Do Issuers Affect Derivative Warrants Overpricing? Evidence of Thailand

Miss Sarunporn Thupthong

A Thesis Submitted in Partial Fulfillment of the Requirements
for the Degree of Master of Science in Finance
Department of Banking and Finance
FACULTY OF COMMERCE AND ACCOUNTANCY
Chulalongkorn University
Academic Year 2021

ผู้ออกใบสำคัญแสดงสิทธิอนุพันธ์มีผลกระทบต่อการที่ใบสำคัญแสดงสิทธิอนุพันธ์ราคาสูงกว่าปกติหรือไม่: กรณีศึกษาจากตลาดหลักทรัพย์แห่งประเทศไทย

น.ส.สรัลพร ทับทอง

วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาวิทยาศาสตรมหาบัณฑิต
สาขาวิชาการเงิน ภาควิชาการธนาคารและการเงิน
คณะพาณิชยศาสตร์และการบัญชี จุฬาลงกรณ์มหาวิทยาลัย
ปีการศึกษา 2564

Thesis Title	Do Issuers Affect Derivative Warrants Overpricing? Evidence of Thailand
By	Miss Sarunporn Thupthong
Field of Study	Finance
Thesis Advisor	Assistant Professor RUTTACHAI SEELAJAROEN, Ph.D.

Accepted by the FACULTY OF COMMERCE AND ACCOUNTANCY, Chulalongkorn University in Partial Fulfillment of the Requirement for the Master of Science

.... Dean of the FACULTY OF COMMERCE AND ACCOUNTANCY
(Associate Professor WILERT PURIWAT, D.Phil.)

THESIS COMMITTEE

.... Chairman
(Assistant Professor TANAKORN LIKITAPIWAT, Ph.D.)

.... Thesis Advisor
(Assistant Professor RUTTACHAI SEELAJAROEN, Ph.D.)

.... Examiner
(Assistant Professor ROONGKIAT RATANABANCHUEN, Ph.D.)

.... External Examiner
(Assistant Professor Nattawut Jenwittayaroje, Ph.D.)

สรัลพร ทับทอง : ผู้ออกใบสำคัญแสดงสิทธิอนุพันธ์มีผลกระทบต่อการที่ใบสำคัญแสดงสิทธิอนุพันธ์ราคาสูงกว่าปกติหรือไม่: กรณีศึกษาจากตลาดหลักทรัพย์แห่งประเทศไทย. (Do Issuers Affect Derivative Warrants Overpricing? Evidence of Thailand) อ.ที่ปรึกษาหลัก : ผศ. ดร.รัฐชัย ศีลาเจริญ

ปัจจุบันนี้ใบสำคัญแสดงสิทธิอนุพันธ์ (derivative warrant: DW) ได้รับความนิยมมากขึ้นในหลายประเทศ อย่างไรก็ตาม มีการค้นพบเป็นจำนวนมากว่าใบสำคัญแสดงสิทธิอนุพันธ์มีราคาสูงเกินไปเมื่อเปรียบเทียบกับออปชั่น (exchange traded options) และการที่ใบสำคัญแสดงสิทธิอนุพันธ์มีราคาที่สูงเกินไป (derivative warrant overpricing) ได้ถูกอธิบายผ่านทางค่าใช้จ่ายในการป้องกันความเสี่ยง (hedging cost) ส่วนเกินสภาพคล่อง (liquidity premium) อำนาจตลาด (market power) และความไม่สมมาตรของข้อมูลของนักลงทุน (asymmetric information of investor) ซึ่งคำอธิบายเหล่านี้มีความเกี่ยวข้องกับลักษณะของผู้ออกใบสำคัญแสดงสิทธิอนุพันธ์ ดังนั้น งานวิจัยฉบับนี้จึงได้จัดทำขึ้น โดยมีวัตถุประสงค์เพื่อนำเสนอการที่ใบสำคัญแสดงสิทธิอนุพันธ์มีราคาที่สูงเกินไป และอธิบายความสัมพันธ์ของปรากฏการณ์นี้กับลักษณะเฉพาะของผู้ออกใบสำคัญแสดงสิทธิอนุพันธ์ (characteristics of derivative warrant issuer)

ผลการวิจัยพบว่าใบสำคัญแสดงสิทธิอนุพันธ์ในประเทศไทย มีแนวโน้มว่าจะมีราคาที่สูงเกินไป อีกทั้งระดับราคาที่สูงเกินไปนั้นยังสามารถเปลี่ยนแปลงได้ตามสภาวะตลาด รวมทั้งจากการที่ ก.ล.ต มีการแก้ไขกฎระเบียบการจัดทำสรุปข้อมูลสำคัญของหลักทรัพย์ (factsheet) ก็สามารถส่งผลให้ระดับราคาที่สูงเกินไปนั้นเปลี่ยนแปลงได้เช่นกัน นอกจากนี้ผลการวิจัยยังพบว่า ผู้ออกใบสำคัญแสดงสิทธิอนุพันธ์แต่ละรายยังมีระดับราคาที่สูงเกินไปแตกต่างกัน โดยอยู่ในช่วงระหว่าง 2.77 ถึง 66.15 เปอร์เซ็นต์ ซึ่งการที่ระดับราคาที่สูงเกินไปนั้นแตกต่างกันสามารถอธิบายได้ผ่านทางลักษณะเฉพาะของผู้ออกใบสำคัญแสดงสิทธิอนุพันธ์ ได้แก่ (1) ส่วนแบ่งการตลาดของผู้ออกใบสำคัญแสดงสิทธิอนุพันธ์ (market share of issuer) (2) ความเสี่ยงด้านเครดิตของผู้ออกใบสำคัญแสดงสิทธิอนุพันธ์ (credit risk of issuer) (3) ผู้ออกใบสำคัญแสดงสิทธิอนุพันธ์จากต่างประเทศ และ (4) รูปแบบการคำนวณค่าการเสื่อมค่าทางเวลาของผู้ออกใบสำคัญแสดงสิทธิอนุพันธ์

สาขาวิชา	การเงิน	ลายมือชื่อนิสิต	....
ปีการศึกษา	2564	ลายมือชื่อ อ.ที่ปรึกษาหลัก	....

6284075726 : MAJOR FINANCE

KEYWORD: Derivative Warrant, Derivative Warrant Overpricing, Derivative Warrant Issuer

Sarunporn Thupthong : Do Issuers Affect Derivative Warrants Overpricing? Evidence of Thailand. Advisor: Asst. Prof. RUTTACHAI SEELAJAROEN, Ph.D.

Derivative warrants have become increasingly popular in many countries. However, numerous literatures provide the empirical evidences that derivative warrants are overpriced relative to the comparable options. Many researchers found that the derivative warrant overpricing can be explained by hedging cost, liquidity premium, market power, and asymmetric information of investors. These explanations are likely to be related to characteristics of derivative warrant issuer. Therefore, this paper comes up with the objective to reconfirm the overpricing phenomenon in Thailand and investigate the issuer identity effect on the derivative warrant overpricing as well as examine what issuer's characteristics cause the level of overpricing differ across issuers. The results demonstrate that Thai derivative warrants tend to be overpriced and the nature of the overpricing phenomenon has changed due to the SEC revised disclosure regulation and the underlying market conditions. Furthermore, the results also show the existence of issuer identity effect on the overpricing level. The overpricing level is different across issuers and ranging from 2.77 to 66.15 percent. The findings can be explained through the issuer's characteristics, namely, market share of issuer, credit risk of issuer, foreign issuer, and style of calculating time decay.

Field of Study:	Finance	Student's Signature ....
Academic Year:	2021	Advisor's Signature ....

ACKNOWLEDGEMENTS

First and foremost, I would like to express very profound gratitude to my thesis advisor, Asst. Prof. Ruttachai Seelajaroen, Ph.D. for his kindness and valuable encouragement throughout the course of this thesis. He was always open whenever I ran into a trouble spot and had a question about this study. His recommendations put me into the right direction to achieve the accomplishment. Second, I am also very grateful to all my thesis committees including Asst. Prof. Tanakorn Likitapiwat, Ph.D., Asst. Prof. Roongkiat Ratanabanchuen, Ph.D., and the external committee from NIDA Business School, Asst. Prof. Nattawut Jenwittayaroje, Ph.D. for their comments and suggestions to make this paper completely. Third, I am thankful to the Financial Laboratory of Department of Banking and Finance, Chulalongkorn Business School and other organizations that were involved in the secondary sources of data and information for this study. this paper could not have been successfully conducted without them. Forth, I would like to thank my best friend, Matina O-warinrat who always stands by me from the bachelor degree to this master degree and others whose names may not all be enumerated. Finally, I would like to give special thanks to my parents for providing me with unfailing support and continuous encouragement throughout the course of Master of Science in Finance (MSF) at Chulalongkorn University. This accomplishment could not have been possible without them.

Sarunporn Thupthong

TABLE OF CONTENTS

Page

LIST OF TABLES

Page

LIST OF FIGURES

Page

CHAPTER 1 INTRODUCTION

Derivative warrants have become increasingly important in Thai financial market as an alternative investment and hedging tool. The popularity of derivative warrants is also observed in other countries such as Hong Kong, Taiwan, South Korea, China, Singapore, and England. For many investors, derivative warrants are similar to exchange-traded options. Both derivative warrants and options allow the holders to gain exposure to the price fluctuations of the underlying asset without owning such asset. They also do not give direct control over the underlying asset until exercise and will expire after a certain period of time. However, there are some key differences between derivative warrants and options. First, derivative warrants are traded in equity markets and require investors to have only bank account while options are standardized contracts traded in future market and require investors to have futures account which have more strict requirements. Second, investors are allowed to only take a long position on derivative warrants, unlike options that investors can take both short and long positions. These features make derivative warrants to be attractive especially for individual investors. Furthermore, it is often found that derivative warrants are more liquid compared with matched options in markets where both derivative warrants and options exist.

Even though derivative warrants are more liquid and accessible than options, many studies found that derivative warrants are more expensive than identical options. For example, Chan and Pinder (2000), Loudon and Nguyen (2006) and Hunt and Terry (2011) study about the overpricing of derivative warrants relative to matched options in Australia. The results show that derivative warrants tend to be overpriced relative to matched options, consistent with the studies of Li and Zhang (2010) and Fung and Zeng (2012) that examine the difference in prices of derivative warrants and options traded in Hong Kong. Additionally, the findings of Wongsirikul (2013) indicate that Thai derivative warrants are mispriced whether applying Black-Scholes model or Cox Square Root (CSR) model. Sirigamolsantichai and Likitapiwat (2015) also reveal that derivative warrants in Thailand are overpriced.

The overpricing of derivative warrants is now considered as well-established empirical evidence. Many researchers have later examined potential causes of this phenomenon. They found that the overpricing of derivative warrants can be explained by hedging cost, liquidity premium, market power, and asymmetric information of investors. These explanations seem to be related to characteristics of derivative warrant issuers. For instance, the size of liquidity premium relies on the identity of issuer as issuer with larger market share should be able to provide more liquidity. To issue derivative warrants, issuers face many market risks which can be controlled by hedging position that are costly. Issuers consequently have an incentive to transmit the cost of carrying hedging position to investors, resulting in higher derivative warrant price.

Derivative warrants issued by lower credit rating issuer are expected to trade at higher discount (Loudon & Nguyen, 2006).

Although it is well documented that derivative warrant is overpriced in the Thai market, the reasons behind such phenomenon have not been subjected to much research. Thai derivative warrants are issued by only securities companies that approved by Securities & Exchange Commission (SEC). Derivative warrant market in Thailand is considered new, as it is only launched in 2009. However, over its 7 years in operation, the market has experienced significant growth. The monthly total trading value tends to increase every year, as shown in Figure 1. The monthly total trading value is around 21 billion baht in January 2014 and significantly increases to 130 billion baht in October 2020. This implies an increasing in popularity of derivative warrant market.

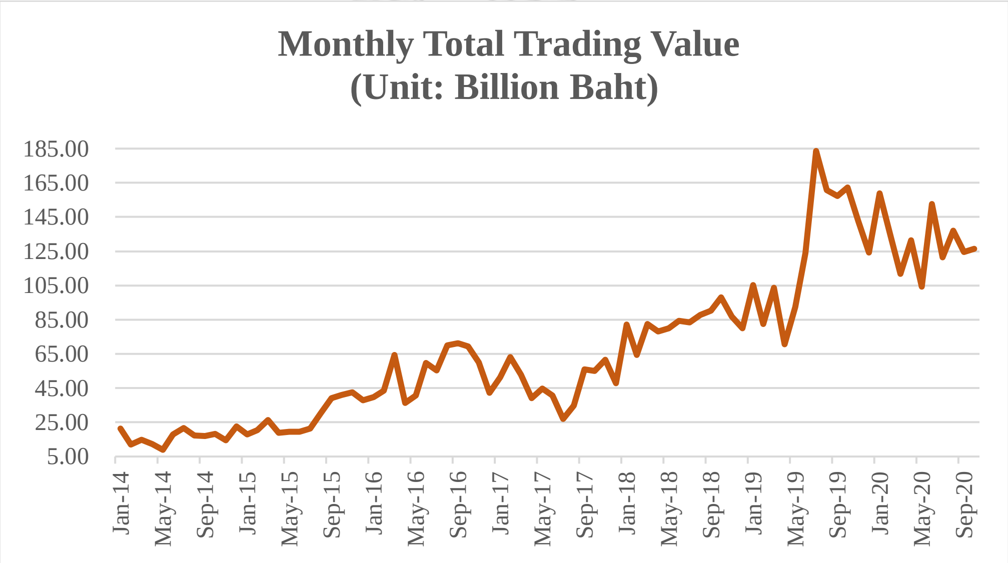

Figure 1 Monthly Total Trading Value

Source: SETSMART, 2020

Given its popularity among Thai investors, SEC revealed that most investors often lose from investing in derivative warrants and the profit is concentrated with market makers and a few investors (The Securities and Exchange Commission Thailand, 2017). Therefore, it is necessary for investors to understand the nature of derivative warrants to averse the risk associated with their portfolios. However, it is surprising that empirical evidences on Thai derivative warrant market are quite limited, compared to other major Asian markets, such as Hong Kong and China. There are some literatures about the derivative warrant mispricing. For instance, Eksaengsri and Suchintabandid (2010) show that a mispricing in Thailand which considered as a new market occur because investors do not concern on issuer's credit risk when trading derivative warrants. The findings of Sirigamolsantichai and Likitapiwat (2015) indicate that maturity, moneyness, and volatility premium have significantly impact on the overpricing level in Thailand. Lerdsuwankij and Suchintabundid (2017) reveal that derivative warrant overpricing has positive correlation with the brand equity and credit risk of issuer but has negative relationship with liquidity of derivative warrant. The positive impact of brand equity reflects that brand equity has a significant effect on investors' willingness to pay a price premium. Meanwhile, the positive influence of credit risk is explained by the difficulty to access information of issuer's credit risk for retail investors and the high credit risk issuer's incentive to tactically pass on their cost of funding into their derivative warrant pricing. Additionally, Prasertkijaphan (2017) shows that most of issuers can make profit from issuing derivative warrants while all retail investors always lose from trading with any brokerage firms if they are holding derivative warrants more than 30 days.

According to the existing studies in Thailand, many issuers can gain profit from issuing derivative warrants while only a few investors can gain profit from investing in derivative warrants and it is found that the overpricing phenomenon is related to issuers. Issuers normally try to encourage investors to trading their derivative warrants because many investors concern about liquidity risk and can be attracted by derivative warrant's volume. Nevertheless, the literatures from other countries found a conflict influence of issuer identity on derivative warrant overpricing. In Hong Kong, Yan (2000) indicates the existence of an issuer identity effect on the derivative warrant mispricing when employing the Black-Scholes model. However, the issuer effect disappears when using the semi-parametric model, reflecting that no issuer can command a higher price after accounting for the contract differences. In Australia, Chan and Pinder (2000) show that the identity of issuer is associated to the pricing difference between warrants and options. In the same way, Loudon and Nguyen (2006) reveal that the identity of issuer has a significant influence on the warrant overpricing level in Australia even after taking liquidity and hedging factors into account. As a result, it is interesting to study about how issuer affect the overpricing level.

To be the best of researcher's knowledge, there are a few literatures in Thailand study about the issuer effect on the overpricing phenomenon and none of them study the impact of macro factors on the overpricing phenomenon. As individual investors play an important role in Thai financial market, some information of issuer's characteristics may not be accessible for them and some used proxies of their characteristics are limited to listed companies while derivative warrant issuers now include both listed and unlisted companies. In addition, most existing literatures in Thailand investigate the derivative warrant overpricing based on the Black-Scholes model which assumes constant volatility. In the real world, constant volatility cannot be occurred. It fluctuates depending on demand and supply.

Consequently, this paper comes up with the main objectives to study the issuer effect on the derivative warrant overpricing in Thailand by referring the theories and research results from other countries. This paper expects to extend the existing literatures by using proxies that accessible for retail investors to examine what characteristics of issuer cause the overpricing level different across issuers. As another explanation of this phenomenon is uninformed investors and SEC try to reduce this cause by revising the disclosure regulation of factsheet to be concise, easy to understand, consistent with investors' behavior, and comply with international standard, starting on September 16, 2019, this paper also examines the effect of the revised disclosure regulation and market conditions on the overpricing phenomenon. This paper tries to answer the following questions:

- Are Thai derivative warrants overpriced?
- Does the SEC revised disclosure regulation reduce the derivative warrant overpricing?
- Do the market conditions affect the derivative warrant overpricing?
- What issuer's characteristic can be related to derivative warrant overpricing?

In general, the SET50 derivative warrants are not based directly on the SET50 index, but it will be based on the SET50 index futures traded on TFEX which are the result of the actual trading of all groups of investors, have high liquidity, and their price will go up and down all the time. As a result, the price of SET50 derivative warrants, which based on the SET50 index futures, can better reflect the actual trading and investors' aspect compared with stock derivative warrants (KGI Securities (Thailand) PCL., 2021). Moreover, the index derivative warrants tend to be more popular and liquid than stock derivative warrants with trading value greater than 50 percent. This paper therefore focuses on SET50 derivative warrants and covers the sample period that SET50 derivative warrant was firstly launched in Thailand. Additionally, the limitation of the Black-Scholes model that volatility is assumed to be constant may lead to the pricing biases and the volatility is a significant factor influencing the option pricing. The accurate measures and forecasts of volatility are consequently important. As a result, this paper uses the Black-Scholes model with GARCH volatility to calculate theoretical price because the distinctive feature of GARCH model is the recognition that volatility is not constant and then examine the overpricing of derivative warrants.

The reminder of this paper is organized as follows: The next section provides the literature review on theoretical framework and related empirical studies. The third section describes research objective and hypotheses of this study. The fourth section describes the data collection and methods employed in this study and the fifth section interprets the empirical results of this study. Last, the sixth section provides conclusion of this study.

CHAPTER 2 LITERATURE REVIEW

Given the popularity of derivative warrants in Thailand, the overpricing phenomenon is observed. This paper aims to examine the issuer effect on the overpricing phenomenon as well as explain the rationale behind the effect. This chapter deals with the review of theoretical framework and related literatures with a specific emphasis on the mispricing of derivative warrants. This chapter is divided into 4 parts, namely evidences of derivative warrant mispricing, determinants of derivative warrant mispricing, theoretical framework, and conclusion of the literature review.

