للتقلب الضمني لأوامر المكالمات المنظمة من ثلاثة بلدان من دول الآسيان، وهي: ماليزيا، وسنغافورة، وتايلاند، في الفترة من أغسطس 2014م إلى يوليو 2015م. وعلى وجه التحديد، إن الهدف من الدراسة هو التحقيق من قدرة النداء المنظم يدعو المتغيرات التفسيرية للتنبؤ، وهو التقلب في يوم واحد والتقلبات على مدى الأيام المتبقية من عقد أوامر منظم. وقد تم تقدير نموذجين تجريبيين، هما التسلسل الزمني للتغيرات التاريخية والتقلبات الضمنية، من أوامر النداء المنظمة. ثم تم فرز جميع العينات من التقلبات، والوقت حتى النضج والمال، ولذا جعل 50 عينة فرعية لكل بلد. بعد ذلك، يتم تقييم هذه التقلبات من خلال افتراضات المربعات الصغرى العادية (OLS) – وهذه المنهجية تمكن من معالجة المحتوى المعلوماتي، والتحيز، وكفاءة التنبؤ المتوقع . وبالإضافة إلى ذلك، يستخدم اختبار دقة التنبؤ داخل العينة لتحديد نموذج التنبؤ الأكثر كفاءة. وجدت هذه الدراسة أنه بالنسبة لماليزيا، وسنغافورة، وتايلاند، كانت التقلبات الضمنية والتاريخية متحيزة وغير فعالة للتنبؤ بالتقلبات المحققة في المستقبل. إن التقلبات الضمنية لا تتضمن جميع المعلومات عن التقلبات المستقبلية المحققة، وكذلك التقلبات التاريخية. غير أن التقلبات التاريخية لديها قدرة تنبؤية أكثر من التقلبات الضمنية عند التنبؤ بالتقلبات في المستقبل. وأخيرا، أظهرت دقة التنبؤ في العينات أيضا أن قدرات التنبؤ كانت ضعيفة بالنسبة لجميع بلدان رابطة أمم جنوب شرقي آسيا الثلاثة. فدراستنا ليست فقط توفر أدلة للأكاديمي؛ ولكن للممارس كذلك. لديهم مدخلات جديدة يمكن أن توفر توقعات أفضل على التقلبات المحققة في المستقبل على أساس التقلبات الضمنية أو التقلبات التاريخية.

APPROVAL PAGE

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DECLARATION

I hereby declare that this thesis is the result of my own investigations, except where otherwise stated. I also declare that it has not been previously or concurrently submitted as a whole for any other degrees at IIUM or other institutions.

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TABLE OF CONTENT

LIST OF TABLE

LIST OF FIGURES

CHAPTER ONE

INTRODUCTION

1.1 BACK GROUND OF STUDY

The topic of volatility is integral to nearly all disciplines within finance and economics that deal with markets and prices. In fact, the quantification, prediction and navigation of volatility are the building blocks of options pricing, portfolio selection and risk management. Despite many decades of theoretical advances in finance, accurate forecasting of volatility remains elusive. Volatility is, essentially, the rate of change by which a certain financial product's price moves, irrespective of the direction of the movement. Understanding the magnitude and/or direction of the price movement is central to traders' likelihood of success in choosing financial products, executing trades or staying on the side-line as it allows forecasting of future performance of the concerned financial product. In the case of options, the most practical aspect of volatility is related to the perspective on options strategies and option prices where it creates the opportunity for the trader to determine the relative valuation of options. The ability to identify undervalued or overvalued options endows traders an edge in buying and selling options as well as timing the trades.

The volatility forecast can be broadly classified into two broad main categories: option-implied volatility and historical time series models, such as historical volatility, Autoregressive Conditional Heteroskedasticity (ARCH) models, and stochastic models. The historical time series volatility forecast is a mathematical expression of the magnitude of past price variation of a financial product (be it daily, weekly, monthly or yearly). This form of volatility is the observation of historical interest as it does not reflect the future expectation of future price volatility. It gives

the trader an indication of how much the future price will move based on the past trends rather than the prediction of the actual trend. High historical volatility may suggest that the price of the financial product has been going up and down rapidly over a period of time, but it may not have actually moved significantly from its original price. Likewise, a low historical volatility may mean that the financial product has not been moving much in price, but it could be going steadily in one direction.