EVIDENCES OF DERIVATIVE WARRANT MISPRICING

Derivative warrants are one of the popular financial instruments in the world, however there are widely believe that derivative warrants are overvalued. The empirical studies try to introduce various methods to investigate the inefficiently pricing of derivative warrants. The first method is comparing derivative warrants with comparable options because the derivative warrants are similar to options in many aspects. The second method is comparing the market price of derivative warrant with theoretical price derived from option pricing model. Theoretically, the behavior of market prices can be described by the Efficient Market Hypothesis (EMH). This theory states that prices fully and instantaneously reflect all information. Securities always trade at their fair value. Underpriced or overpriced stocks are impossibly traded and abnormal return cannot be earned. Third, the mispricing is shown by the difference between implied volatility and historical volatility because it is found that the overestimated volatility is one of the causes of derivative warrant overpricing.

The empirical studies found that derivative warrants are inefficiently priced in many countries. In Australia, Chan and Pinder (2000), Loudon and Nguyen (2006), and Hunt and Terry (2011) examine the mispricing of warrants relative to options in Australia and the results show that the warrants tend to be more expensive than the options. In European markets, Horst and Veld (2008) reveal that the call warrants are strongly overpriced during the first five trading days and the average overpricing level is between 25 and 30 percent. Sakarya and Aksu (2018) compare pricing performance of Black-Scholes pricing model and Gram-Charlier pricing model by using the data of 23 call and 23 put covered warrants based on Eregli Demir Celik Fabrikaları T.A.S. stocks, issued and expired in 2015. The results reveal that Black-Scholes model is suitable for pricing call warrants while Gram-Charlier model is appropriate to price put warrants. However, prices of both models are not close to the market prices. The observed market prices are higher than the model prices, implying an overvaluation of the warrants. This paper concludes that both models are not suitable for pricing warrants in Turkey.

The mispricing of derivative warrants is also observed in Asian markets. In Hong Kong where is the biggest derivative warrants market in the world in terms of turnover since 2007 based on data from the World Federation of Exchanges (J.P. Morgan, 2019), Yan (2000) reveals that derivative warrants are generally underpriced by Black-Scholes model, suggesting that the implied volatility inferred from the derivative warrant price is higher than the historical volatility. This study also found that the Black-Scholes model overprices derivative warrants during the high volatility periods. This paper also shows that the stock options are cheaper than derivative warrants after controlling for the differences in contract specifications. Li and Zhang (2010) study the price difference between derivative warrants and identical options by focusing on the difference in liquidity and reveal that derivative warrants are typically more expensive than identical options in Hong Kong market because of liquidity premium of derivative warrants over options. In the same way, Fung and Zeng (2012) examine the pricing efficiency of derivative warrants and options in Hong Kong. The Black-Scholes option pricing model and comparing implied volatility of derivative warrants (and options) with realize volatility that calculated from futures price are used to investigate the overpricing of derivative warrants relative to options. The results also show that derivative warrants are more expensive and liquid than options. A direct comparison between implied volatility and realized volatility reveals that even though implied volatility is greater than realized volatility on average, the implied volatility of at-the-money derivative warrants is not statistically different from the realized volatility. Furthermore, the regression analysis also shows that implied volatility of at-the-money and out-of-money derivative warrants provide unbiased forecasts of realized volatility. The results indicate that at-the-money derivative warrant prices are in line with realized volatility, implying that these derivative warrants are fairly priced.

Furthermore, in China, Liu and Rangan (2012) reveal that the implied volatility is greater than the realized volatility across maturities, reflecting a overpricing of the warrants. Powers and Xiao (2014) investigate the mispricing of Chinese warrants by comparing market price with theoretical price calculated from 3 option pricing models, namely Black-Scholes model, Jamp-Diffusion model, and Constant Elasticity of Variance (CEV) model, because each model relaxes different assumptions. The findings indicate that the 3 option pricing models provide the similar results that call warrants are underpriced while put warrants are overpriced. In Malaysia, Sakti and Qoyum (2017) study factors that affect warrant mispricing in Malaysia by employing panel data analysis and natural logarithms of the actual price divided by theoretical price are used as a proxy of warrant mispricing. This study reveals that the market is inefficient on the warrant traded for 4 companies observed. The actual price of warrant is lower than the theoretical price calculated from the Black-Scholes model, reflecting an underpricing of the warrant.

Additionally, there are the evidences provide that the derivative warrants are also mispriced in Thai market. Wongsirikul (2013) applies the percentage of pricing error and the mean difference to compare the pricing performance of Black-Scholes and Cox Square Root models for Thai derivative warrants. The results indicate that the Black-Scholes model which assumes volatility constant during the life of the options provides lower percentage pricing error than the Cox Square Root models which assumes stochastic volatility. Sirigamolsantichai and Likitapiwat (2015) extend the study of Fung and Zeng (2012) by examining the mispricing of derivative warrants in Thai market. This paper reveals that the prices of derivative warrants in Thai market are not fairly priced as can see from the direct comparison between implied volatility and realized volatility of underlying stock that implied volatility of derivative warrant is significant above the corresponding realized volatility for both call and put derivative warrants. The results are reaffirmed by the regression analysis which indicates that implied volatility provides biased forecast of realized volatility. Additionally, Prasertkijaphan (2017) studies about the profit of derivative warrant issuers and investors in Thai market. The paper reveals that most of issuers can make profit from issuing derivative warrants while all retail investors make loss from trading with any brokerage firms if they are holding derivative warrants more than 30 days.

DETERMINANTS THAT CAUSED DERIVATIVE WARRANTS MISPRICING

Apart from investigating the mispricing of derivative warrants, the prior literatures found that the mispricing phenomenon can be explained through both macro and micro factors. With regard to the macro factors, Chan and Pinder (2000) indicate that the warrants are overpriced compared with comparable options and the mean of the pricing difference has reduced because the introduction of electronic option trading can remove the obstructions in the floor-traded options market such as slower traded execution and the inability to observe the order book being removed or substantially reduced. Powers and Xiao (2014) reveal 2 major factors of the warrant mispricing in China. First, investors take the potential burst of an equity market bubble into account and thus imposed an implicit discount on the current price of underlying asset when pricing warrants. Second, investors will switch from stock trading to warrant trading after the exogenous tax increase on stock transaction announced on May 29, 2007. This suggests that investors will shift their speculative activities to the lower cost venue.

The micro factors include the trading behavior, derivative warrant’s contract specifications, and issuer’s characteristics. First, it is found that liquidity can be attributed to the derivative warrant mispricing. The liquidity of a security plays an important role to affect its market price and many investors concern about the liquidity risk. A number of prior studies analyze the impact of liquidity on derivative warrant mispricing. In general, many studies have applied bid-ask spread, turnover ratio, and trading volume as a proxy of liquidity. Horst and Veld (2008) reveal that the log of the trading volume is positively related to the overpricing level, implying that a higher trading volume is related to a higher overpricing level. Li and Zhang (2010) examine the effect of liquidity on the overpricing of derivative warrants relative to options and the findings indicate that there is a significant positive relationship between liquidity and price difference between derivative warrants and options. In other words, the higher liquidity requires higher price premium for derivative warrants relative to options because the better liquidity and higher short-term holding period returns of derivative warrants make them a good tool for the short-term trading purpose. However, more liquidity of derivative warrants implies the higher hedging costs for liquidity providers and these costs can be interpreted that derivative warrants are more illiquid than options for the liquidity providers' viewpoint. In the same way, Chen, Gau, and Tai (2014) show a positive relationship between liquidity and warrant pricing error in Taiwan which indicating that greater trading volume tend to increase pricing error. Powers and Xiao (2014) consider liquidity as one of the determinants of pricing errors of warrant in China. The paper reveals that there is a positive relationship between liquidity and pricing errors of put warrants, either included or excluded other determinants, consistent with speculation or trading purposes of investors. However, this paper also found that liquidity is insignificantly related with the pricing errors of call warrants when considered its own, but liquidity is positively and significantly related with the pricing errors of call warrants when included other determinants.

On the contrary, there are some studies found a opposite relationship between the overpricing and liquidity as well. Chan and Pinder (2000) document the overpricing of warrants relative to options in Australia market and also show a negative relationship between the premium of warrants over options and the relative liquidity between the 2 markets (i.e., the ratio of option volume to warrant volume). Similarly, Lerdsuwankij and Suchintabundid (2017) show that liquidity has a negative relationship with overpricing level of derivative warrants. This may occur from the extreme overpricing attracts the informed traders to trade more, leading higher liquidity in derivative warrants which may give higher profit to issuers and allow them to reduce their overpriced premium.

Another factor is hedging difficulty. To reduce risk of price movement, issuers are attempt to employ a hedged position for limiting or offsetting probability of loss from the risks. With hedging, the issuers have to incur the cost of carrying a hedged position and the cost can be expressed in term of option Greeks, such as delta, gamma, and theta (McDonald, 2013c). The hedging costs faced by issuers may be transferred to investors, reflecting a higher warrant price. As a result, there are some studies explain the price divergence via hedging difficulty. Current volatility is considered as an indicator of hedging difficulty. Volatility reflects a measure of price risk for hedging and speculation decisions. Loudon and Nguyen (2006) and Sakti and Qoyum (2017) indicate a positive relationship between current volatility and the degree of warrant mispricing. These may be described that higher volatility implies higher cost to keep delta-neutral. This additional cost will be transferred to investors, causing higher price of derivative warrant. Powers and Xiao (2014) found that stock volatility is positively related to pricing error of call warrants because the stock return volatility is a key input in the option pricing model.

On the other hand, Yan (2000) reveals a negative relationship between the mispricing level of derivative warrants and stock volatility, reflecting that higher risk induces higher model price of derivative warrants. Chen et al. (2014) show a negative relationship between implied volatility and warrant pricing error in Taiwan which reflects that pricing errors decline with implied volatility. Additionally, Fung and Zeng (2012) and Sirigamolsantichai and Likitapiwat (2015) investigate the impact of volatility premium on the derivative warrant overpricing. Their results show a positive relationship between volatility premium (i.e., the ratio of implied volatility and realized volatility) and the derivative warrant overpricing, confirming that overpricing level is largely determined by volatility premium.

Additionally, delta represents the expected change in price of derivative warrant with respect to 1-unit change in underlying price. It is an important parameter for hedging activities, known as delta-hedging. As the cost of delta hedging is related to delta, delta is used to supplement volatility as a measure of hedging difficulty. Loudon and Nguyen (2006) study the overpricing of Australia warrants relative to options and consider delta as an indicator of hedging difficulty. The results from both univariate and regression analyses indicate that there is a strongly negative relationship between relative price differences and delta, either including or excluding liquidity measure. In addition, Prasertkijaphan (2017) examines the profit after hedging of Thai derivative warrant issuers compensated with the risk of issuing derivative warrants and considers delta as a risk from price movement of underlying asset. The findings show that delta risk is insignificantly related to profit of issuers for call derivative warrants because this paper already hedges delta risk, but delta risk is negatively related to profit of issuers for put derivative warrants because there is a difficulty of continuously hedging delta risk.

Third, several papers reveal that moneyness has an influence on the overpricing of derivative warrants, but the direction of relationship is ambiguous. Loudon and Nguyen (2006), Horst and Veld (2008), and Sakti and Qoyum (2017) provide the evidence that moneyness is negatively related to derivative warrant overpricing. In contrast, Chen et al. (2014) report a positive relationship between moneyness and pricing error, consistent with smile effect that if the at-the-money warrants are closer to the out-of-money side, warrant pricing will go down (a smirk effect). Fung and Zeng (2012) and Sirigamolsantichai and Likitapiwat (2015) show that moneyness is negatively related to the overpricing of call derivative warrants and positively related to the overpricing of put derivative warrants, implying that writing out-of-money call and put derivative warrants are more profitable. Intra and Nimanusornkuk (2019) report that moneyness is insignificantly related to the overpricing of call derivative warrants but negatively related to the overpricing of put derivative warrants.

The fourth determinant is maturity, the date that life of financial instrument ends. The findings of Loudon and Nguyen (2006) and Sakti and Qoyum (2017) show that maturity has positive relationship with the overpricing, implying that the longer maturity positively affects the warrant mispricing to increase while other literatures found an unclear relationship between maturity and the warrant mispricing. For instance, Fung and Zeng (2012) report that the longer time-to-maturity causes higher overpricing level for call derivative warrants and lower overpricing level for put derivative warrants. However, Sirigamolsantichai and Likitapiwat (2015) who extend the study of Fung and Zeng (2012) by capturing Thai market reveal that the longer time-to-maturity increases the overpricing level, except deep out-of-money that both long-term call and put derivative warrants are less overpricing level. Powers and Xiao (2014) indicate that time-to-maturity is positively related to the overpricing of put warrants, referring that the value of holding put warrant will be higher when it has longer time-to-maturity. However, the effect of time-to-maturity on call warrants is opposite, implying that its market price tends to converge to intrinsic value as the call warrant get close to expired date. Chen et al. (2014) mention that the relationship between time-to-maturity and warrant pricing error is depend on industry of underlying. There is a negative relationship for food, textile, shipping and transportation, and financial and insurance whereas time-to-maturity has a positive relationship for plastic, electric machinery, chemical industry, glass and ceramic, paper and pulp, iron and steel, rubber, electronic parts/semiconductors, and tourism.

Moreover, there are literatures that considered time decay as a determinant of the valuation of derivative warrants. Time decay is a measure of the declining rate in the value of an option due to the passage of time. It is also known as Theta, one of the option Greeks. Prasertkijaphan (2017) tests impact of option Greeks on the profit of derivative warrant issuers. The results show that Theta is insignificant for call derivative warrants, but it has negatively related to put derivative warrants. The results are contrast with Intra and Nimanusornkuk (2019) who offer an evidence that an increase in time decay causes a percentage of difference between market price and theoretical price of derivative warrants to go up.

The fifth determinant is credit risk, a probability that a borrower fails to make a payment. Chen et al. (2014) examine the impact of issuer credit rating and warrant mispricing in Taiwan for each underlying's industries and applies a dummy variables of credit rating in regression analysis. The findings show that issuer credit rating negatively affects the warrant pricing error, implying that there is a less price distortion or manipulation involved in warrant issued by issuer with high credit rating. In Thailand, Eksaengsri and Suchintabandid (2010) examine the impact of credit risk parameters (probability of default and default intensity) and credit rating of issuers on the price of call derivative warrants in Thailand and Hong Kong. The results reveal that credit risk parameters significantly influence on derivative warrant prices, but they do not correlate with credit rating of issuers in both countries. This paper explains that the mispricing in Thailand, which considered as a new market, occurs because investors do not concern on issuer's credit risk when trading derivative warrants. Wongsirikul (2013) shows that the Black-Scholes model provides a better performance than the Cox Square Root model for both high and low credit ratings of issuer. The paper also shows that the pricing error is negatively related to credit rating level in Thailand. Corresponding, Lerdsuwankij and Suchintabundid (2017) use credit spread as a proxy of credit risk and reveal a positive relationship between credit risk and the overpricing of derivative warrants. It means that the higher credit risk of issuer leads the higher overpricing level. This paper explains that the relationship may be happened because information of issuer's credit risk is difficult to access for retail investors and high credit risk issuer may need to tactically pass on their cost of funding into their derivative warrant pricing. However, Prasertkijaphan (2017) investigates the effect of issuer credit rating to profit of issuers from issuing derivative warrants. This paper employs Altman's Z-score method to convert the credit rating to number and regression model to analyze the effect. The results indicate that credit rating of issuers is not significantly related with the profit of issuers.

It is clear that some factors of derivative warrant overpricing are related with the issuer. For example, the size of liquidity premium seems to rely on the identity of issuer as issuer with larger market share should be able to provide more liquidity. Investors may require more price discount from derivative warrants issued by lower credit rating issuer. Issuers may have incentive to transmit the cost of carrying hedged position to investors, resulting in a higher price of derivative warrants. A few literatures confirm that the identity of issuers is one of the important determinants of derivative warrant overpricing. Chan and Pinder (2000) investigate the impact of liquidity on the pricing differences between derivative warrants and options and adopts dummy variables of issuers as a control variable for credit risk. The findings reveal that the identity of issuers tends to have effect on the pricing difference, probably reflecting the different levels of credit risk or the manifestation of the different characteristics of the underlying assets in respect of which the warrants were issued. Likewise, Loudon and Nguyen (2006) offer the evidence that the identity of issuer has a significant relationship with the pricing difference between derivative warrants and options, even after liquidity and hedging factors are taken into account. As the issuers are usually large financial institutions, the different credit ratings may not large enough to be detectable in derivative warrant price. In addition, the sample of this study consists mainly warrants with a life less than 1 years, any discount for credit risk is relatively small. Thus, the relationship is more likely to be explained by differences in market power and investor perceptions than differential credit risk. Horst and Veld (2008) not only provide the evidence of the issuer identity effect on the warrant overpricing in Dutch market but also reveal that the warrants issued by foreign issuers are more overpriced than the warrants issued by Dutch issuers. The findings are explained that the foreign issuers have to incur higher operating costs in the Dutch market.

Nevertheless, Yan (2000) also reveals that the identity of issuer predicts the Black-Scholes pricing error. However, when using the semi-parametric model, the results show that no issuer can command a higher price after accounting for contract differences. The paper concludes that the effect may result from the properties of the derivative warrant contract instead of the identity of issuer.

Additionally, Lerdsuwankij and Suchintabundid (2017) test the impact of issuer's brand equity value on the derivative warrant overpricing. Band equity is the differential effect of brand knowledge on buyer response to the promoting activity of the brand. The paper applies market-to-book ratio, the experience of issuer in doing derivative warrants, the percentage trading market share of issuer, and the variety of derivative warrant issued as a proxy of brand equity value. The findings indicate that a higher brand equity value leads to an increasing level of derivative warrant overpricing, implying that brand image of issuer has an important effect on consumer's willingness to pay.

Apart from factors mentioned above, some literatures found other determinants of derivative warrants overpricing. Horst and Veld (2008) explain the overvaluation of warrants relative to options through other possible explanations. First is flexibility of call warrants for individual investors which shown by a negative relationship between warrant ratio and the overpricing level. Second, transaction costs are lower for call warrants that are relatively cheap compared with other call warrants with the same warrant ratio. However, transaction costs cannot fully explain the overpricing. This paper found a negative relation between the normalized warrant price and the overpricing level. Third, it is impossible for investors to do arbitrage. Last is a combination of financial marketing and framing. Issuers have created an image for call warrants different from call options. Additionally, Horst and Veld (2002) send questionnaires to investigate how explanations of the overvaluation affect investors' decision. The paper reveals that the first thing that investors prefer to invest in call options over call warrants is the price of the product since investors realize that call warrants are overpriced relative to call options. The second thing is the risk of the product, followed by the publicity on newspapers and magazines and recommendations from friends and acquaintances. The last one is transaction cost.

In addition, Prasertkijaphan (2017) reports that Rho risk is the risk factor that market pay the highest premium for both call and put derivative warrants in Thailand because issuers are bearing the sensitivity of derivative warrants to a change in interest rate. Intra and Nimanusornkuk (2019) found that there are other factors affected the difference between market price and theoretical price of derivative warrants in Thailand, namely sensitivity, effective gearing, and all-in-premium. Sensitivity is a market instrument's reaction to a change in some relevant factor. It has a negative effect on the pricing difference for both call and put derivative warrants. Effective gearing represents the percentage change in price of derivative warrant with respect to 1 percent change in underlying price. It has a negative relationship with the pricing difference of call derivative warrants but has insignificant effect on the pricing difference of put derivative warrants. All-in-premium reflects the value that how much the purchase of derivative warrant and immediately converts it into the underlying stock is more expensive than directly buying underlying stocks. It is positively related to the pricing difference for call derivative warrants, implying that higher all-in-premium causes an increase in percentage of pricing difference. However, it is not related to the pricing difference of put derivative warrants.

THEORETICAL FRAMEWORK

According to the Efficient Market Hypothesis (EMH), the market cannot be beaten because it reflects all information into stock prices, so stocks are traded at fair price. Underpriced or overpriced are mispricing. To observe mispricing of derivative warrant, the option pricing model is applied to calculate theoretical price for comparing with the market price. Black-Scholes model is the widely used option pricing model. Thai derivative warrant issuers apply this model to generate indicative price. According to the existing literatures, the overpricing of derivative warrants is still observed even the pricing model is changed and the results from each model are not different much. Wongsirikul (2013) reports that the Black-Scholes model provides less pricing error for derivative warrant than the Cox Square Root (CSR) model. Numpa (2014) reveals that Black-Scholes model is a good model in emerging market because of more simplicity process while its performance is not different much from Heston (1993) continuous time stochastic model and Heston and Nandi (2000) GARCH type discrete model. Powers and Xiao (2014) study about the mispricing of Chinese warrants by using 3 models, namely Black Scholes model, Jump-Diffusion model, and Constant Elasticity of Variance model. The 3 models generate similar theoretical prices. Black-Scholes provides the least pricing error for put warrants but the most pricing error for calls. Sakarya and Aksu (2018) compare pricing performance of Black-Scholes pricing model and Gram-Charlier pricing model by using the data of covered warrants traded in Turkey market. The results indicate that Black-Scholes model is suitable for pricing call warrants while Gram-Charlier model is appropriate to price put warrants. However, prices derived from both models are lower than the observed market prices.

In Black-Scholes model, volatility is only one factor that unobservable. The Black-Scholes model assumes constant volatility over the option’s life. However, volatility is not constant in the real world. It fluctuates with the level of demand and supply. Estimating volatility is important because it is a measure of risk which is the main concern of investors. The concept of non-constant volatility is introduced in GARCH model. The model is widely used to model and forecast volatility of financial time series. Dash, Dagha, Sharma, and Singhal (2012) and Bi, Yousuf, and Dash (2014) use the GARCH(1,1) model to estimate volatility and apply the estimated volatility in the Black-Scholes model to calculated theoretical price. Dash et al. (2012) reveal that the implied volatility is overestimated compared with estimated volatility based on the GARCH model and the option price is overvalued compared with the model price calculated from the Black-Scholes model with GARCH volatilities. Bi et al. (2014) report that options are overpriced and the put options are more overpriced than call options. Namugaya, Weke, and Charles (2014) apply the GARCH model of different lag to estimate volatility of stock return and found that GARCH(1,1) model are outperformed the other GARCH(p,q) models in estimating volatility.

Consequently, this paper uses the Black-Scholes model with GARCH(1,1) volatility to calculate theoretical price and then examine the overpricing of derivative warrants.

Black-Scholes Option Pricing Model

Option pricing model uses to theoretically value an option. It provides the fair value of options that issuers or traders apply it for creating investment strategy. There are a lot of option pricing model, but the commonly used option pricing model is *Black-Scholes model*.

Black-Scholes model is a mathematical model used to determine the theoretical price for call or put options based on following variables, namely current stock price (S), strike price (K), annual volatility of underlying return (σ), risk-free rate (r), and time-to-maturity (in year) (T). The Black-Scholes formula for call option is

$$C(S,K,\sigma,r,T) = SN(d_1) - Ke^{-rT}N(d_2) \tag{2.1}$$

where

$$d_1 = \frac{\ln\left(\frac{S}{K}\right) + \left(r + \frac{1}{2}\sigma^2\right)T}{\sigma\sqrt{T}} \tag{2.2a}$$

$$d_2 = d_1 - \sigma\sqrt{T} \tag{2.2b}$$

Similar to the Equation (2.1), the Black-Scholes formula for put option is shown in the following equation:

$$P(S,K,\sigma,r,T) = Ke^{-rT}N(-d_2) - SN(-d_1) \tag{2.3}$$

The function $N(x)$ in the equations is the cumulative distribution function of the standard normal distribution (McDonald, 2013a). Moreover, there are a number of assumptions hold under the Black-Scholes model, as follow:

- Markets are efficient and there is no arbitrage opportunity.
- There is no transaction cost.
- The option is European style which can only be exercised at its maturity.
- The stocks do not pay any dividends during the life of option.
- The returns on the underlying are normally distributed and independent overtime.
- The risk-free rate and volatility of the underlying are known and constant.

With regard to the 5 inputs of the Black-Scholes model, all of them can be directly observed, except volatility. As volatility is unobservable, traders usually use *Implied Volatility* to monitor the expected volatility of a stock. It is volatility implied by option prices observed in the market (Hull, 2018). Implied volatility is directly influenced by demand and supply of the underlying options and by the expectation of the direction of the share price. For example, as expectation or the demand for options increase, implied volatility will increase, resulting in higher option premium. Implied volatility can be calculated by solving σ from the Black-Scholes formula mentioned previously.

GARCH (Generalized Autoregressive Conditional Heteroscedasticity) Model

GARCH model is the widely used method to model and forecast volatility of financial time series, such as stock return, interest rates, and foreign exchange rate. It is an extension of the ARCH model by allowing the volatility to depend on its history. If return is modeled as

$$y_t = a_0 + \beta x_t + \varepsilon_t \tag{2.4}$$

The GARCH (p, q) model is

$$h_t = \alpha_0 + \sum_{i=1}^{q} \alpha_i \varepsilon_{t-i}^2 + \sum_{j=1}^{p} \beta_j h_{t-j} \tag{2.5}$$

where h_t is the conditional variance, ε_t is the residual return, p is the order of the GARCH (lagged volatility) terms, and q is the order of the ARCH (lagged squared error) terms. All coefficients in the equation are restricted to be positive in order to ensure that the variance is always positive. This model shows that volatility at a point in time depends upon recent volatility and recent squared returns (McDonald, 2013b).

CONCLUSION OF LITERATURE REVIEW

All literatures are the guideline to develop this research topic. The literatures come from many sources such as articles and related research papers. The empirical studies provide the evidence that derivative warrants are inefficiently priced and tend to be overpriced in many countries. Most of literatures investigate the derivative warrant mispricing based on the Black-Scholes model. Other pricing model is also employed to examine the pricing efficiency of derivative warrant and the results show that derivative warrants are mispriced whether using the Black-Scholes model or using other pricing models.

Numerous literatures reveal that the overpricing phenomenon may be occurred from imperfect market or uninformed investors and can be explained through such as liquidity, volatility, hedging activity, market power, investors' perceptions. It implies that the overpricing level is affected by both macro (e.g., changing in regulation) and micro (e.g., derivative warrant contract specification and issuer's characteristics) factors. Some explanations seem to be related to the issuer of derivative warrants. The issuers commonly have an incentive to encourage trading in their derivative warrants in order to be able to create and place further derivative warrants issues with their consumers as well as provide liquidity to their clients. Therefore, it is interesting to examine whether the issuer has any effect on the derivative warrant overpricing. However, there are a few literatures study about the issuer effect on the overpricing of derivative warrants in Thailand and none of them study the impact of macro factors on the overpricing phenomenon. As the derivative warrant market is dominated by individual investors, some proxies of issuer characteristics applied in the existing literatures seem difficult to access for individual investors and some proxies are limited to only listed issuers while issuers in Thailand now are both listed and unlisted companies.

As a result, this paper aims to contribute the existing papers in Thailand by testing whether the identity of issuer has any influence on the overpricing phenomenon as well as explain the rationale behind the phenomenon by applying the proxies of issuer's characteristics that accessible for retail investors. This paper also examines the effect of the underlying market conditions and the SEC revised disclosure regulation on the overpricing phenomenon because one of the causes of this phenomenon is uninformed investors and SEC try to reduce this cause by revising the disclosure regulation of factsheet to be concise, easy to understand, consistent with investors' behavior, and comply with international standard. Finally, almost literatures in Thailand study the overpricing of derivative warrants based on the Black-Scholes model. The model assumes volatility to be constant over the option's life, but it in fact fluctuates depending on demand and supply. As volatility plays an important role in investment because it is a measure of risk, this paper therefore examines the overpricing phenomenon by using Black-Scholes model with GARCH volatility.

CHAPTER 3 HYPOTHESES

RESEARCH OBJECTIVE

Although derivative warrant market in Thailand has grown up every year and derivative warrants are popular among retail investors, it is found that the derivative warrants are overpriced and most of investors often lose from investing in derivative warrants. The prior studies reveal that the overpricing phenomenon is related to issuers and behavior preferences of investors. Issuers normally try to encourage investors to trading their derivative warrants because many investors concern about liquidity risk and can be attracted by derivative warrant’s volume. It is interesting to study about how issuer affect the overpricing level. As this overpricing phenomenon is also concerned by SEC and they found that providing basic knowledge and disclosing important information may improve investors’ understanding and reduce the investors’ overestimation, they try to reduce this phenomenon by adjusting the disclosure regulation of factsheet to be concise, easy to understand, consistent with investors’ behavior, and comply with international standard. As a result, this paper aims to examine the issuer effect on derivative warrant overpricing in Thailand and explain what cause the size of overpricing differ across issuers by using issuer’s characteristics which retail investors are accessible and easily to understand as well as investigate the impact of the adjusted regulation and the underlying market conditions on the changing nature of the overpricing phenomenon. This paper tries to answer the following questions:

- Are Thai derivative warrants overpriced?
- Does the SEC revised disclosure regulation reduce the derivative warrant overpricing?
- Do the market conditions affect the derivative warrant overpricing?
- What issuer’s characteristic can be related to derivative warrant overpricing?

HYPOTHESIS DEVELOPMENT

To answer the research questions, this paper assumes that the overpricing of derivative warrant is existing and the hypotheses are formulated, as follow:

Hypothesis 1: *The market price of derivative warrant is higher than its theoretical price.*

The difference between the theoretical value and the market value of a financial instrument is important in financial market. It drives a lot of trading that occurs. The market price reflects a price that set by market maker and beaten by investors while the theoretical price provides a fair value of option. The theoretical price is calculated from option pricing model to estimate the probability that an option will be exercised, or be in-the-money (ITM), at expiration. According to the Efficient Market Hypothesis (EMH), the market cannot be beaten because it reflects all information into stock prices, so stocks are traded at fair price. Underpriced or overpriced are mispricing. When the investors think that the market value is higher than the theoretical price, they will expect that the market value will drop to reflect the overvaluation.

Hypothesis 1.1: *The revised disclosure regulation from SEC leads to lower overpricing level of derivative warrants.*

SEC revealed that derivative warrant becomes more popular in Thai market. Most of investors often lose from investing in derivative warrants and the profit is concentrated with market makers and a few investors. SEC also found that providing sufficient information about derivative warrants may enhance the investors' understanding about derivative warrants and provide more investment choices to investors. (The Securities and Exchange Commission Thailand, 2017). SEC revised the disclosure regulation of factsheet to be concise, easy to understand, consistent with investors' behavior, and comply with international standard, starting on September 16, 2019. (The Securities and Exchange Commission Thailand, 2019). As Thai financial market is dominated by individual investors who might be uninformed and the overpricing of derivative warrant is occurred from uninformed investors' action that beat the market price and drive the gap between market price and the theoretical price up, the disclosure regulation may help them to understand more about the nature of derivative warrants, leading to have more investment choices. Investor's decision will not depend only on trends or acquaintance's recommendations, so the huge demand for some derivative warrants will not occur and drive the market price up dramatically. Therefore, the overpricing level will be lower after the revised disclosure regulation announced.

Hypothesis 1.2: *Call derivative warrants are more overpriced in the bull market and put derivative warrants are more overpriced in the bear market.*

Call derivative warrant provides a right to buy the underlying asset and its price will follow to the underlying price. It offers an opportunity to earn more if the value of the underlying asset continues to go up, so it is appropriate for investors who have bullish expectations on the underlying asset. In the bull market, higher demand for the call derivative warrants will drive the market price to go up. The widen gap between the market price and the theoretical price reflects higher level of the call derivative warrant overpricing.

Put derivative warrant provides a right to sell the underlying asset and its price moves in the opposite direction with the underlying price. It is generally chosen by investors with a bearish expectation on the underlying asset as it provides opportunity to get more earning if the value of the underlying asset continues its downward trend. In the bear market, higher demand for the put derivative warrants will drive the market price to go up. The widen gap between the market price and the theoretical price reflects higher level of the put derivative warrant overpricing.

Hypothesis 2: *The overpricing level of derivative warrants is driven by specific characteristics of issuers.*

According to the existing literatures, the explanations of derivative warrant overpricing are related to the issuers. For example, the size of liquidity premium seems to be related to the identity of issuer because issuers with larger market share should be able to provide more liquidity. The higher price of derivative warrants may reflect the ability of issuers to transfer the cost of carrying hedging position to investors. Issuers with higher profile or good brand image may be able to attract investors to pay higher premium (Loudon & Nguyen, 2006).

Additionally, theoretical price of derivative warrant depends on many variables, such as volatility of underlying and assumed interest rate. Different issuer employs different assumptions to set the theoretical price and has different style of issuing derivative warrants. For example, in Thailand, derivative warrant from BLS[1] has high liquidity, low effective gearing, and covering all underlying asset while derivative warrant from KS[2] has low time decay, so investor can hold derivative warrant longer than other companies (Wealthythai, 2019).

In order to explain the rationale behind the issuer effect on the derivative warrant overpricing, this paper takes characteristics of issuers into considerations and set sub-hypotheses, as follow;

Hypothesis 2.1: *The overpricing level of derivative warrants is different across issuers.*

Derivative warrants are financial products favored by many individual investors and Horst and Veld (2008) reveal that the overpricing of warrants compared with matched options is related to a combination of financial marketing and framing. Issuers advertise investing in warrants by creating a different image for warrants compared with options. As a result, branding and marketing action of issuers have an important role in competition among issuers in derivative warrant market. Issuers try to establish a different image of their warrant compared to other issuers in order to attract investing in their derivative warrants. For example, in Thailand, derivative warrant from BLS has high liquidity, low effective gearing, and covering all underlying asset while derivative warrant from KS has low time decay, so investor can hold derivative warrant longer than other companies (Wealthythai, 2019). Issuers with good brand image and effective marketing actions can require higher price premium because investors believe that their

[1] Bualuang Securities Public Company Limited
[2] Kasikorn Securities Public Company Limited

derivative warrant series have higher quality, regardless of actual quality differentiation. Therefore, the overpricing level of derivative warrants is different across issuers.

Hypothesis 2.2: *There is a positive relationship between derivative warrant overpricing level and market share of issuer.*

Market share is a percentage of total sales in an industry generated by a specific company. It reflects the consumers' preference for its product over its competitors. High maker share implies good reputation of the company which can help to increase sales and customer bases. Moreover, high market share implies that the company dominates over the industry and has higher bargaining power which helps it to negotiate to its advantage and distribution channel members.

One of the factors that investors care when investing in derivative warrant is liquidity. Investors try to avoid liquidity risk, risk that investors are not able to sell derivative warrant at desirable price due to the lack of liquidity. Issuer with higher market share is able to provide more liquidity to investors and can require a higher price of derivative warrants. Therefore, market share of issuer is positively related to the overpricing of derivative warrants.

Hypothesis 2.3: *There is a positive relationship between derivative warrant overpricing level and credit rating of issuer.*

One of the risks of derivative warrants is credit risk, the risk that issuer may not be able to paying cash settlement or fails to comply fully with its obligations under the terms and conditions. Therefore, investors should take credit rating of issuer into consideration. Credit rating is an evaluation of credit quality of a debt instrument. Because investors view low credit rating as high credit risk, they demand more price discount to compensate higher risk. Consequently, credit rating has positive relationship with the overpricing level of derivative warrants.

Hypothesis 2.4: *Derivative warrant issued by foreign issuers has higher overpricing level than derivative warrant issued by domestic issuers.*

In investors' view, derivative warrants issued by foreign issuers tend to be more expensive than derivative warrants issued by domestic issuers because the foreign issuers have to incur higher cost to operate in domestic market and they may have an incentive to pass on this cost into derivative warrant pricing. Therefore, derivative warrant issued by foreign issuers is more expensive than derivative warrant issued by domestic issuers.

Hypothesis 2.5: *Different style of calculating time decay causes the degree of overpricing different across issuers.*

Since derivative warrants have limited life, one of the factors that investors should concern when investing in derivative warrant is time decay. In general, issuers have estimated and displayed time decay in their website for helping investors consider the decreasing rate of derivative warrant value with respect to the passage of time (i.e., cost of holding derivative warrants), but different issuer has different way to calculate time decay. Some issuers calculate time decay based on trading days while some issuers compute time decay based on calendar days. Within a week, time value of derivative warrant that time decay calculated based on trading days will decline more than time value of derivative warrant that time decay calculated based on calendar days. A week passed, time decay calculated by both ways are equal. Investors should understand the style of calculating time decay and make investment decision based on their holding period (KGI DW13 Thaiwarrant, 2020). For example, investor who wants to hold derivative warrant for a short time is suitable for derivative warrants from issuer who calculates time decay based on calendar day while investor who prefer to buy derivative warrant on Friday and sell it on Monday is better to choose derivative warrants from issuer who calculates time decay based on trading day.

As Horst and Veld (2008) reveal that the overpricing of warrants relative to matched options can be attributed to a combination of issuer's marketing and the framing effect and it can say that the style of calculating time decay is one of the advertising strategies of issuer which issuer who calculates time decay based on trading day commonly tries to create an image for their derivative warrants different from derivative warrant from other issuers, especially during long weekend, the individual investors, who favor the derivative warrants and misunderstand about time decay, may believe in the advertisement and invest in derivative warrants that mismatch with their investment style. For instance, investors who prefer to hold derivative warrants during weekend have to incur more time decay if their derivative warrants calculated time decay based on calendar day. This action will widen a gap between the market price and theoretical price. Therefore, different way of calculating time decay causes different level of overpricing across issuers.

Figure 2 The Advertisement of the Style of Calculating Time Decay

Source: Facebook of DW19, 2018 Source: Facebook of DW06, 2020

CHAPTER 4 METHODOLOGY

To investigate the derivative warrant overpricing and the rationale behind this phenomenon, this chapter represents the data collection and methodology employed to carry out this study.

DATA

Generally, the price of SET50 derivative warrant is not based directly on the SET50 index, but it is based on the SET50 index futures traded on TFEX which are the result of the actual trading of all groups of investors, have high liquidity, and their price will go up and down all the time Therefore, the price of SET50 derivative warrants which based on the SET50 index futures reflects the actual trading and investors' view better than stock derivative warrants (KGI Securities (Thailand) PCL., 2021). Moreover, monthly trading value of index derivative warrants are typically greater than security derivative warrants, shown in Figure 3. Consequently, this paper focuses on SET50 derivative warrants traded on the Stock Exchange of Thailand (SET) and captures the daily data for the period of April 2014 to October 2020 covered the first time that SET50 derivative warrants were introduced in Thai market.

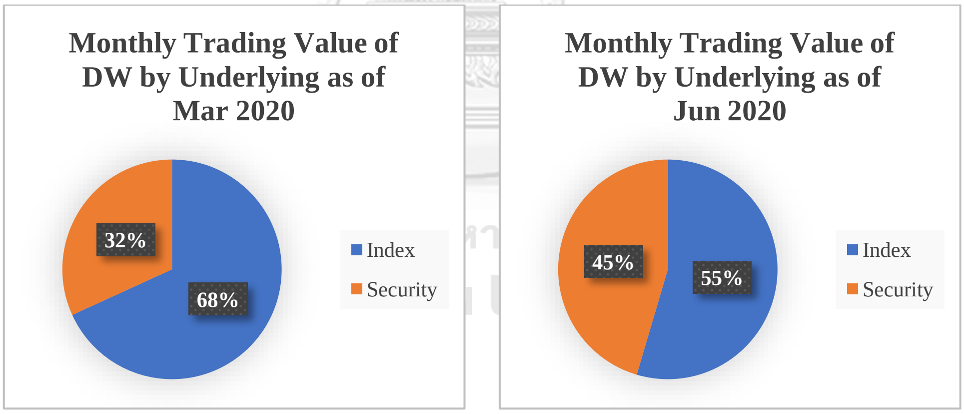

Figure 3 Monthly Trading Value of Derivative Warrant by Underlying

Source: The Stock Exchange of Thailand, 2020

The data employed in this study are divided into 4 main groups. The first group is derivative warrants. The data is collected from SETSMART with the following exclusion criteria:

1. Derivative warrants with no trading volume are excluded.
2. Derivative warrants with less than 5 trading days to maturity are excluded to reduce the impact of liquidity and market microstructure concerns because investors rarely trade derivative warrants when the derivative

warrants get close to the expire date. Specifically, Thai derivative warrants stop to trade 3 trading days before expired date.