On the other hand, option-implied volatility is regularly used by option traders due to its straightforwardness. Since most of the parameters that need to be calculated are readily available, option-implied volatility enjoys popularity. Bacha (2012) listed the two most common uses of the option-implied volatility: (1) traders can ascertain the value of an option and compare it with another and (2) to determine the option of mispricing: which is to evaluate the implied volatility against the actual or historical volatility. If the implied volatility is higher than the historical volatility, the option is overvalued or overpriced and vice versa. Furthermore, option-implied volatility for an option contract represents the future forecast of the average volatility of the underlying assets over the remaining life of the option contract (Hull and White, 1987). In order to obtain the option-implied volatility, the Black-Scholes (1973) option pricing model needs to be solved first. The model has five parameters, which area) stock price, b) exercise price of the option, c) time to maturity, d) interest rate and e) volatility of the underlying assets. The first four parameter s are observable, whereby the information can be retrieved directly from the market. However, for the last parameter, or the volatility, which is the main item in the valuation, it is not directly observable from the market.

The implied volatility is forward looking because it is an estimation of the future volatility of the underlying assets. In addition, it gives an indication of how much the price of the underlying assets will move in the future. The implied volatility is also said to be the investors' fear gauge, and according to the studies of Whaley (2002) and Shaikh and Padhi (2014) it relates to the volatility index (VIX) in the Chicago Board of Option Exchange (CBOE) and Indian VIX. These studies indicated that during a period of high volatility the price of the underlying assets falls as the volatile market triggers nervousness among the market participants. The investors would require a higher rate of return on their stock, which, in turn, leads to the fall in the price of the stocks.

The second common use of implied volatility is to evaluate options mispricing, when valuing the options using the Black-Scholes (1973) option pricing model, where the model incorporates the historical volatility in determining the price of the options. The earlier studies gave evidence that there was mispricing of options when using an option valuation model, such the Black-Scholes option pricing model. The theoretical price recorded over-pricing for out-of-money options and underpriced for in-the-money options when compared to the market price in countries such as the USA (Macbeth and Merville, 1979), Malaysia (Haron, 2006 and 2014), Thailand (Shastri and Sirodom, 1995) and China (Powers and Xiao, 2014). Moreover, Harvey and Whaley (1992) stated that studies on implied volatility pertaining to option price have focused on three aspects. These are (1) how well the implied volatility predicts future volatility (Latane and Randleman, 1979), (2) the dynamic linkages between changes in implied market volatility and changes in microeconomic variables (Schmalensee and Trippi, 1978) or implied volatility of individual stocks option and (3) changes in

implied market volatility as a measure of abnormal activity in the marketplace (Day and Lewis, 1988).

Options are financial derivatives where the owners have the right, but not the obligation, to buy or sell underlying assets at prices before the expiration of the options. When the owner or buyer of the option has the right to buy at a strike price, the option is called a call option and when the owner of the option has the right to sell the underlying at a strike price, the option is called the put option. The focus in this study was the structured call warrants a type of option, which is listed in the same market with the underlying shares. The warrants listed in the above mentioned countries' stock exchanges can be broadly classified into two types: (1) company warrants and (2) structured warrants. These warrants can be distinguished by (1) the characteristics of the issuer, (2) the duration to maturity, (3) the effect on the paid-up capital or number of shares, (4) the presence of market maker and (5) the conversion ratio (Appendix A). In this study we choose the structured call warrants as the samples because the characteristics of this warrants are more similar to a real options.

1.2 MOTIVATION OF STUDY

In 2007, the ASEAN countries launched a blueprint to establish the ASEAN Economic Community (AEC) by 2015 with a vision to create ASEAN as a single market and production entity that will subsequently develop ASEAN to be a more dynamic and competitive region. Moving to reach the AEC, ASEAN had set four goals, which are (1) single market and production base, (2) competitive economic region, (3) equitable economic development and, finally, (4) ASEAN's integration into the global economy. Within the first goal, there are five core elements that were

listed: (1) free flow of goods, (2) free flow of services, (3) free flow of investment, (4) free flow of capital and, lastly, (5) free flow of skilled labor.

In promoting the fourth element, which is the free flow of capital, the stock exchanges under the ASEAN-5 and Vietnam came together to form the ASEAN Exchanges. Subsequently, in 2012, the Singapore Stock Exchanges (SGX) and the Bursa Malaysia Berhad (Bursa) started the ASEAN Trade link. This was to enable an individual or an institutional investor to have access to other exchanges by going through local brokerage. It was later joined by the Thailand Stock Exchanges (SET), and with the three exchanges combined, the investors were able to choose from 2,200 companies with a market capitalization of USD1.4 trillion[1].