3. Derivative warrants that absolute value of delta lower than 20 percent are excluded in order to avoid deep out-of-money which its price does not follow the underlying asset (Macquarie Group Limited, n.d.). In addition, some issuers guarantee to buy some out-of-money derivative warrants back at 0.01 baht and some issuers guarantee to buy all out-of-money derivative warrant at 0.01 baht. This may cause the price of derivative warrant extremely higher than its actual value.

4. Derivative warrants that bid-ask spread is lower than zero are excluded because negative bid-ask spread is an unusual situation that hardly occurred in the advance of electronic trading. This situation may temporarily occur when either extremely fast trading conditions in volatile markets or extremely slow movement in illiquid markets.

Issuer Number	**Issuer Symbol**	**Issuer Company**	**Number of Derivative Warrants**		
			Call	**Put**	**Total**
8	ASPS	Asia Plus Securities Company Limited	15	11	26
1	BLS	Bualuang Securities Public Company Limited	141	137	278
24	FSS	Finansia Syrus Securities Public Company Limited	14	10	24
41	JPM	JPmorgan Securities (Thailand) Limited	31	29	60
13	KGI	KGI Securities (Thailand) Public Company Limited	108	91	199
6	KKPS	Kiatnakin Phatra Securities Public Company Limited	43	42	85
11	KS	Kasikorn Securities Public Company Limited	2	3	5
28	MACQ	Macquarie Securities (Thailand) Limited	97	78	175
42	MBKET	Maybank Kim Eng Securities (Thailand) Public Company Limited	1	1	2
16	TNS	Thanachart Securities Public Company Limited	11	9	20
19	YUANTA	Yuanta Securities (Thailand) Company Limited	14	12	26
		Total	477	423	900

Table 1 SET50 Derivative Warrant Issuers

The final sample consists of 900 SET50 derivative warrants which issued by 11 issuers. It includes daily closing price, last bid and ask prices, trading volume, and other contract specifications such as maturity, strike price, and exercise ratio. The second group is the underlying asset which is SET50 index. The data is also obtained from SETSMART and captures between November 2011 and October 2020. It includes daily closing prices. The third thing is issuers of derivative warrants. Currently, there are 13 issuers[3]of derivative warrants in Thai financial markets, but this paper focuses only on 11 issuers who issued SET50 derivative warrants, as shown in Table 1. All of them are securities companies approved by Securities & Exchange Commission (SEC). The data includes credit rating which obtained from the website of TRIS rating, Fitch ratings and SETSMART as well as financial statement which obtained from the website of SEC. Last, risk-free rate is collected from the website of ThaiBMA as 1-year Thai Government Bond Yield.

The data description is represented in Table 2 and divided into 3 groups, namely the data that used to examine the derivative warrant mispricing, the data that used to calculate the theoretical price, and the data that used in regression model. The descriptive statistics of data that used in regression model is illustrated in Table 3. The table reports the mean, median, standard deviation, minimum value, and maximum value for describing the distribution of the variables. The first variable is the percentage overpricing level. It shows that, on average, the derivative warrants are overpriced with the mean of 30.08 percent. Its standard deviation is high, implying that the data points are spread out over a large range of values. Second, the table shows that the debt-to-equity ratio is positively skewed with the mean of 1.45 and the median of 0.99. The third variable is bid-ask spread. It is also positively skewed with the mean of 0.03 and the median of 0.01. Next, trading volume shows that the derivative warrants are active. 0.57 hundred million derivative warrants are traded on average. The table shows that derivative warrants are in-the-money with the mean of 2.68 percent and derivative warrants are expected to be short-term options with 67 days to maturity on average. Sixth, the volatility of underlying asset is also positively skewed. Its average value is equal to 15.73 percent and its median value is equal to 13.51 percent. The seventh variable is delta. It is negatively skewed with the mean of 3.61 percent and the median of 22.15 percent. Its high standard deviation implies that the data is widely spread. The last variable is multiplier. It has very low standard deviation, implying that the data points are very close to the mean which is equal to 0.02 THB per index point.

[3] As of October, 29 2020

Panel A: To Examine the Mispricing of Derivative Warrant			
Notation	**Unit**	**Description**	**Source/Calculation**
$\%Overpricng$	Percent	The overpricing of derivative warrant	The data is calculated by using the following formula: $\%Overpricng = \ln\frac{P_i}{\hat{P}} \times 100$
P_i	THB	The market price of derivative warrant	The data is collected from the closing price of SET50 derivative warrant and obtained from SETSMART.
$\hat{P}$	THB	The theoretical price of derivative warrant	The data is calculated from the Black-Scholes model. $C(S,K,\sigma,r,T) = SN(d_1) - Ke^{-rT}N(d_2)$ $P(S,K,\sigma,r,T) = Ke^{-rT}N(-d_2) - SN(-d_1)$ where $d_1 = \frac{\ln\left(\frac{S}{K}\right)+\left(r+\frac{1}{2}\sigma^2\right)T}{\sigma\sqrt{T}}$ $d_2 = d_1 - \sigma\sqrt{T}$
Panel B: To Calculate the Theoretical Price of Derivative Warrant			
Notation	**Unit**	**Description**	**Source/Calculation**
S	THB	The price of underlying stock (i.e., The current price of SET50)	The data is obtained from SETSMART.
K	THB	The strike price	The data is obtained from SETSMART.
σ		The annual volatility of underlying return	The data is calculated from GARCH(1,1) model. The daily conditional variance was estimated using rolling estimation method which chooses data from 600 historical trading days, and then turn into the annual volatility by using the following formula: $\sigma = \sqrt{252} \times \sqrt{h_t}$ where h_t is the daily conditional variance.
r	Percent	The risk-free rate (i.e., 1-year Thai Government Bond Yield)	The data is obtained from ThaiBMA.
T	Year	Time-to-maturity	The data is obtained from SETSMART.

Table 2 Data Description

Panel 3: Regression Analysis			
Notation	**Unit**	**Description**	**Source/Calculation**
$Issuer_i$		Dummy variables for each issuer	$Issuer_i = \begin{cases} 1 \; for\ issuer\ i \\ 0 \; for\ other\ issuer \end{cases}$
$RANK_{it}$		Rank of issuer's market share (YTD) by trading value	The trading value is collected from SETSMART and then the market share of issuer is calculated in monthly basis by using the following formula: $MKTSHARE = \frac{Total\ Trading\ Value\ of\ the\ Issuer}{Total\ Trading\ Value\ of\ the\ Market} \times 100$ Note: Issuer with the biggest market share is ranked the first, and so on.
$FOREIGN_{it}$		Dummy variable for foreign issuer	$FOREIGN_{it} = \begin{cases} 1 \; for\ foreign\ issuer \\ 0 \; for\ domestic\ issuer \end{cases}$
CR_{it}		Dummy variable of credit rating	Credit rating of issuer is collected from the website of TRIS rating, Fitch ratings and SETSMART. $CR_{it} = \begin{cases} 1 \; for\ issuer\ with\ credit\ rating\ higher\ than\ class\ A \\ 0 \; for\ issuer\ with\ credit\ rating\ equal\ or\ lower\ than\ class\ A \end{cases}$ Note: The class of credit rating will change when the company's credit rating is upgraded or downgraded.
DE_{it}		Debt-to-equity ratio (semiannually)	The data is calculated by using the following formula: $DE_{it} = \frac{Total\ Liabilities}{Total\ Equity}$
TD_{it}		Dummy variable style of calculating time decay	The data is obtained from the issuer's website. $TD_{it} = \begin{cases} 1 \; for\ issuer\ who\ compute\ time\ decay\ based\ on\ calendar\ day \\ 0 \; for\ issuer\ who\ compute\ time\ decay\ based\ on\ trading\ day \end{cases}$
$SPREAD_{it}$	THB	Bid-ask spread	The last bid and ask prices are obtained from SETSMART and the bid-ask spread is calculated by using the following formula: $SPREAD = Ask\ Price - Bid\ Price$

Table 2 Data Description (Continued)

Panel 3: Regression Analysis (Continued)			
Notation	**Unit**	**Description**	**Source/Calculation**
$VOLUME_{it}$	Hundred million derivative warrant	Trading volume	The data is obtained from SETSMART.
$MONEY_{it}$	Percent	Moneyness	The data is calculated by using the following formula: $Moneyness = \begin{cases} \frac{S-K}{K} \times 100 \; for\ call\ derivative\ warrants \\ \frac{K-S}{K} \times 100 \; for\ put\ dericative\ warrants \end{cases}$
T_{it}	Day	Time-to-maturity	The data is calculated by using the following formula: $T_{it} = Expired\ date - Working\ date$
$VOLATILITY_{it}$	Percent	Historical volatility of underlying asset calculated by 91 historical trading days	The data is calculated by using the following formula: $VOLATILITY = \sqrt{\frac{1}{n-1}\sum_{i=1}^{n}(u_t - \bar{u})^2} \times 100$ where u_t is return of underlying asset which calculated by $u_t = \ln \frac{S_t}{S_{t-1}}$.
$DELTA_{it}$	Percent	Delta	The data is based on the Black-Scholes model and calculated by using the following formula: $Delta = \begin{cases} e^{-\delta T} \times N(d_1) \times 100 \; for\ call\ derivative\ warrants \\ e^{-\delta T} \times [N(d_1) - 1] \times 100 \; for\ put\ derivative\ warrants \end{cases}$ where $d_1 = \frac{\ln\left(\frac{S}{K}\right) + \left(r - \delta + \frac{1}{2}\sigma^2\right)T}{\sigma\sqrt{T}}$.
$MULTIPLIER_{it}$	THB/Index Point	Multiplier of derivative warrant	The data is obtained from SETSMART.

Table 2 Data Description (Continued)

	Mean	Med	SD	Min	Max
%Overpricing (Unit: Percent)	30.0832	35.3209	61.9463	-620.1483	261.9679
D/E Ratio	1.4450	0.9937	0.8744	0.2294	4.4187
Bid-Ask Spread (Unit: THB)	0.0287	0.0100	0.2496	0.0000	25.7500
Trading Volume (Unit: Hundred Million DW)	0.5736	0.1552	1.2186	0.0000	21.8391
Moneyness (Unit: Percent)	2.6827	1.7878	7.7522	-41.3733	46.3471
Time-to-Maturity (Unit: Day)	67.0826	63.0000	38.7105	5.0000	392.0000
Volatility (Unit: Percent)	15.7264	13.5099	9.6710	4.6690	49.5034
Delta (Unit: Percent)	3.6102	22.1485	68.3207	-100.0000	100.0000
Multiplier (Unit: THB/Index Point)	0.0194	0.0161	0.0116	0.0030	0.1148

Table 3 Descriptive Statistics

Additionally, to ensure that there is no multicollinearity problem, the correlation analysis between each variable is conducted. In statistics, multicollinearity is an event that some independent variable is a linear combination of other independent variables and can lead to a misleading result. The correlation metric is reported in Table 4.

	Mispricing	Issuer A	Issuer B	Issuer C	Issuer D	Issuer E	Issuer F	Issuer G	Issuer H	Issuer I	Issuer J
Mispricing	1										
Issuer A	-0.0099	1									
Issuer B	-0.1080	-0.1114	1								
Issuer C	-0.0732	-0.0189	-0.1143	1							
Issuer D	0.0570	-0.0281	-0.1699	-0.0288	1						
Issuer E	0.0126	-0.0715	-0.4323	-0.0733	-0.1090	1					
Issuer F	0.0322	-0.0468	-0.2834	-0.0481	-0.0715	-0.1819	1				
Issuer G	0.0163	-0.0075	-0.0451	-0.0077	-0.0114	-0.0289	-0.0190	1			
Issuer H	0.1544	-0.0581	-0.3516	-0.0596	-0.0887	-0.2256	-0.1479	-0.0235	1		
Issuer I	0.0094	-0.0026	-0.0156	-0.0026	-0.0039	-0.0100	-0.0066	-0.0010	-0.0081	1	
Issuer J	-0.0718	-0.0145	-0.0877	-0.0149	-0.0221	-0.0563	-0.0369	-0.0059	-0.0458	-0.0020	1
Issuer K	-0.0727	-0.0221	-0.1339	-0.0227	-0.0338	-0.0859	-0.0563	-0.0090	-0.0699	-0.0031	-0.0174
Rank	0.0149	0.1328	-0.5792	0.4099	0.1083	-0.2224	0.6181	0.1449	0.1326	0.0711	0.1881
CR	-0.1044	-0.1285	0.8666	-0.1319	0.2185	-0.4989	-0.3271	0.0580	-0.4057	0.0200	-0.1012
DE	0.1182	-0.0923	-0.6854	-0.0814	-0.1739	0.2205	0.4454	-0.0592	0.4135	0.0267	-0.0186
Foreign	0.1230	-0.1201	-0.7269	-0.1233	0.2338	0.5948	-0.3058	-0.0486	0.4837	0.0214	-0.0946
TD	0.1263	-0.1185	-0.7168	0.1595	0.2371	0.6031	-0.3015	-0.0480	0.4905	0.0217	-0.0933
Spread	-0.0391	0.0609	-0.0312	0.0240	-0.0014	0.0047	-0.0060	-0.0012	-0.0225	-0.0014	0.0357
Volume	0.1079	-0.0488	-0.0683	-0.0560	0.0328	0.2552	-0.1468	-0.0193	-0.0202	-0.0079	-0.0330
Money	-0.0057	-0.0478	0.2865	-0.1109	-0.1044	-0.0466	-0.0875	-0.0224	-0.1163	-0.0094	-0.0205
T	0.0885	-0.0217	-0.1221	0.0292	0.0144	-0.0305	0.2213	-0.0196	-0.0232	0.0299	0.0583
Volatility	-0.2638	-0.0295	-0.1598	0.0710	0.1769	-0.0369	-0.0098	-0.0107	0.0424	0.0039	0.0582
Delta	-0.0687	0.0186	-0.0180	-0.0060	-0.0100	0.0156	0.0117	-0.0135	0.0239	0.0011	-0.0410
Multiplier	-0.0590	0.1618	-0.2857	0.2724	0.1019	0.0902	0.0197	0.0157	-0.0034	-0.0164	0.0780

Table 4 The Correlation Metric between each Variable

	Issuer K	Rank	CR	DE	Foreign	TD	Spread	Volume	Money	T	Volatility
Issuer K	1										
Rank	0.0800	1									
CR	0.1722	-0.4818	1								
DE	0.1310	0.4273	-0.7062	1							
Foreign	0.1842	-0.0164	-0.5670	0.4581	1						
TD	-0.1424	0.0709	-0.6596	0.3945	0.9087	1					
Spread	0.0540	0.0511	-0.0142	-0.0223	0.0041	-0.0065	1				
Volume	-0.0427	-0.1515	-0.0700	0.0586	0.1963	0.1950	-0.0327	1			
Money	-0.0400	-0.2507	0.2244	-0.1685	-0.1785	-0.1965	0.1013	-0.1991	1		
T	0.0189	0.2014	-0.1093	0.0876	-0.0293	-0.0274	-0.0306	0.0028	-0.2102	1	
Volatility	0.2187	0.1613	-0.0181	-0.0424	0.1412	0.0909	0.1600	-0.0918	-0.1108	0.0608	1
Delta	-0.0280	-0.0121	-0.0320	0.0250	0.0174	0.0248	-0.0708	0.0172	-0.0077	0.0179	-0.0814
Multiplier	0.0648	0.3018	-0.2184	0.1114	0.1333	0.1879	0.1712	0.1772	-0.3678	-0.0136	0.1497

	Delta	Multiplier
Delta	1	
Multiplier	-0.0913	1

Table 4 The Correlation Metric between each Variable (Continued)

METHODOLOGY

According to the Efficient Market Hypothesis (EMH), prices fully and instantaneously reflect all information. Securities always trade at their fair value. To examine the overpricing of derivative warrants, this paper employs the simplest method which is comparing the market price with theoretical price. To compute theoretical price, the GARCH(1,1) model is employed to estimate the volatility. The model is shown in Equation (4.1). The estimated volatility is calculated by using the rolling window method with a size of 600 trading days each because the academic researches usually use more than 500 data points for constructing the GARCH(1,1) model, for example, Zhu (2018) uses the rolling estimation method with 600 trading days before every prediction interval to construct the GARCH(1,1) model and Costa (2017) uses 3 different estimation windows, namely 500 days, 1000 days, and 2000 days to estimate the conditional volatility in order to account for non-constant parameters and reduce the risk of structural changes. Then, the estimated volatilities are applied to calculate theoretical price based on Black-Scholes option pricing model by using the Equation (2.1) and (2.3), and then comparing the theoretical price with market value of derivative warrant.

$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1} \tag{4.1}$$

where h_t is the conditional variance and ε_t is the residual return.

$$C(S, K, \sigma, r, T) = SN(d_1) - Ke^{-rT}N(d_2) \tag{2.1}$$

$$P(S, K, \sigma, r, T) = Ke^{-rT}N(-d_2) - SN(-d_1) \tag{2.3}$$

To make the derivative warrant overpricing be normally distributed, the overpricing is calculated by using the following formula:

$$\%Overpricng = \ln \frac{P_i}{\hat{P}} \times 100 \tag{4.2}$$

where P_i indicates market price of derivative warrant and $\hat{P}$ represents theoretical price of derivative warrant derived from Equations (2.1) and (2.3).

In order to explain the overpricing phenomenon, this paper aims to investigate the impact of issuer on derivative warrant overpricing. Both univariate and regression analyses are conducted in this paper.

Univariate Analysis

The univariate analysis is employed to examine the effect of the SEC revised disclosure regulation and the underlying market conditions on the changing nature of derivative warrant overpricing as well as document the simple relationship between overpricing of derivative warrants and the issuer's characteristics. Difference between mean is used to examine the impact of the revised disclosure regulation and market conditions on the changing nature of derivative warrant overpricing as well as measure the absolute difference between the mean value of overpricing across 10 derivative warrant issuers, foreign and domestic issuers, credit rating of issuers, and market share of issuers. T-test is applied to test difference between 2 means and F-test is employed to analyze difference between 3 or more means. The hypotheses of each group are shown below;

- To Examine the Changing Nature of Derivative Warrant Overpricing
  - The SEC Revised Disclosure Regulation

    H_0: $\mu_{before} = \mu_{after}$ where μ_i is the mean value of overpricing level before and after the announcement of the SEC revised disclosure regulation

    H_1: $\mu_{before} \neq \mu_{after}$
  - The Underlying Market Conditions

    H_0: $\mu_{bull} = \mu_{bear}$ where μ_i is the mean value of overpricing level in the bull and bear markets

    H_1: $\mu_{bull} \neq \mu_{bear}$
- To Investigate the Simple Relationship Between Overpricing of Derivative Warrants and the Issuer's Characteristics
  - Issuers of Derivative Warrant:

    H_0: $\mu_A = \mu_B = \cdots = \mu_K$ where μ_i is the mean value of overpricing level of issuer i

    H_1: At least one of the means is different.
  - Foreign and Domestic Issuers

    H_0: $\mu_F = \mu_D$ where μ_i is the mean value of overpricing level of foreign (F) and domestic (D) issuers

    H_1: $\mu_F \neq \mu_D$
  - Credit Rating of Issuers:

    H_0: $\mu_{AA} = \mu_A = \mu_B$ where μ_i is the mean value of overpricing level of Class AA, A and B credit rating of issuers

    H_1: At least one of the means is different.
  - Market Share of Issuers:

    H_0: $\mu_S = \mu_L$ where μ_i is the mean value of overpricing level of small (S) and large (L) market share of issuers

    H_1: $\mu_S \neq \mu_L$

Regression Analysis

The pooled OLS regression analysis is used to examine the effect of issuer on derivative warrant overpricing while controlling other determinants of derivative warrant overpricing. According to the prior literatures, the overpricing level can be explained through liquidity premium. Therefore, bid-ask spread is used as a proxy of liquidity. As another explanation of the overpricing phenomenon is related to the hedging cost incurred by issuers, volatility and delta are included as indicators of hedging difficulty. Finally, moneyness, multiplier, and time-to-maturity are included to control differences in derivative warrant's characteristics. In Model 1, the percentage of derivative warrant overpricing is considered as dependent variable whereas independent variables include identity of issuer and other determinants of derivative warrant overpricing which applied as control variables. The regression model is shown below;

Model 1 Testing the Impact of Identity of Issuer on Derivative Warrant Overpricing

$$\begin{aligned}\%Overpricing_{it} &= \beta_0 + \beta_1 ISSUER_{A_{it}} + \cdots + \beta_{10} ISSUER_{J_{it}} + \beta_{11} SPREAD_{it} \\ &+ \beta_{12} MONEY_{it} + \beta_{13} T_{it} + \beta_{14} VOLATILITY_{it} + \beta_{15} DELTA_{it} \\ &+ \beta_{16} MULTIPLIER_{it} + \varepsilon_{it}\end{aligned} \quad (4.3)$$

where i represents series of derivative warrants.

t denotes working date.

$ISSUER_A$ through $Issuer_J$ are dummy variables for each issuer.

$SPREAD_{it}$ is bid-ask spread of derivative warrant which is a proxy of liquidity.

$MONEY_{it}$ is moneyness of derivative warrant.

T_{it} is time-to-maturity of derivative warrant.

$VOLATILITY_{it}$ is historical volatility of underlying asset calculated by 91 historical trading days.

$DELTA_{it}$ is delta of derivative warrant.

$MULTIPLIER_{it}$ is multiplier of derivative warrant.

According to the findings of Horst and Veld (2002), factors that influenced investors to invest in call options and call warrants are price of the product, risk of the product, publicity in newspapers and magazines, recommendations of acquaintances, and transaction costs. Additionally, based on investment advice websites in Thailand, most investors care about time decay and liquidity when choosing issuers of derivative warrants. Consequently, this paper also takes other characteristics of issuers into consideration. Market share is employed as an indicator of access ability to customers. Credit rating is used as an indicator of default risk of a company. The regression model is shown below;

Model 2 Testing the Impact of Issuer's Characteristics on Derivative Warrant Overpricing

$$\begin{aligned}\%Overpricing_{it} &= \beta_0 + \beta_1 CHARACTER_{it} + \beta_2 SPREAD_{it} + \beta_3 MONEY_{it} + \beta_4 T_{it} \\ &+ \beta_5 VOLATILITY_{it} + \beta_6 DELTA_{it} + \beta_7 MULTIPLIER_{it} + \varepsilon_{it}\end{aligned} \tag{4.4}$$

where $CHARACTER_{it}$ represents the proxies of issuer's characteristic included $RANK_{it}$ denotes rank of issuer's market share which issuer with the biggest market share is classified as the first rank, CR_{it} is a dummy variable of credit rating of issuer and equal to 1 if the credit rating is higher than Class A and a value of 0 otherwise, $FOREIGN_{it}$ is a dummy variable which equal to 1 for foreign issuer and a value of 0 otherwise, TD_{it} is a dummy variable which equal to 1 for issuer who compute time decay only calendar day and a value of 0 otherwise.

As mentioned previously, the SEC announcement of revised disclosure regulation on September 16, 2019 may reduce the uninformed investors which is one of causes of derivative warrant overpricing. Uninformed investors will understand more about the nature of derivative warrants and will not care only branding, marketing action, or recommendations from friends or acquaintances. Thus, the effect of issuer's characteristics may diminish after the announcement. Since the relationship between the overpricing level and the control variables is believed that it will be constant whether before or after the announcement, the dummy variable for after the announcement of revised disclosure rule is interacted with issuer's characteristics to further explore whether the determinants of derivative warrant overpricing changed after the revised rule announced. The regression models are shown in the following equation.

Model 3 Testing the Relationship between Derivative Warrant Overpricing and Issuer's Characteristics Responded to the Announcement of New Rule

$$\begin{aligned}\%Overpricing_{it} &= \beta_0 + \beta_1 CHARACTER_{it} + \beta_2 SPREAD_{it} + \beta_3 MONEY_{it} + \beta_4 T_{it} \\ &+ \beta_5 VOLATILITY_{it} + \beta_6 DELTA_{it} + \beta_7 MULTIPLIER_{it} \\ &+ \beta_8 CHARACTER_{it} * RULE + \varepsilon_{it}\end{aligned} \tag{4.5}$$

where $RULE$ is a dummy variable that equal to 1 for observations after the disclosure rule announced.

Finally, this paper also performs robustness check in order to make sure that the regression models are robust by changing proxy of default risk from credit rating to debt-to-equity ratio (DE_{it}) as well as switching the liquidity variable from bid-ask spread to trading volume ($VOLUME_{it}$).

CHAPTER 5 RESULTS

This chapter provides the evidence of derivative warrant overpricing. The empirical results are reported in form of table and divided into 3 sections, namely summary statistics, univariate analysis, and regression analysis.

SUMMARY STATISTICS

For the final sample of 900 derivative warrants, there are 38,892 observations which 20,277 observations are for the 477 call derivative warrants and 18,615 observations are for the 423 put derivative warrants. Table 5 reports the summary statistics of the percentage overpricing of derivative warrants. It provides a strong evidence that the derivative warrants tend to be overpriced with the mean of 30.08 percent and the median of 35.32 percent. Considering type of derivative warrants, put derivative warrants have a higher overpricing level than call derivative warrants with the means of 33.69 and 26.97 percent, respectively.

	No. of Observation	Mean	Med	SD	Min	Max
All DW	38,892	30.0832	35.3209	61.9463	-620.1483	261.9679
Call DW	20,277	26.9700	27.4419	72.1172	-620.1483	253.5841
Put DW	18,615	33.6914	43.9034	47.0210	-396.4234	261.9679

Table 5 Summary Statistics of the Overpricing of Derivative Warrants (Unit: Percentage)

UNIVARIATE ANALYSIS

To examine the changing nature of derivative warrant overpricing, Table 6 illustrates the effect of the revised disclosure regulation announcement and the underlying market conditions on the derivative warrant overpricing in panel A and B, respectively. T-test is applied to test difference between two means. The null hypothesis is the difference in group mean is zero. Since mean and median of each group are not equal, median test (Chi-square) is also employed to test the equality of medians. The null hypothesis is the samples were drawn from populations with the same median.

In panel A, it provides an evidence that the pricing error of derivative warrant can be attributed to the announcement of revised disclosure regulation. Overall, the null hypothesis of T-test is rejected at 1 percent significant level, suggesting that the means of both groups are not equal. The means of pricing error are equal to 40.74 percent before the regulation announced and 14.23 percent after the regulation announced. However, when considering the median test, it fails to reject the null hypothesis that the samples were drawn from populations with the same median. This implies that the medians of both groups are not different. The medians of pricing error are equal to 30.06 percent before the rule announced and 30.21 percent after the rule announced.

As for call derivative warrants, the null hypothesis of the T-test is rejected at 1 percent significant level. The mean of pricing error before the announcement is higher relative to after the announcement. Before the announcement, call derivative warrants are overpriced with 35.67 percent on average, but they are underpriced with the mean of 14.81 percent after the announcement. The null hypothesis of the median test is also rejected at 1 percent significant level. However, the median of pricing error of before the announcement is lower than after the announcement with 25.92 and 37.11 percent, respectively.

As regards put derivative warrants, the null hypotheses of the T-test and the median test are rejected at 1 percent significant level. The put derivative warrants before the announcement are more overpriced relative to after the announcement for both mean and median. The means of pricing error are 46.89 percent before the announcement and 34.91 percent after the announcement while the medians of pricing error are 35.57 percent before the announcement and 25.19 percent after the announcement.

Because mean can be skewed due to outliners, median is more appropriate to describe the impact of the announcement of revised disclosure regulation on the overpricing level as median is not affected by outliners. Overall, it can be concluded that the announcement of revised regulation cannot reduce the overpricing phenomenon. When considering each type of derivative warrants, the announcement of revised regulation also cannot reduce the overpricing level of call derivative warrants, but the announcement can diminish the overpricing level of put derivative warrants. Additionally, the skewness of mean may be occurred because the first wave Covid-19 pandemic caused investors slowed down their investment in stocks and derivative warrants, resulting in the extreme underpricing of derivative warrants between March and April 2020 (Prachachat, 2020). This paper also does the univariate analysis excluding the Covid-19 pandemic. The results are reported in Appendix 3 and show that the overpricing level before the announcement is lower than after the announcement. To conclude, the announcement of revised regulation can be related to the overpricing level, but it cannot reduce the uninformed investors who cause the derivative warrant overpricing.

Panel B illustrates the pricing error of derivative warrant across underlying market conditions. The market conditions which shown by closing price of SET50 index are demonstrated in Figure 4. The bear market is shown in the shaded area. The null hypotheses of the T-test and the median test are rejected at 1 percent significant level, implying that means and medians of each category is not equal. The results provide an evidence that the underlying market conditions can be related to the

Panel A: The Impact of New Disclosure Rule Announced by SEC							
		No. of Observation	**Mean**	**Med**	**SD**	**Min**	**Max**
Before Adjusted Rule Announced		30,947	40.7363	30.0566	42.1325	-396.4234	256.6599
After Adjusted Rule Announced		7,945	14.2272	30.2083	106.3575	-620.1483	261.9679
T-test	34.5433	**Pr(|T| > |t|)**	0.0000	**chi2**	0.0571	**Pr** > chi2	0.8110
Call Derivative Warrants							
Before Adjusted Rule Announced		16,972	35.6704	25.9201	38.4474	-390.6648	245.7820
After Adjusted Rule Announced		3,305	-14.8135	37.1099	148.9636	-620.1483	253.5841
T-test	38.1136	**Pr(|T| > |t|)**	0.0000	**chi2**	69.0854	**Pr** > chi2	0.0000
Put Derivative Warrants							
Before Adjusted Rule Announced		13,975	46.8886	35.5723	45.4629	-396.4234	256.6599
After Adjusted Rule Announced		4,640	34.9124	25.1889	50.3767	-253.0501	261.9679
T-test	15.1242	**Pr(|T| > |t|)**	0.0000	**chi2**	72.2719	**Pr** > chi2	0.0000
Panel B: The Impact of Market Condition							
		No. Of Observation	**Mean**	**Med**	**SD**	**Min**	**Max**
Bear Market		19,330	38.2772	35.0589	55.9956	-574.0314	261.9679
Bull Market		19,562	32.3997	25.4266	67.1855	-620.1483	256.6599
T-test	9.3660	**Pr(|T| > |t|)**	0.0000	**chi2**	297.2439	**Pr** > chi2	0.0000
Call Derivative Warrants							
Bear Market		8,741	35.7641	38.5442	67.5365	-574.0314	246.7652
Bull Market		11,536	21.1361	19.1209	74.7916	-620.1483	253.5841
T-test	14.3762	**Pr(|T| > |t|)**	0.0000	**chi2**	740.8536	**Pr** > chi2	0.0000
Put Derivative Warrants							
Bear Market		10,589	40.3518	31.5088	44.1525	-396.4234	261.9679
Bull Market		8,026	48.5892	36.1152	50.1767	-244.5217	256.6599
T-test	-11.8817	**Pr(|T| > |t|)**	0.0000	**chi2**	29.7318	**Pr** > chi2	0.0000

Table 6 The Effect of SEC New Disclosure Rule Announcement and Underlying Market Conditions on the Derivative Warrant Overpricing (Unit: Percentage)

derivative warrant overpricing. Overall, derivative warrants have higher overpricing level in the bear market for both mean and median. The means of pricing error are 38.28 percent in the bear market and 32.40 percent in the bull market. The medians of pricing error are 35.06 percent in the bear market and 25.43 percent in the bull market. This is consistent with the derivative warrants are used as a hedging tool, especially in the bear market.

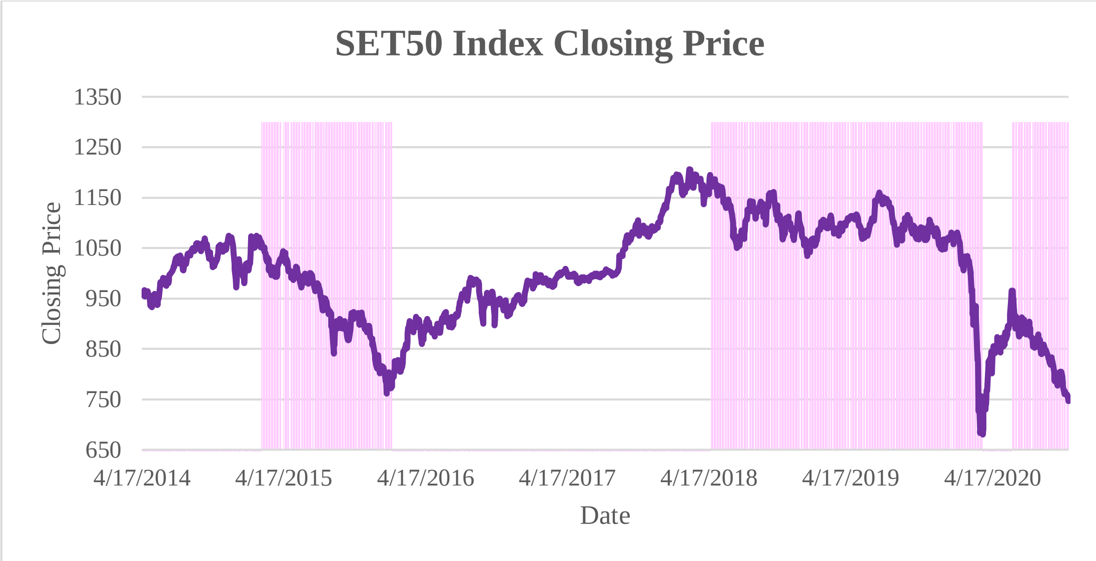

Figure 4 The Underlying Market Conditions

Source: SETSMART, 2020

Considering each type of derivative warrants, call derivative warrants are more overpriced in the bear market relative to the bull market for both mean and median. The means of the pricing error are 35.76 percent in the bear market and 21.14 percent in the bull market. The medians of the pricing error are 38.54 in the bear market and 19.12 percent in the bull market. In contrast, put derivative warrants are more overpriced in the bull market relative to the bear market. The means of the pricing error are 40.35 percent in the bear market and 48.59 percent in the bull market while the medians of the pricing error are 31.51 in the bear market and 36.12 in the bull market. The unexpected results might be occurred because issuers may issue more call derivative warrants when market go up and more put derivative warrants when market go down. The increase in number of the derivative warrants may force the issuers to reduce the overpriced premium.

Additionally, the univariate analysis is also conducted to report the means of the overpricing level for various splits of the entire sample. Table 7 illustrates the simple relationship between the derivative warrant overpricing and issuer's characteristics. The number of observations in each category is in parenthesis. The first characteristic is identity of issuer. The results demonstrate the existence of issuer identity effect on derivative warrant mispricing and support the hypothesis that the overpricing level is different across issuers. On average, almost issuers overprice derivative warrants and the degrees of the overpricing are ranging from 2.77 to 66.15 percent.

Second, the results show that derivative warrants issued by foreign issuers have higher overpricing level than derivative warrants issued by domestic issuers with the means of 43.92 and 28.58 percent, respectively. Another characteristic is credit rating.

There is a negative relationship between credit rating and the degree of overpricing. The derivative warrants issued by high credit rating issuers have lower overpricing level. The mean of overpricing level is 28.49 percent for derivative warrants issued by class AA issuers while derivative warrants issued by issuers with lower than class AA has the mean of the overpricing level around 41 percent. Last characteristic is market share of issuers. There is an unexpected negative relationship between issuer's market share and the overpricing level. Derivative warrants issued by small market share issuers are more overpriced relative to derivative warrants issued by large market share issuers. On average, the overpricing levels of derivative warrants issued by small and large market share are 43.25 and 31.52 percent, respectively.

By Identity of Issuer				**By Foreign and Domestic Issuer**			
Issuer A	30.8047	(703)		Foreign	43.9221	(17,093)	
Issuer B	27.1739	(15,657)		Domestic	28.5766	(21,799)	
Issuer C	2.7667	(740)		**T-Test**	-24.4323	**Pr(|T|>|t|)**	0.0000
Issuer D	52.3773	(1,598)		**By Credit Rating**			
Issuer E	36.8081	(8,445)		AA	28.4950	(18,394)	
Issuer F	41.0952	(4,143)		A	41.4584	(17,620)	
Issuer G	53.7155	(117)		BBB	41.3716	(2,878)	
Issuer H	57.6519	(6,028)		**F-Test**	214.21	**Prob > F**	0.0000
Issuer I	66.1515	(14)		**By Market Share of Issuer**			
Issuer J	-6.2997	(439)		Large	31.5249	(26,303)	
Issuer K	7.7031	(1,008)		Small	43.2523	(12,589)	
F-Test	192.71	**Prob > F**	0.0000	**T-Test**	17.5372	**Pr(|T|>|t|)**	0.0000

Number of observations in parentheses

Table 7 The Mean of the Overpricing Level for Various Splits of the Entire Sample (Unit: Percentage)

As regards F-tests and T-test, the null hypothesis that there is no difference among the means is rejected at 1 percent significant level in each category. The difference in means of pricing error provides a strong evidence that the overpricing level can be attributed to characteristics of issuer.

REGRESSION ANALYSIS

The regression analysis is performed to examine the effect of issuer's characteristics on the derivative warrant overpricing after controlling derivative warrant's characteristics and trading behavior. The results from the regression model are reported in form of table and divided into 4 sections, namely the impact of issuer identity on the overpricing, the impact of issuer's characteristics on the overpricing, how the relationship between the overpricing and issuer's characteristics responded after the revised disclosure regulation announced, and robustness check. Additionally, Breusch-Pagan test is applied to detect heteroskedasticity. In statistics, the heteroskedasticity is a situation that the variance of the residuals is unequal over a range of measured values and can lead to an invalid result. The analysis is shown in Appendix 4. All regression models reject the null hypothesis that residuals are homoskedastic and conclude that residuals are not homogeneous. Therefore, in this paper, the heteroskedasticity-robust standard errors are used to deal with heteroskedasticity problem.

The Impact of Identity of Issuer on Derivative Warrant Overpricing

Model 1 is applied to reconfirm the impact of issuer identity on derivative warrant overpricing. The regression results are reported in Table 8. The results provide an evidence that there is an issuer identity effect on derivative warrant overpricing after controlling derivative warrant's characteristics and trading behavior. In Table 8, all issuer variables are statistically significant. Almost issuer variables have positive coefficient, except issuer J whose coefficient is negative. This implies that issuer J have lower overpricing level compared with issuer C which is reference group whereas other issuers have higher overpricing level relative to issuer C. The results support the hypothesis that the degree of overpricing is different across issuers. However, this method may not be a good way to investigate the issuer identity effect on the overpricing level because it does not exactly tell that the overpricing level is different across issuers. It only tells that the overpricing of each issuer differs from the overpricing level of the reference group.