The introduction of structured warrants in the ASEAN capital market is relatively new and, most of the existing researches related to the capital market were using the underlying assets or shares. The daily transaction value recorded for the all the three markets' trades is quite small. The Malaysia, Singapore and Thailand stock exchanges' structured call warrants only record a mere 3.4 percent, 2.0 percent and 5.2 percent of the total value traded the in respective stock exchanges, respectively. (Appendix B) Hence we hope this research will give some understandings on the trading of structured call warrants in these three markets in the ASEAN region.

On top of that, research on volatility in the ASEAN community only related to the spot price, such as forecasting volatility by Kuen and Hoong (1992) who studied the Singapore stock market using five indices in the stock market for the period from 1975 to 1988. Wong and Kok (2005) compared the performance of six forecasting models during and before the Asian financial crisis using the benchmark index in the

[1]See www.aseanexhanges.com

ASEAN-5 countries. Guidi and Gupta (2012) studied whether the asymmetric effect characterized the relation among the stock return and volatility in the ASEAN-5 market. Their study covered the period from 2002 until 2012 and uses the daily return of MSCI indices in the local currency. The other study by Pisedtasalasai and Gunasekarage (2007) looked into the relation among return volatility and trading volume for the period 1990 to 2004 in the ASEAN-5.

In addition, the analysis of volatility in ASEAN stock markets will assist portfolio managers by providing an overview in relation to the risks associated with the investment in these markets. Given the significant influence of stock market volatility on economic growth and development, finding more precise information about the determinant factors of stock market volatility among the ASEAN-3 countries (Malaysia, Singapore and Thailand) is relevant. Furthermore, the ASEAN-3 stock markets are located in the same region, are characterised by the implementation of similar cultural and economic policies and are closely related by trade policies (Gee and Karim, 2010). The current study looks into the ASEAN region, and specifically 3 out of the ASEAN countries, namely Malaysia, Singapore and Thailand. One of the sure-fire ways of stimulating integration is embracing a single market allowing free capital flow from one economy to another. Consequently, the launch of ASEAN exchanges in April 2011 carried a vision to enable investors to invest directly through a platform called ASEAN trade link. It was started by the Bursa Malaysia Berhad, Singapore Exchange and Thailand Stock Exchange[2]. Hence, having a good volatility indicator could be a very useful tool to monetary policy decision makers in monitoring the vulnerability of their financial markets and economy (Poon and Granger, 2003).

[2] see www.aseanechange.com

1.3 PROBLEM STATEMENT

Volatility forecasting is one of the core subject areas in derivative securities pricing, such as share options and index options. One challenge posed by the financial markets is to correctly forecast the daily volatility of financial assets to obtain reasonable and fair prices for the derivatives securities. Methods for predicting volatility were mainly divided into two categories: (1) historical information method, based on the historical information to predict the future volatility, and (2) implied volatility method: calculating the expectation of the future volatility based on the market price of the option.

In relation to the Black-Scholes Option Pricing Model (BSOPM), the implied volatility should be an unbiased and an efficient forecast of realized volatility. Hence, implied volatility ought to incorporate the information contained in all other variables in the market information set when explaining future volatility. It is hypothesized that the implied volatility capture all the information contained in the historical returns. Therefore, in an informationally efficient options market, the forecasts based on implied volatility should outperform the forecasts based on the historical returns.

In contrast, there are also studies that reject the hypothesized opinion, where the implied volatility cannot capture all the information available on the past return and cannot be a good forecast of future volatility. Thus, it leads to the notion that the options market is informationally inefficient. Invariably, options trading is market direction based (Chan, Chung, and Johnson, 1993). Either the trader trades in the direction of the market or against the direction of the market. Thus, implied volatility gives the trader a tool to anticipate the movement of future prices.

It is worth noting that the results obtained from previous studies, including from a number of empirical studies, on informational efficiency depicted that the option-implied volatility can be a predictor of the future volatility. In addition, a pioneering study used cross-sectional data to examine 24 stock options from CBOE using weekly data for a period of less than a year to examine the predictive ability of implied volatility, and the results portrayed a positive correlation between implied volatility and realized volatility (Latane and Randleman, 1976), while other studies have used larger samples and longer periods of time (Chiras and Manaster, 1978; Becker, 1981).Moreover, some studies in the later years have used the time-series data on exchange rate futures option (Xu and Taylor, 1995)and the Daily Eurodollar futures and futures option (Amin and Ng, 1997). In addition, it has been documented that the implied volatility outperformed past volatility in forecasting future volatility during the monthly expiry cycle of Standard and Poor 100 OEX (Christensen and Prabahala, 1998), German DAX stock index, DAX volatility index (Bluhm and Yu, 2000) and Nifty index option from 2006 to 2011 (Singh, 2013). On the other hand, several studies found that the option-implied volatility failed to predict future volatility, as it had been unable to capture all the information available in the past return. Those studies used the weekly Standard and Poor 100 OEX as the assets under study (Day and Lewis, 1992; Canina and Figlewski, 1993) and the Standard and Poor CNX Nifty index (Dixit, Yadav and Jain, 2010).

On the contrary, empirical studies on option-implied volatility did not only focus on equity market, but also on other options, such as crude oil (Day and Lewis, 1993), foreign currencies' futures options (Jorion, 1996) and a study of 35 future option markets from eight separate exchanges (Szakmary, Ors, Kim, and Davidson, 2003). It was found that for a majority of the commodities studied, the option-implied

volatility outperformed the historical volatility as the predictor of future realized volatility.

Over the years, the research focus has shifted from studying informational content of option-implied volatility to comparing volatility forecasting between option-implied volatility with (1) historical volatility, such as Exponentially Weighted Moving Average, ARMA and ARIMA, (2) ARCH family, for instance Generalized ARCH, Threshold GARCH and IGARCH and (3) Stochastic Volatility, like the quasi-maximum likelihood estimation, and the generalized method of moment, to name a few (Lemoureux and Lastrapes, 1993; Jorion, 1996; Guo 1996 and Fleming, 1998); whereby, they found that the option-implied volatility had some predictive power, which was better than the historical volatility. Besides, it was suggested that the best forecast came from the option-implied volatility due to the fact that these forecasts were based on a larger and a timelier data set (Poon and Granger, 2005).

Nevertheless, despite the widely shared belief among finance practitioner that implied volatility is a much better estimator than historical volatility. Studies has produce mized result about whether implied volatility actually estimates future volatility or whether it does so efficiently. Contrasting past findings and recent research gives rise to questions on the widely-shared belief that implied volatility does contained information on future realized volatility, and that it is superior than historical volatility. Subsequently, in academia, pertinent questions have arisen regarding the informational content of implied volatility (Agarwal, 2014).

In addition, looking at geographical studies, the majority of empirical studies on volatility and forecasting abilities have been carried out in the USA and European countries. This is in contrast with the emerging market, where studies are lacking still. Portfolio managers pay more attention to the Asian financial markets, and one of

the reason is that these countries have transformed their financial policies to facilitate cross-country investing (Beirne, Caporale, Schulze-Ghattas, and Spagnolo, 2010; Wang, and Liu, 2016). This has sparked interest with international portfolio managers on the issue of stock market volatility within the emerging markets. Specifically, for these 3 countries, Malaysia, Singapore and Thailand this issue is unexplored, which the current study attempts to remedy.

1.4 RESEARCH OBJECTIVES

This study intends to look into the ability of implied volatility to forecast future volatility. It will explore an investigation of the information content or the ability of either option-implied volatility or the historical volatility to forecast the future realized volatility and the predictive power of the explanatory variable, which are the option-implied volatility and historical volatility to forecast volatility over the remaining days of the option contract. Hence it provide information on trading strategies should be adopted by market players.

Specifically, for these 3 countries, Malaysia, Singapore and Thailand this issue is unexplored, which the current study attempts to remedy. It strives to achieve the following objectives:

i. To investigate whether implied volatility contain information of the future volatility.
ii. To determine whether implied volatility contain information of the future volatility, more than the historical volatility.
iii. To explore whether the information from the historical volatility contribute to the betterment of the realized volatility forecast.

iv. To establish whether the volatility forecast from the implied volatility is reliable.

1.5 RESEARCH QUESTIONS

The objectives of this study are to investigate both the informational efficiency and the predictive power of option-implied volatility in Malaysia, Singapore and Thailand. Informational efficiency is a measure in terms of the ability of the explanatory variable to forecast 1-day volatility. On the other hand, the test for predictive power has a focus on the volatility over the remaining days of the option contract (Vlastakis and Markellos, 2012). To achieve the above mentioned objectives, the implied volatility is pitted against historical volatility. The four research questions are:

i. Does implied volatility is an unbiased estimate of the future realized volatility?
ii. Does implied volatility has more explanatory power than the historical volatility in forecasting realized volatility?
iii. Does implied volatility efficiently incorporate all information regarding future volatility, while historical volatility contains no information beyond what is already included in implied volatility?
iv. Does the in-sample forecast using Root Mean Square Error (RMSE) can determine that the implied volatility is a more efficient forecast than the historical volatility?

1.6 THE SCOPE AND LIMITATION OF STUDY

This particular study focused on implied volatility obtained from option market, from three ASEAN countries which are Malaysia, Singapore and Thailand. Thus, the result might only generalizable to the above population or the ASEAN region. The above