Additionally, the results show that bid-ask spread is positively related to the overpricing level, implying a negative relationship between the overpricing level and liquidity. This is consistent with the finding of Lerdsuwankij and Suchintabundid (2017) which explain that the negative relationship is happened from the extreme overpricing attracts the informed traders to trade more, leading higher liquidity in derivative warrants. The higher liquidity therefore gives higher profit to issuers and allow them to reduce the overpriced premium, so the derivative warrant market efficiency will be improved. Moneyness is insignificant, reflecting that there is no relationship between the overpricing level and moneyness. The results also show a positive relationship between the overpricing level and time-to-maturity. This relationship is consistent with the findings of Loudon and Nguyen (2006) and Sakti and Qoyum (2017) that longer time-to-maturity increase that overpricing level of derivative warrant. The positive relationship may happen because derivative warrant is used for speculation. Derivative warrants with longer time-to-maturity have higher probability to be profitable or expire in-the-money. The higher demand for them will drive the market price to go up and the overpricing level will increase.

In contrast, volatility of the underlying asset is negatively related to the overpricing level, implying that the overpricing level decreases when volatility of underlying asset increases. This negative relationship is explained by Yan (2000) that higher risk lead to higher theoretical price of derivative warrants. The findings also reveal

VARIABLES	(1)
Issuer A	15.2945***
	(5.2010)
Issuer B	7.0200*
	(3.9648)
Issuer D	53.3927***
	(4.3284)
Issuer E	20.4171***
	(3.9872)
Issuer F	20.8642***
	(4.1121)
Issuer G	35.7612***
	(5.2649)
Issuer H	44.4344***
	(3.9780)
Issuer I	42.4778***
	(6.8257)
Issuer J	-16.5363**
	(7.2478)
Issuer K	16.0046***
	(5.1608)
Spread	3.7659***
	(1.2540)
Money	0.1366
	(0.1061)
T	0.1694***
	(0.0069)
Volatility	-1.9597***
	(0.0615)
Delta	-0.0951***
	(0.0031)
Multiplier	-207.1756***
	(50.8378)
Constant	39.4738***
	(4.0382)
Observations	38,892
R-squared	0.1471
Adj R-squared	0.1468

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 8 Regression Result for Model 1

a negative relationship between the overpricing level and delta, suggesting that high delta implies high risk from price movement, so investors will require higher return to compensate with higher risk. This outcome is also consistent with Loudon and Nguyen (2006) who apply delta as an indicator of hedging difficulty and reveal that it is strongly negatively related to the pricing error. Finally, this table also reports a negative relationship between the overpricing level and the multiplier, reflecting that derivative warrants with smaller multiplier are more attractive for investors, especially retail investors who dominate in Thai derivative warrant market, and the higher demand for them will drive the overpricing level to go up.

<u>The Impact of Issuer’s Characteristics on Derivative Warrant Overpricing</u>

To investigate the relationship between derivative warrant overpricing and issuer’s characteristics, Table 9 illustrates the regression results for Model 2. The results show the positive relationship between the rank of issuer’s market share and the overpricing level. As mention previously, the issuer with the biggest market share will get the first rank, and vice versa, the results indicate an unexpected negative relationship between the overpricing level and the market share of issuer, reflecting that issuer with bigger market share is associated with a lower overpricing level. This might be occurred because liquidity heavily depends on competition among issuers and the issuers with bigger market share are able to provide more liquidity by quoting narrow bid-ask spread in order to attract investors to invest with them.

The negative coefficient of credit rating contrasts with the hypothesis that credit rating of issuer is positively related to the overpricing level. The results show that derivative warrants issued by issuers with credit rating higher than Class A are less overpriced than derivative warrants issued by issuers with credit rating lower than or equal to Class A. However, the unexpected negative relationship between the overpricing level and credit rating is consistent with existing literatures (Chen et al., 2014; Lerdsuwankij & Suchintabundid, 2017; Wongsirikul, 2013). This negative relationship is explained in the existing literatures that high credit risk issuers have more price distortion or manipulation since they may have an incentive to pass on their funding cost into derivative warrant pricing.

The results also show that foreign issuer is associated with the overpricing level, consistent with the finding of Horst and Veld (2008). Derivative warrants issued by foreign issuers have the higher overpricing level compared with derivative warrants issued by domestic issuers. This may be explained that foreign issuers need to incur higher cost to operate in domestic country and they may have an intensive to transfer this cost into derivative warrant pricing.

In addition, the results indicate that the style of calculating time decay is related to the overpricing of derivative warrants. Derivative warrants issued by issuers who calculate time decay based on calendar day have higher overpricing level than derivative warrants issued by issuers who calculate time decay based on trading day. The result corresponds with the hypothesis that the style of calculating time decay is an advertising strategy of each issuer, so investors who do not understand about time decay

VARIABLES	(1)	(2)	(3)	(4)
Rank	1.3727***			
	(0.1672)			
CR		-13.8572***		
		(0.6488)		
Foreign			21.9691***	
			(0.7830)	
TD				21.0498***
				(0.7735)
Spread	2.6610**	2.5187**	3.2325***	3.7358***
	(1.1067)	(1.0786)	(1.1210)	(1.1611)
Money	-0.2062*	-0.1185	-0.0315	-0.0450
	(0.1054)	(0.1050)	(0.1051)	(0.1053)
T	0.1469***	0.1460***	0.1802***	0.1776***
	(0.0068)	(0.0067)	(0.0067)	(0.0068)
Volatility	-1.8073***	-1.7565***	-1.9147***	-1.8463***
	(0.0602)	(0.0590)	(0.0606)	(0.0595)
Delta	-0.0878***	-0.0915***	-0.0922***	-0.0932***
	(0.0031)	(0.0031)	(0.0031)	(0.0032)
Multiplier	-270.2252***	-308.0150***	-263.3044***	-321.4683***
	(53.7435)	(54.0316)	(52.9407)	(54.0822)
Constant	56.1863***	66.2581***	49.1254***	49.9268***
	(1.3567)	(1.4677)	(1.1969)	(1.2596)
Observations	38,892	38,892	38,892	38,892
R-squared	0.0926	0.1021	0.1199	0.1172
Adj R-squared	0.0925	0.1019	0.1197	0.1170

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 9 The Regression Result for Model 2

clearly may believe the advertisement and choose derivative warrants from issuer that not match with their investment style and cause the overpricing level go up.

For the control variables, the results are similar to Table 8 that bid-ask spread and time-to-maturity have positive influence with the overpricing level while volatility of underlying asset, delta, and multiplier have negative impact on the overpricing level. Unlike Table 8, the results show that there is a negative relationship between the overpricing level and moneyness when applying rank of issuer’s market share as issuer’s characteristic.

<u>How the Relationship between the Overpricing of Derivative Warrants and its Determinants Responded to the Announcement of New Disclosure Rule</u>

To examine whether the relationship between the overpricing of derivative warrants and issuer's characteristics changed after the adjusted disclosure regulation announced, Model 3 is performed. Table 10 illustrates the regression results for Model 3. The results reveal that the relationship between the overpricing level and issuer's characteristics have changed between the two sub-period. The rank of market share is positively related to the overpricing level, implying a negative relationship between the overpricing level and issuer's market share. The magnitude of the negative influence of issuer's market share on the overpricing level has been diminished by the announcement of the revised disclosure regulation. This may be explained that the announcement of revised disclosure regulation may improve investors' understanding about the nature of derivative warrants. Investors who normally care about liquidity risk are willing to pay higher price premium for derivative warrants issued by issuers with bigger market share because bigger market share implies a good reputation of issuers and issuers with bigger market share should be able to provide more liquidity.

Derivative warrants issued by issuers with credit rating higher than class A have lower overpricing level compared with derivative warrants issued by issuers with credit rating lower or equal to class A, implying a negative relationship between the overpricing level and issuer's credit rating. The announcement of revised disclosure regulation has also reduced the magnitude of the negative effect of the credit rating of issuer on the overpricing level. This may be explained that the announcement of revised regulation may increase investors' understanding about the nature of derivative warrants and investors may be easier to access the information about issuer's credit risk, so they concern more about the credit rating of issuer and they may require more return to compensate higher credit risk.

The influences of foreign issuer and style of calculating time decay have also decreased after the announcement. After the announcement, the overpricing level of derivative warrants issued by foreign issuers is still higher than derivative warrants issued by domestic issuers by smaller magnitude relative to before the announcement. Similarly, after the announcement, the overpricing level of derivative warrants which time decay calculated based on calendar day is still higher compared with derivative warrants which time decay calculated based on trading day by smaller magnitude relative to before the announcement. This may imply that the announcement of revised disclosure regulation may enhance investors' understanding and reduce uninformed investors who believe in issuer's advertise and cause the derivative warrant overpricing, so the effect of issuer's advertising strategy on the overpricing level has been diminished after the announcement.

Moreover, the relationship between the overpricing level and the control variables is similar to Table 9. Bid-ask spread and time-to-maturity have positive influences on the overpricing level while volatility of underlying asset, delta, and multiplier have negative impacts on the overpricing level. Moneyness is negatively related to the overpricing level when applying rank of issuer's market share as issuer's characteristic.

VARIABLES	(1)	(2)	(3)	(4)
Rank	2.3350***			
	(0.1648)			
CR		-18.7772***		
		(0.7147)		
Foreign			22.5931***	
			(0.6761)	
TD				21.7964***
				(0.6765)
Spread	2.9162***	2.7046**	3.2194***	3.6738***
	(1.0945)	(1.0896)	(1.1188)	(1.1551)
Money	-0.2062**	-0.0492	-0.0331	-0.0479
	(0.1049)	(0.1064)	(0.1050)	(0.1052)
T	0.1413***	0.1424***	0.1807***	0.1783***
	(0.0068)	(0.0067)	(0.0067)	(0.0067)
Volatility	-1.6323***	-1.9599***	-1.8760***	-1.8029***
	(0.0587)	(0.0657)	(0.0648)	(0.0624)
Delta	-0.0909***	-0.0889***	-0.0932***	-0.0943***
	(0.0032)	(0.0031)	(0.0031)	(0.0032)
Multiplier	-232.9323***	-386.1069***	-266.7177***	-321.0975***
	(52.4065)	(56.6780)	(52.2678)	(54.0580)
Rank * Rule	-2.3039***			
	(0.2219)			
CR * Rule		19.1044***		
		(1.7308)		
Foreign * Rule			-2.7174*	
			(1.4732)	
TD * Rule				-3.4681**
				(1.5804)
Constant	52.3197***	71.3565***	48.5982***	49.2369***
	(1.2497)	(1.6589)	(1.2905)	(1.2793)
Observations	38,892	38,892	38,892	38,892
R-squared	0.0956	0.1082	0.1200	0.1174
Adj R-squared	0.0954	0.1080	0.1198	0.1172

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 10 The Regression Result for Model 3

<u>The Robustness Check</u>

To examine robustness, the regression analysis is repeated by replacing the liquidity variable from bid-ask spread to trading volume (VOL_{it}) as well as switching proxy of default risk from credit rating to debt-to-equity ratio (DE_{it}). Table 11 demonstrates the robustness

VARIABLES	(1)
Issuer A	14.7620***
	(5.1522)
Issuer B	2.3280
	(3.9589)
Issuer D	48.1664***
	(4.2660)
Issuer E	13.3136***
	(3.9869)
Issuer F	19.1747***
	(4.0717)
Issuer G	33.9903***
	(5.2563)
Issuer H	40.3100***
	(3.9422)
Issuer I	40.1630***
	(6.8882)
Issuer J	-18.6584***
	(7.1730)
Issuer K	12.7454**
	(5.1103)
Volume	4.7740***
	(0.3294)
Money	0.2907***
	(0.1087)
T	0.1667***
	(0.0068)
Volatility	-1.8751***
	(0.0588)
Delta	-0.0973***
	(0.0032)
Multiplier	-275.2483***
	(50.0592)
Constant	41.2005***
	(4.0027)
Observations	38,892
R-squared	0.1543
Adj R-squared	0.1540

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 11 The Robustness Check for Model 1

check of the impact of identity of issuer on derivative warrant overpricing. The results reconfirm the existence of issuer effect on the overpricing level. The overpricing level is still different across issuers. Almost issuer variables are statistically significant, except issuer B. The overpricing level of issuer J is lower than issuer C which is the reference group while other issuers have the higher overpricing level compared to issuer C.

In addition, the results also provide similar relationship between the overpricing level and the control variables as shown in previous tables that time-to-maturity is still positively associated with the overpricing level whereas volatility of underlying asset, delta, and multiplier still have negative effect on the overpricing level. Unlike Table 8, the results show that the influence of liquidity on the overpricing becomes positive when using trading volume as liquidity proxy. This may be explained that many investors concern about liquidity risk and can be attracted by derivative warrant's volume, so they may require more price discount to compensate with illiquid derivative warrants or issuers may demand more liquidity premium from providing more liquidity of derivative warrants. Moneyness becomes significant at 0.01 level and its coefficient is positive. This implies that there is a positive relationship between the overpricing level and moneyness, consistent with the finding of Chen et al. (2014) that explained this relationship by using smile effect. If the at-the-money warrants are closer to the out-of-money side, warrant pricing will decrease.

Table 12 illustrates the robustness check of other issuer's characteristics on derivative warrant overpricing. The results are similar to Table 9. The rank of issuer's market share is positively related to the overpricing level, reflecting a negative relationship between the overpricing level and the issuer's market share that issuers with smaller market share tend to overprice derivative warrants compared with issuers with bigger market share. Debt-to-equity ratio has a positive impact on the overpricing level, implying that the derivative warrants issued by high credit risk issuers tend to be overpriced compared with the derivative warrants issued by low credit risk issuers. These findings reconfirm that issuers with better quality have less price distortion or manipulation. The results also show that foreign issuer and style of calculating time decay are associated with the overpricing level. Derivative warrants issued by foreign issuers have higher overpricing level than derivative warrants issued by domestic issuers. The issuer who calculated time decay based on calendar day overprices derivative warrants compared with the issuer who calculated time decay based on trading day.

For the control variables, the relationship between the overpricing level and time-to-maturity is always positive while volatility of underlying asset, delta, and multiplier are always negatively related to the overpricing level. Moneyness still insignificant even when applying the rank of the market share as issuer's characteristic. In contrast to Table 9, the relationship between the overpricing level and liquidity becomes positive when trading volume is applied as liquidity proxy.

VARIABLES	(1)	(2)	(3)	(4)
Rank	2.1248***			
	(0.1820)			
DE		7.2513***		
		(0.3853)		
Foreign			20.6077***	
			(0.7508)	
TD				19.7145***
				(0.7457)
Volume	5.4869***	4.5578***	3.1302***	3.3555***
	(0.3505)	(0.3130)	(0.2901)	(0.2962)
Money	-0.0205	-0.0017	0.0581	0.0541
	(0.1087)	(0.1072)	(0.1066)	(0.1069)
T	0.1435***	0.1535***	0.1814***	0.1791***
	(0.0068)	(0.0067)	(0.0067)	(0.0068)
Volatility	-1.7265***	-1.6456***	-1.8436***	-1.7740***
	(0.0574)	(0.0558)	(0.0584)	(0.0573)
Delta	-0.0903***	-0.0912***	-0.0934***	-0.0944***
	(0.0031)	(0.0031)	(0.0031)	(0.0032)
Multiplier	-372.1069***	-298.8012***	-289.3853***	-344.7732***
	(53.6635)	(52.4949)	(51.6882)	(52.7967)
Constant	51.5094***	43.9418***	47.0921***	47.6376***
	(1.2495)	(1.2090)	(1.1282)	(1.1809)
Observations	38,892	38,892	38,892	38,892
R-squared	0.1028	0.1082	0.1231	0.1209
Adj R-squared	0.1026	0.1081	0.1230	0.1208

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 12 The Robustness Check for Model 2

To perform the robustness check of how influence of the issuer's characteristics on the overpricing changed after the adjusted disclosure regulation announced, Table 13 reveals the robustness check for Model 3. The results are similar to Table 10. They confirm that the effect of issuer's characteristics on the overpricing level has changed after the adjusted disclosure regulation announced. The rank of market share is positively related to the overpricing level, implying a negative relationship between the overpricing level and issuer's market share. The magnitude of the negative impact of issuer's market share on the overpricing level has been diminished by the announcement of the revised regulation. The positive relationship between the overpricing level and debt-to-equity ratio implies that derivative warrants issued by high credit risk issuers are more overpriced and the magnitude of the relationship has been reduced after the announcement. The influences of foreign issuer and style of calculating time decay have also decreased after the announcement.

VARIABLES	(1)	(2)	(3)	(4)
Rank	3.2010***			
	(0.1883)			
DE		7.8925***		
		(0.3678)		
Foreign			21.4910***	
			(0.6533)	
TD				20.7268***
				(0.6534)
Volume	5.6529***	4.7453***	3.2076***	3.4430***
	(0.3552)	(0.3190)	(0.2902)	(0.2982)
Money	-0.0136	-0.0030	0.0573	0.0515
	(0.1083)	(0.1069)	(0.1065)	(0.1067)
T	0.1373***	0.1531***	0.1822***	0.1801***
	(0.0069)	(0.0067)	(0.0067)	(0.0068)
Volatility	-1.5317***	-1.5286***	-1.7854***	-1.7120***
	(0.0562)	(0.0562)	(0.0621)	(0.0600)
Delta	-0.0938***	-0.0935***	-0.0948***	-0.0959***
	(0.0032)	(0.0032)	(0.0031)	(0.0032)
Multiplier	-333.4404***	-284.9661***	-295.5150***	-345.7457***
	(52.2416)	(52.7138)	(50.9246)	(52.6921)
Rank * Rule	-2.5218***			
	(0.2230)			
DE * Rule		-3.8669***		
		(0.5714)		
Foreign * Rule			-3.9917***	
			(1.4681)	
TD * Rule				-4.8545***
				(1.5823)
Constant	47.1074***	41.9043***	46.2814***	46.6375***
	(1.1628)	(1.2252)	(1.2219)	(1.1983)
Observations	38,892	38,892	38,892	38,892
R-squared	0.1063	0.1095	0.1234	0.1213
Adj R-squared	0.1061	0.1093	0.1232	0.1211

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 13 The Robustness Check for Model 3

Moreover, time-to-maturity always have positive impact on the overpricing level while volatility of underlying asset, delta, and multiplier still have negative effect on the overpricing level. In contrast to Table 10, liquidity becomes positively associated with the overpricing level when using trading volume as liquidity proxy. Meanwhile, there is no relationship between the overpricing level and moneyness even when applying rank of market share as issuer's characteristic.

Furthermore, the paper also reconfirms how the determinants of derivative warrant overpricing respond after the revised regulation announced by interacting the dummy variable for after the announcement of revised disclosure regulation with the issuer's characteristics and the control variables. The results are reported in Appendix 5. The results still show a negative relationship between the overpricing level and issuer's credit rating. The announcement has diminished the magnitude of the negative effect of the credit rating of issuer on the overpricing level. However, the debt-to-equity ratio becomes negatively related to the overpricing level and the magnitude of the relationship has been decreased after the announcement. In addition, the results report that the issuer's market share becomes positively related to the overpricing level and the magnitude of the relationship has been diminished after the announcement whereas the magnitude of the influences of foreign issuers and style of calculating time decay has increased after the announcement. The unexpected relationship between the determinants of derivative warrant overpricing and the overpricing level after the announcement of revised regulation may be occurred because of 2 reasons. First, the period after announcement is too short compared with the period before announcement. Second, in 2020, Thai stock market is extremely volatile due to the Covid-19 pandemic, so derivative warrants have become increasingly popular and have the highest trading volume over its 11 years in operation because investors can gain benefit from trading derivative warrants either bull or bear markets. However, between March and April 2020, the first wave of the Covid-19 pandemic in Thailand, investors slowed down their investment in stocks and derivative warrants (Prachachat, 2020). This may cause the extreme underpricing of derivative warrants in Thailand in this period.

In conclusion, the robustness checks confirm the existence of issuer identity effect on the derivative warrant overpricing. The overpricing level is different across issuers. They also confirm the influences of issuer's characteristics on the overpricing. They demonstrate that market share of issuer has negative impact on the overpricing while the issuer's credit risk is positively relative to the overpricing. These suggest that derivative warrant issued by issuers with high quality and good brand image are more fairly priced. They also show that foreign issuer and style of calculating time decay can be attributed to the overpricing level. Additionally, the robustness checks also show that the announcement of adjusted disclosure regulation has altered the relationship between the overpricing level and issuer's characteristics.

Unfortunately, it can be seen that using bid-ask spread and trading volume as liquidity proxy always provides opposite results. This may happen because the proxies capture different aspect of liquidity. Bid-ask spread is a measure of liquidity cost in exchange traded securities. Narrow spread means low liquidity cost for investors, implying high liquidity. Meanwhile, trading volume represents the market's activity and liquidity. High trading volume refers high liquidity of securities. Trading volume also reflects creditability of issuer and ability of market maker to manage prices of high-traded derivative warrants. However, high trading volume can also be a trap for investors because it can come from robot trade.

CHAPTER 6 CONCLUSION

Derivative warrants have become increasingly important in Thai financial market as an alternative investment and hedging tool. They are financial products favored by many individual investors. Nevertheless, there are many evidences that derivative warrants are overpriced relative to comparable options in many countries, including Thailand. The prior studies try to explain the overpricing phenomenon through a liquidity premium, hedging cost, market power, and asymmetric information of investors. The explanations seem to be related to the derivative warrant issuers. However, to be the best of researcher's knowledge, there are a few literatures in Thailand study the issuer effect on the derivative warrant overpricing and none of them study the impact of macro factors on the overpricing phenomenon. Furthermore, most literatures examine the overpricing based on the Black-Scholes model which have the limitation from the assumption of constant volatility over the option's life.

As a result, this paper aims to reconfirm the overpricing of Thai derivative warrants and provide the evidence that it is associated with the identity of issuer as well as examine what issuer's characteristics are related to the overpricing phenomenon. Moreover, it is found that the overpricing phenomenon can be explained by the uninformed investors and SEC try to reduce this cause by revised the disclosure requirement in September 16, 2019. Therefore, this paper also studies the impact of the announcement and the underlying market conditions on the overpricing phenomenon. As most literatures in Thailand investigate the overpricing based on the Black-Scholes model, this paper has consequently applied the Black-Scholes model with GARCH(1,1) volatility to calculate the theoretical price of the derivative warrants. This paper has employed 900 SET50 derivative warrants issued and traded between April 2014 to October 2020.

Firstly, the univariate analysis demonstrates that Thai derivative warrants tend to be overpriced. The results reveal that the changing nature of derivative warrant overpricing can be related to the SEC announcement of revised disclosure regulation. However, the revised disclosure regulation cannot reduce the uninformed investors who cause the overpricing of derivative warrants. The results also show that the underlying market conditions can be attributed to the overpricing level. Derivative warrants tend to be more overpriced in the bear market. This may be explained that value of holding derivative warrants for hedging purpose being higher when market go down. Given that investors with the bullish expectations on the underlying assets are appropriate to hold call derivative warrants while investors with the bearish expectation on the underlying assets are suitable to hold put derivative warrants, the higher demand for them should increase their market value. However, the findings are unexpected. The call derivative warrants are more overpriced in the bear market while put derivative warrants are more overpriced in the bull market. This may be explained that the higher supply of those derivative warrants may force the issuers to reduce their overpriced premium. Additionally, the findings also show that there is an existence of issuer effect on the overpricing phenomenon. The overpricing level is different across issuers and issuer's characteristics can be related to the overpricing level.

The existence of issuer effect is reconfirmed by the regression analysis. It is employed to examine the effect of issuer identity and issuer's characteristics on the overpricing level after controlling the derivative warrant's characteristics and trading behavior as well as explore whether the relationship between the overpricing level and issuer's characteristics changed after the revised regulation announced. The results indicate an existence of issuer identity effect on the overpricing level. They confirm the hypothesis that the overpricing level is different across issuers. The results imply that the brand image of issuer can be attributed to the overpricing of derivative warrants.

Additionally, this paper found that the difference of the overpricing level across issuers can be explained through the issuer's characteristics. As for the first characteristic, the results show that the issuer's market share is negatively related to the overpricing level. The relationship is contrast with the hypothesis that issuer with higher market share should be able to provide more liquidity to investors and can require a higher price of derivative warrants. The unexpected results may be explained as many investors concern about liquidity risk. Issuer with the big market share is able to provide more liquidity by quoting narrow bid-ask spread to attract investors to trading their derivative warrants. Next, given that high credit risk is represented by low credit rating and investors should demand more price discount to compensate higher credit risk, the results reveal an unexpected negative relationship between the overpricing level and credit rating that the low credit rating issuers tend to overprice derivative warrants relative to high credit rating issuers. The result is also confirmed by robustness check that derivative warrant issued by higher debt-to-equity issuers are more overpriced. These findings imply that high credit risk issuers have more price distortion or manipulation since they may pass on their cost of funding into derivative warrant pricing. The influences of market share and credit risk on the overpricing level suggest that high quality and good brand image issuers more fairly price derivative warrants. Thirdly, the results support the hypothesis that foreign issuer can be attributed to the overpricing level. Foreign issuers tend to overprice derivative warrants relative to domestic issuers because the foreign issuers need to incur higher cost to operate in domestic market and this cost may be tactically transferred into derivative warrant pricing. Last, the paper found that style of calculating time decay is associated with the overpricing level. This outcome is consistent with the hypothesis that the style of calculating time decay is an advertising strategy of issuer. Issuers who calculate time decay based on trading day commonly try to create an image for their derivative warrants different from derivative warrants from other issuers in order to attract investors to trade their derivative warrants. This outcome is also consistent with the prior literature that the overpricing is attributed by issuer’s marketing action and framing effect. Since Thai derivative warrant market is dominated by retail investors and many investors usually hold derivative warrant for short-term, investors who not understand about time decay may believe in the advertisement and invest in derivative warrants that mismatch with their investment style. This may widen gap between the market price and the model price, resulting in the higher overpricing level.

Furthermore, the regression analysis also shows that the announcement of revised disclosure regulation has changed the relationship between the overpricing level and issuer’s characteristics. This may imply that the announcement can improve the investors’ understanding about the nature of derivative warrants and reduce the uninformed investors. Consequently, the influences of issuer’s characteristics on the derivative warrant overpricing have diminished.

In conclusion, the overpricing phenomenon can be attributed to both macro and micro factors. The specific characteristics of derivative warrant issuers have significantly influence on the derivative warrant overpricing. Finally, there are the interesting points that worth to be considered for the further development. It is interesting for the further researches to take stock derivative warrants into consideration as well as incorporate more issuer’s characteristics to explain what causes the level of the overpricing differ across issuers.

LIMITATIONS OF THE STUDY

There are some limitations in this paper. First, as mentioned previously, the regression model 1 has limitation that it does not directly tell that the overpricing level is different across issuers. It only tells that the overpricing of each issuer differs from the overpricing level of the reference group. Therefore, the further researches may employ another method to examine the issuer identity effect on the overpricing level.

Second, the sample data covers the first wave of Covid-19 pandemic which may cause biased result and lead to unusual relationship between the overpricing level and its determinants. So, it is interesting to for the further researches to exclude the period of the Covid-19 pandemic and examine how the results change. In addition, it is also interesting to study how the relationship between derivative warrant overpricing and issuer’s characteristics responded to the Covid-19 pandemic.

Last, since the sample data in this paper seem to be dominated by a few issuers, the further researches may try to drop some dominated issuers and examine how the relationship between derivative warrant overpricing and issuer’s characteristics change.

POLICY IMPLICATIONS

Since this paper aims to explain what issuer's characteristics cause the overpricing level differ across issuers as well as study the effect of the revised disclosure regulation and underlying market conditions on the changing nature of derivative warrant overpricing. There is a suggestion that would be benefit to related organizations. Since one of the causes of the derivative warrant overpricing is asymmetric information of investors, the related organizations should focus on the improvement of derivative warrant market efficiency in term of reducing uninformed investors. The related organizations should force derivative warrant issuers to provide more information not only about characteristics of derivative warrants and derivative warrant issuers but also macro factors such as regulations and market conditions because the derivative warrant overpricing is related to both macro and micro factors. The related organizations may provide information in form of comparison in order to make investors easy to understand and make investment decision.

REFERENCES

Bi, Z., Yousuf, A., & Dash, M. (2014). A Study on Options Pricing Using GARCH and Black-Scholes-Merton Model. *Asian Journal of Finance & Accounting, 6*. doi:10.5296/ajfa.v6i1.4830

Chan, H. W.-H., & Pinder, S. M. (2000). The value of liquidity: Evidence from the derivatives market. *Pacific-Basin Finance Journal, 8*(3), 483-503. doi:https://doi.org/10.1016/S0927-538X(00)00018-4

Chen, M.-H., Gau, Y.-F., & Tai, V. W. (2014). Issuer Credit Ratings and Warrant-Pricing Errors. *Emerging Markets Finance and Trade, 49*(sup3), 35-46. doi:10.2753/ree1540-496x4904s303

Costa, F. J. M. (2017). *Forecasting volatility using GARCH models.* (Master in Finance Thesis). School of Economics and Management, University of Minho, Retrieved from https://core.ac.uk/download/pdf/132797589.pdf

Dash, M., Dagha, J., Sharma, P., & Singhal, R. (2012). An Application of GARCH Models in Detecting Systematic Bias in Options Pricing and Determining Arbitrage in Options. *Journal of CENTRUM Cathedra: The Business and Economics Research Journal, 5*. doi:10.7835/jcc-berj-2012-0069

Eksaengsri, A., & Suchintabandid, S. (2010). *The Effect of Credit Risk to Derivative Warrant Price.* (Special Project). Chulalongkorn University, Retrieved from http://ezproxy.car.chula.ac.th/login?url=https://search.ebscohost.com/login.aspx?direct=true&db=cat05085a&AN=chu.b1889327&site=eds-live Available from EBSCOhost CU Library database.

Fung, J. K. W., & Zeng, T. Z. X. (2012). Are Derivative Warrants Overpriced? *Journal of Futures Markets, 32*(12), 1144-1170. doi:10.1002/fut.21578

Horst, J. t., & Veld, C. (2002). *Behavioral Preferences for Individual Securities: The Case for Call Warrants and Call Options.* (CentER Discussion Paper; Vol. 2002-95). Tilburg.

Horst, J. t., & Veld, C. (2008). An Empirical Analysis of the Pricing of Bank Issued Options versus Options Exchange Options. *European Financial Management, 14*(2), 288-314. doi:https://doi.org/10.1111/j.1468-036X.2007.00394.x

Hull, J. C. (2018). The Black-Scholes-Merton Model. In *Options, Futures, and Other Derivatives* (Global Edition, 9th ed., pp. 343-369): Pearson Education Limited.

Hunt, B., & Terry, C. (2011). Australian equity warrants: Are retail investors getting a fair go? *JASSA, 2*, 48-54.

Intra, K., & Nimanusornkuk, C. (2019). *Factors Affecting the Differences Between the Theoretical Price and Market Price of Derivative Warrant (DW in Stock Exchange Thailand).* Chiang Mai University,

J.P. Morgan. (2019). J.P. Morgan to Become Biggest Issuer of Derivative Warrants in Thailand. Retrieved from https://www.jpmorgan.com/country/TH/en/detail/1320572980728

KGI Securities (Thailand) PCL. (2021, 3 March 2021). 7 Things must be known before trading DW. Retrieved from https://www.setinvestnow.com/th/knowledge/article/148-7-things-to-know-before-trading-dw

Lerdsuwankij, T., & Suchintabundid, S. (2017). *Why Derivative Warrants are overpriced? Empirical evidence from Thailand.* (Special Project).

Chulalongkorn University, Retrieved from http://ezproxy.car.chula.ac.th/login?url=https://search.ebscohost.com/login.aspx?direct=true&db=cat05085a&AN=chu.b2151189&site=eds-live Available from EBSCOhost CU Library database.

Li, G., & Zhang, C. (2010). Why Are Derivative Warrants More Expensive Than Options? An Empirical Study. *Journal of Financial and Quantitative Analysis, 46*(1), 275-297. doi:10.1017/s0022109010000670

Liu, M.-H., & Rangan, N. K. (2012). Do Chinese Retail Option Traders Know Anything about Market Volatility? *Front. Bus. Res. China, 6*(4), 508-526. Retrieved from https://fbr.rmbs.ruc.edu.cn/userfiles/download/1394183369789.pdf

Loudon, G. F., & Nguyen, K. T. (2006). Evidence on the issuer effect in warrant overpricing. *Applied Financial Economics, 16*(3), 223-232. doi:10.1080/09603100500390976

Macquarie Group Limited. (n.d.). Thailand Warrants Education: Delta. Retrieved from https://www.thaidw.com/eduhtml?p=delta

McDonald, R. L. (2013a). The Black-Scholes Formula. In *Derivatives Markets* (3rd ed., pp. 349-353): Pearson Education, Inc.

McDonald, R. L. (2013b). The GARCH Model. In *Derivatives Markets* (3rd ed., pp. 727-729): Pearson Education, Inc.

McDonald, R. L. (2013c). Market-Making and Delta-Hedging. In *Derivatives Markets* (3rd ed., pp. 381-408): Pearson Education, Inc.

Namugaya, J., Weke, P. G. O., & Charles, W. M. (2014). Modelling Volatility of Stock Returns: Is GARCH(1,1) enough? *International Journal of Sciences: Basic and Applied Research (IJSBAR), 16*, 216-223. Retrieved from https://gssrr.org/index.php/JournalOfBasicAndApplied/article/view/2483

Numpa, W. (2014). *Comparison of Static, Stochastic and GARCH Volatility Models in Derivative Warrants Pricing and Delta Hedging: Evidence from Thailand.* (Master of Science Program in Finance Independent Study). Thammasat University,

Powers, E., & Xiao, G. (2014). Mispricing of Chinese warrants. *Pacific-Basin Finance Journal, 30*, 62-86. doi:https://doi.org/10.1016/j.pacfin.2014.07.002

Prachachat. (2020, February 3, 2020). Investors actively trade DW, catching the stock market volatility. *Prachachat*. Retrieved from https://www.prachachat.net/finance/news-606748

Prasertkijaphan, M. (2017). *Are Derivative Warrants Profitable?* (Master of Science Program in Finance Independent Study). Thammasat University,

Sakarya, Ş., & Aksu, M. (2018). Pricing of Covered Warrants: An Analysis on Borsa İstanbul. *Sosyoekonomi*, 201-218. doi:10.17233/sosyoekonomi.2018.03.11

Sakti, M. R. P., & Qoyum, A. (2017). Testing The Warrants Mispricing and Their Determinants: The Panel Data Models. *Global Review of Islamic Economics and Business, 5*, 118. doi:10.14421/grieb.2017.052-05

Sirigamolsantichai, S., & Likitapiwat, T. (2015). *Are Derivative Warrants Mispriced? Evidence from Thailand.* (Thesis). Chulalongkorn University,

The Securities and Exchange Commission Thailand. (2017). SEC reveals research results at the SEC Working Papers Forum 2017 that the DW market is growing fast and hopes to develop a regulatory framework for more efficient trading mechanism. Retrieved from https://www.sec.or.th/TH/Pages/News_Detail.aspx?SECID=6887

The Securities and Exchange Commission Thailand. (2019). SEC revises the criteria for derivative warrants disclosure by focusing on concise and easy to understand for investors. Retrieved from https://www.sec.or.th/TH/Pages/News_Detail.aspx?SECID=7668

Wealthythai. (2019). Know DW in 5 minutes and 5 things need to know before trading. Retrieved from https://www.wealthythai.com/web/contents/WT190700146

Wongsirikul, C. (2013). *An Empirical Test of the BS and CSR Valuation Model for Thai Derivative Warrants and the Issue Specific Factors.* (Master of Science Program in Finance Independent Study). Thammasat University,

Yan, Y. (2000). *Three essays on the semi-parametric pricing of derivative warrants and stock options.* (Thesis). Hong Kong University of Science and Technology,

Zhu, Y. (2018). *Comparison of Three Volatility Forecasting Models.* (Thesis). The Ohio State University, Retrieved from https://kb.osu.edu/bitstream/handle/1811/84909/1/Thesis.pdf

APPENDIX

APPENDIX 1: THE OVERPRICING LEVEL OF DERIVATIVE WARRANTS

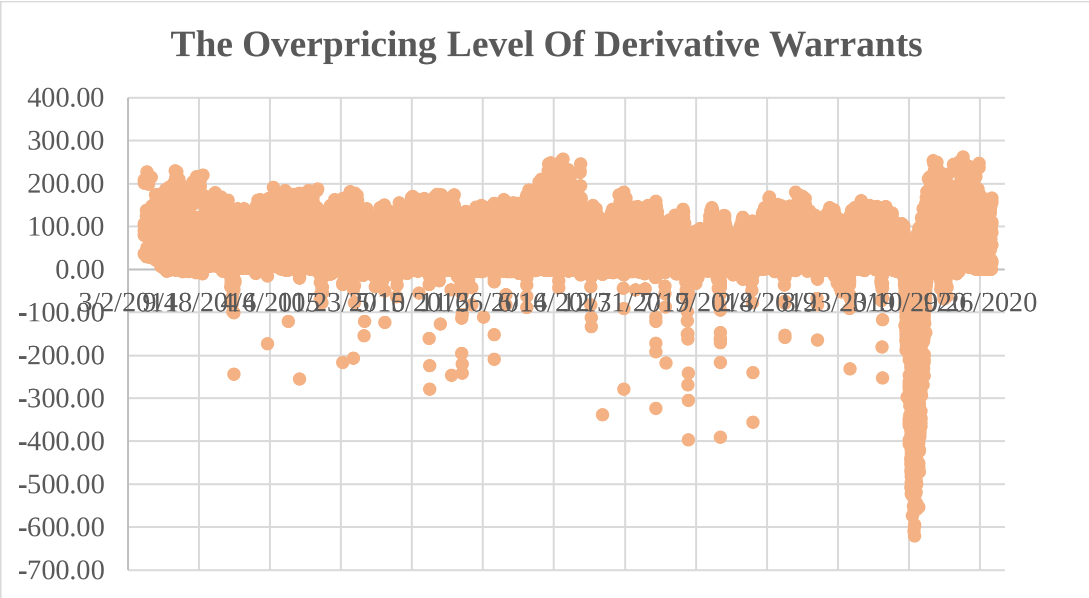

Figure 5 The Overpricing Level of Derivative Warrants (Unit: Percentage)

APPENDIX 2: THE RELATED TIMELINE

Mar 17, 2014

SET50 derivative warrant was firstly introduced in Thailand.

Sep 16, 2019

SEC revised the disclosure regulation of factsheet to be concise, easy to understand, consistent with investors’ behavior, and comply with international standard

Mar 2020

The first wave of Covid-19 pandemic in Thailand started.

May 2020

The first wave of Covid 19 pandemic started recovering.

APPENDIX 3: THE OVERPRICING OF DERIVATIVE WARRANTS EXCLUDING COVID-19 PANDEMIC

SUMMARY STATISTICS

	No. of Observation	Mean	Med	SD	Min	Max
All DW	34,683	41.8247	32.4526	41.5594	-396.4234	256.6598
Call DW	18,433	37.0812	28.1752	38.2945	-390.6648	245.7821
Put DW	16,250	47.2054	37.4709	44.36845	-396.4234	256.6598

Table 14 Summary Statistics of the Overpricing of Derivative Warrants Excluding Covid-19 Pandemic (Unit: Percentage)

UNIVARIATE ANALYSIS

<table>
<tr><th colspan="8">Panel A: The Impact of New Disclosure Rule Announced by SEC</th></tr>
<tr><th colspan="2"></th><th>No. of Observation</th><th>Mean</th><th>Med</th><th>SD</th><th>Min</th><th>Max</th></tr>
<tr><td colspan="2">Before Adjusted Rule Announced</td><td>30,947</td><td>40.7363</td><td>30.0566</td><td>42.1325</td><td>-396.4234</td><td>256.6598</td></tr>
<tr><td colspan="2">After Adjusted Rule Announced</td><td>3,736</td><td>50.8405</td><td>49.8415</td><td>35.2023</td><td>-253.0501</td><td>159.4180</td></tr>
<tr><td>T-test</td><td>-14.0773</td><td>Pr(|T| > |t|)</td><td>0.0000</td><td>chi2(1)</td><td>571.5481</td><td>Pr > chi2</td><td>0.0000</td></tr>
<tr><th colspan="8">Call Derivative Warrants</th></tr>
<tr><td colspan="2">Before Adjusted Rule Announced</td><td>16,972</td><td>35.6704</td><td>25.9201</td><td>38.4474</td><td>-390.6648</td><td>245.7821</td></tr>
<tr><td colspan="2">After Adjusted Rule Announced</td><td>1,461</td><td>53.4703</td><td>52.0553</td><td>32.2358</td><td>-131.1253</td><td>138.1631</td></tr>
<tr><td>T-test</td><td>-17.1837</td><td>Pr(|T| > |t|)</td><td>0.0000</td><td>chi2(1)</td><td>504.9712</td><td>Pr > chi2</td><td>0.0000</td></tr>
<tr><th colspan="8">Put Derivative Warrants</th></tr>
<tr><td colspan="2">Before Adjusted Rule Announced</td><td>13,975</td><td>46.8886</td><td>35.5723</td><td>45.4629</td><td>-396.4234</td><td>256.6598</td></tr>
<tr><td colspan="2">After Adjusted Rule Announced</td><td>2,275</td><td>49.1517</td><td>47.9739</td><td>36.8902</td><td>-253.0501</td><td>159.4180</td></tr>
<tr><td>T-test</td><td>-2.2564</td><td>Pr(|T| > |t|)</td><td>0.0241</td><td>chi2(1)</td><td>109.7002</td><td>Pr > chi2</td><td>0.0000</td></tr>
</table>

Table 15 The Effect of SEC New Disclosure Rule Announcement and Underlying Market Conditions on the Derivative Warrant Overpricing Excluding Covid-19 Pandemic (Unit: Percentage)

<table>
<tr><th colspan="8">Panel B: The Impact of Market Condition</th></tr>
<tr><th></th><th>No. Of Observation</th><th>Mean</th><th>Med</th><th>SD</th><th>Min</th><th>Max</th></tr>
<tr><td>Bear Market</td><td>17,273</td><td>43.2767</td><td>37.3915</td><td>39.3284</td><td>-396.4234</td><td>191.4042</td></tr>
<tr><td>Bull Market</td><td>17,410</td><td>40.3842</td><td>27.3136</td><td>43.6139</td><td>-338.7267</td><td>256.6598</td></tr>
<tr><td>T-test</td><td>6.4845</td><td>Pr(|T| > |t|)</td><td>0.0000</td><td>chi2(1)</td><td>314.9415</td><td>Pr > chi2</td><td>0.0000</td></tr>
<tr><th colspan="8">Call Derivative Warrants</th></tr>
<tr><td>Bear Market</td><td>7,996</td><td>44.0496</td><td>39.6965</td><td>38.1412</td><td>-390.6648</td><td>186.7653</td></tr>
<tr><td>Bull Market</td><td>10,437</td><td>31.7426</td><td>19.8071</td><td>37.5484</td><td>-338.7267</td><td>245.7821</td></tr>
<tr><td>T-test</td><td>21.9034</td><td>Pr(|T| > |t|)</td><td>0.0000</td><td>chi2(1)</td><td>807.8930</td><td>Pr > chi2</td><td>0.0000</td></tr>
<tr><th colspan="8">Put Derivative Warrants</th></tr>
<tr><td>Bear Market</td><td>9,277</td><td>42.6104</td><td>34.9059</td><td>40.3137</td><td>-396.4234</td><td>191.4042</td></tr>
<tr><td>Bull Market</td><td>6,973</td><td>53.3188</td><td>40.6589</td><td>48.5820</td><td>-244.5216</td><td>256.6598</td></tr>
<tr><td>T-test</td><td>-15.3371</td><td>Pr(|T| > |t|)</td><td>0.0000</td><td>chi2(1)</td><td>41.3785</td><td>Pr > chi2</td><td>0.0000</td></tr>
</table>

Table 15 The Effect of SEC New Disclosure Rule Announcement and Underlying Market Conditions on the Derivative Warrant Overpricing Excluding Covid-19 Pandemic (Unit: Percentage) (Continued)

APPENDIX 4: TESTING FOR HOMOSKEDASTICITY

Model		**Breusch-Pagan Test for Heteroskedasticity** (H_0: Constant Variance)	
		chi2	**Prob > chi2**
Model 1		28,897.85	0.0000
Model 2	Rank of Market Share	24,390.53	0.0000
	Credit Rating	25,312.57	0.0000
	Foreign Issuer	26,127.40	0.0000
	Style of Calculating Time Decay	25,616.14	0.0000
Model 3	Rank of Market Share	25,642.81	0.0000
	Credit Rating	26,955.73	0.0000
	Foreign Issuer	26,170.49	0.0000
	Style of Calculating Time Decay	25,744.29	0.0000
Robustness Check			
Model 1		30,697.99	0.0000
Model 2	Rank of Market Share	27,418.95	0.0000
	Debt-to-Equity Ratio	28,554.39	0.0000
	Foreign Issuer	27,436.43	0.0000
	Style of Calculating Time Decay	27,066.09	0.0000
Model 3	Rank of Market Share	28,581.09	0.0000
	Debt-to-Equity Ratio	28,730.92	0.0000
	Foreign Issuer	27,539.75	0.0000
	Style of Calculating Time Decay	27,293.76	0.0000

Table 16 Breusch-Pagan Test for Heteroskedasticity

APPENDIX 5: ROBUSTNESS CHECK FOR MODEL 3

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Rank	-1.9845***				-2.0628***			
	(0.1101)				(0.1145)			
CR		-4.4766***						
		(0.4201)						
DE						-2.2458***		
						(0.2346)		
Foreign			6.5624***				6.7428***	
			(0.4087)				(0.4053)	
TD				5.6805***				5.8314***
				(0.4130)				(0.4089)
Spread	-46.9849***	-51.8921***	-54.1726***	-53.4027***				
	(15.4063)	(16.6605)	(17.4442)	(17.1718)				
Volume					-1.2490***	-0.5700***	-0.8964***	-0.8090***
					(0.1888)	(0.1823)	(0.1829)	(0.1828)
Money	-4.4852***	-4.2963***	-4.2481***	-4.2839***	-4.4042***	-4.4435***	-4.2552***	-4.2810***
	(0.0498)	(0.0476)	(0.0485)	(0.0489)	(0.0498)	(0.0492)	(0.0480)	(0.0484)
T	0.1567***	0.1293***	0.1455***	0.1419***	0.1762***	0.1456***	0.1508***	0.1484***
	(0.0061)	(0.0060)	(0.0059)	(0.0060)	(0.0061)	(0.0059)	(0.0059)	(0.0060)
Volatility	-0.9374***	-1.0574***	-1.0075***	-1.0263***	-0.6436***	-0.8489***	-0.9392***	-0.9396***
	(0.0661)	(0.0626)	(0.0611)	(0.0632)	(0.0642)	(0.0614)	(0.0600)	(0.0616)
Delta	-0.0319***	-0.0370***	-0.0380***	-0.0375***	-0.0303***	-0.0324***	-0.0372***	-0.0366***
	(0.0019)	(0.0019)	(0.0019)	(0.0019)	(0.0019)	(0.0019)	(0.0019)	(0.0019)
Multiplier	-289.6923***	-419.0261***	-404.6303***	-420.1627***	-158.4681***	-303.5606***	-371.7006***	-382.6723***
	(31.8972)	(31.2418)	(30.3548)	(31.1488)	(31.9406)	(30.8084)	(30.1384)	(30.8153)
Rank * Rule	6.7631***				8.6823***			
	(0.3694)				(0.3889)			
CR * Rule		18.4088***						
		(1.9556)						
DE * Rule						6.7655***		
						(0.9687)		
Foreign * Rule			19.2437***				13.6950***	
			(1.9031)				(1.9478)	

Table 17 Robustness Check for Model 3

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
TD * Rule				25.2131***				20.4202***
				(2.0022)				(2.0341)
Spread * Rule	43.4955***	48.5614***	50.5506***	50.6638***				
	(15.5299)	(16.8050)	(17.5750)	(17.2945)				
Volume * Rule					13.3922***	9.3367***	8.5974***	8.1330***
					(0.8424)	(0.7367)	(0.7261)	(0.7190)
Money * Rule	8.2081***	8.0022***	8.0316***	8.1216***	8.1611***	8.1930***	8.0570***	8.1330***
	(0.1669)	(0.1663)	(0.1681)	(0.1684)	(0.1594)	(0.1664)	(0.1644)	(0.1645)
T * Rule	-0.2136***	-0.1419***	-0.1736***	-0.1705***	-0.3334***	-0.2104***	-0.2149***	-0.2139***
	(0.0235)	(0.0220)	(0.0207)	(0.0212)	(0.0240)	(0.0220)	(0.0208)	(0.0212)
Volatility * Rule	-0.5210***	-0.3979***	-0.6062***	-0.5523***	-0.6119***	-0.4253***	-0.4901***	-0.4779***
	(0.0870)	(0.0840)	(0.0854)	(0.0853)	(0.0853)	(0.0859)	(0.0857)	(0.0851)
Delta * Rule	0.1452***	0.1666***	0.1945***	0.1922***	0.1100***	0.1427***	0.1726***	0.1725***
	(0.0156)	(0.0152)	(0.0156)	(0.0162)	(0.0157)	(0.0155)	(0.0155)	(0.0161)
Multiplier * Rule	-935.1803***	-563.5021***	-372.6205***	-485.2003***	-1,300.7380***	-751.7860***	-519.3033***	-601.3950***
	(83.6374)	(80.7361)	(76.2744)	(77.8765)	(84.8738)	(78.8732)	(75.2145)	(76.4002)
Constant	68.9357***	71.3919***	64.4937***	65.7024***	61.1843***	66.7735***	62.3222***	63.0588***
	(1.5276)	(1.4808)	(1.3736)	(1.4376)	(1.4827)	(1.4470)	(1.3379)	(1.3880)
Observations	38,892	38,892	38,892	38,892	38,892	38,892	38,892	38,892
R-squared	0.3567	0.3495	0.3561	0.3600	0.3733	0.3571	0.3624	0.3658
Adj R-squared	0.3565	0.3493	0.3560	0.3598	0.3731	0.3569	0.3622	0.3656

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 17 Robustness Check for Model 3 (Continued)

APPENDIX 6: THE ESTIMATED VOLATILITY

Date	GARCH Volatility	Coefficient			
		return_cons	ARCH L1	GARCH L1	ARCH_cons
2014-04-17	0.0000516	0.0012655	0.1119194	0.8745427	0.0000023
2014-04-18	0.0000553	0.0012786	0.1148674	0.8715606	0.0000023
2014-04-21	0.0000520	0.0012804	0.1176209	0.8688282	0.0000024
2014-04-22	0.0000477	0.0012436	0.1171263	0.8707585	0.0000022
2014-04-23	0.0000440	0.0012729	0.1190063	0.8697012	0.0000022
2014-04-24	0.0000404	0.0012928	0.1197572	0.8691842	0.0000022
2014-04-25	0.0000392	0.0012870	0.1207309	0.8685170	0.0000021
2014-04-28	0.0000396	0.0012045	0.1165728	0.8702568	0.0000024
2014-04-29	0.0000567	0.0012098	0.1163677	0.8706276	0.0000023
2014-04-30	0.0000520	0.0011976	0.1157807	0.8715250	0.0000023
2014-05-02	0.0000476	0.0012087	0.1164523	0.8710794	0.0000022
2014-05-06	0.0000441	0.0012314	0.1160346	0.8718326	0.0000022
2014-05-07	0.0000438	0.0012085	0.1138341	0.8728479	0.0000023
2014-05-08	0.0000603	0.0011868	0.1125188	0.8744937	0.0000023
2014-05-09	0.0000580	0.0011639	0.1178456	0.8670348	0.0000026
2014-05-12	0.0000913	0.0011523	0.1171815	0.8675630	0.0000026
2014-05-14	0.0000813	0.0011603	0.1139062	0.8713506	0.0000025
2014-05-15	0.0000757	0.0011771	0.1133539	0.8721849	0.0000025
2014-05-16	0.0000901	0.0011693	0.1138984	0.8714387	0.0000025
2014-05-19	0.0000817	0.0011759	0.1150759	0.8700410	0.0000025
2014-05-20	0.0000805	0.0011407	0.1132849	0.8733259	0.0000024
2014-05-21	0.0000744	0.0010970	0.1144747	0.8720990	0.0000025
2014-05-22	0.0000911	0.0011005	0.1139628	0.8724521	0.0000025
2014-05-23	0.0000830	0.0010680	0.1133374	0.8735834	0.0000024
2014-05-26	0.0000752	0.0010631	0.1131949	0.8736787	0.0000024
2014-05-27	0.0000754	0.0010665	0.1136154	0.8735068	0.0000024
2014-05-28	0.0000766	0.0010689	0.1127435	0.8743960	0.0000024
2014-05-29	0.0000696	0.0010934	0.1127593	0.8744928	0.0000023
2014-05-30	0.0000678	0.0010950	0.1121983	0.8750754	0.0000023
2014-06-02	0.0000625	0.0010840	0.1122514	0.8752275	0.0000023
2014-06-03	0.0000593	0.0011335	0.1095191	0.8773740	0.0000024
2014-06-04	0.0000942	0.0011494	0.1091640	0.8777221	0.0000024
2014-06-05	0.0000948	0.0011244	0.1082823	0.8788072	0.0000023
2014-06-06	0.0000880	0.0011326	0.1068085	0.8803329	0.0000023
2014-06-09	0.0000798	0.0011511	0.1061566	0.8810832	0.0000023
2014-06-10	0.0000732	0.0011561	0.1055909	0.8817459	0.0000022
2014-06-11	0.0000677	0.0011783	0.1054649	0.8819031	0.0000022
2014-06-12	0.0000680	0.0011654	0.1050945	0.8822874	0.0000022
2014-06-13	0.0000666	0.0011586	0.1050174	0.8824300	0.0000022
2014-06-16	0.0000669	0.0011492	0.1048680	0.8825945	0.0000022
2014-06-17	0.0000623	0.0011589	0.1048514	0.8826372	0.0000022
2014-06-18	0.0000702	0.0011532	0.1045645	0.8829438	0.0000022
2014-06-19	0.0000657	0.0011185	0.1046471	0.8825865	0.0000022
2014-06-20	0.0000831	0.0011149	0.1043377	0.8829397	0.0000022
2014-06-23	0.0000792	0.0011073	0.1037891	0.8835015	0.0000022
2014-06-24	0.0000726	0.0011097	0.1039023	0.8833565	0.0000022
2014-06-25	0.0000665	0.0010942	0.1044052	0.8827469	0.0000022
2014-06-26	0.0000662	0.0011143	0.1047881	0.8823853	0.0000022
2014-06-27	0.0000633	0.0011385	0.1051949	0.8820148	0.0000022
2014-06-30	0.0000616	0.0011212	0.1070881	0.8807408	0.0000022

Table 18 The Estimated Volatility by GARCH(1,1) Model

Date	GARCH Volatility	Coefficient			
		return_cons	ARCH L1	GARCH L1	ARCH_cons
2014-07-02	0.0000580	0.0011357	0.1071919	0.8808466	0.0000021
2014-07-03	0.0000533	0.0011311	0.1072933	0.8809657	0.0000021
2014-07-04	0.0000493	0.0011331	0.1076379	0.8808489	0.0000021
2014-07-07	0.0000454	0.0011291	0.1083350	0.8804132	0.0000020
2014-07-08	0.0000419	0.0011418	0.1089129	0.8799874	0.0000020
2014-07-09	0.0000407	0.0011699	0.1100161	0.8792255	0.0000020
2014-07-10	0.0000389	0.0011523	0.1112241	0.8785481	0.0000019
2014-07-14	0.0000368	0.0011636	0.1107071	0.8790056	0.0000019
2014-07-15	0.0000394	0.0011876	0.1102624	0.8792824	0.0000019
2014-07-16	0.0000424	0.0011637	0.1101456	0.8796647	0.0000019
2014-07-17	0.0000412	0.0011713	0.1103136	0.8798674	0.0000019
2014-07-18	0.0000384	0.0011772	0.1108445	0.8797482	0.0000018
2014-07-21	0.0000361	0.0011568	0.1112195	0.8796604	0.0000018
2014-07-22	0.0000350	0.0011671	0.1121260	0.8793078	0.0000017
2014-07-23	0.0000349	0.0010874	0.1088471	0.8798980	0.0000020
2014-07-24	0.0000514	0.0011099	0.1112493	0.8767807	0.0000021
2014-07-25	0.0000644	0.0011083	0.1099088	0.8783149	0.0000021
2014-07-28	0.0000585	0.0011089	0.1090444	0.8793780	0.0000020
2014-07-29	0.0000542	0.0010883	0.1091638	0.8792266	0.0000020
2014-07-30	0.0000548	0.0010765	0.1100276	0.8780841	0.0000021
2014-07-31	0.0000624	0.0010469	0.1103461	0.8783894	0.0000020
2014-08-01	0.0000577	0.0010318	0.1116543	0.8766154	0.0000021
2014-08-04	0.0000718	0.0010070	0.1099181	0.8785813	0.0000021
2014-08-05	0.0000669	0.0010358	0.1114379	0.8768270	0.0000022
2014-08-06	0.0000791	0.0010371	0.1098773	0.8784378	0.0000021
2014-08-07	0.0000740	0.0010305	0.1087086	0.8796440	0.0000021
2014-08-08	0.0000697	0.0010239	0.1075595	0.8808340	0.0000020
2014-08-13	0.0000635	0.0010075	0.1069901	0.8814360	0.0000020
2014-08-14	0.0000612	0.0010783	0.1092736	0.8786356	0.0000022
2014-08-15	0.0000926	0.0010617	0.1076288	0.8803181	0.0000021
2014-08-18	0.0000845	0.0010475	0.1066127	0.8814651	0.0000021
2014-08-19	0.0000767	0.0010363	0.1055735	0.8824705	0.0000021
2014-08-20	0.0000720	0.0010366	0.1048375	0.8831551	0.0000020
2014-08-21	0.0000658	0.0010562	0.1048391	0.8831723	0.0000020
2014-08-22	0.0000623	0.0010591	0.1049027	0.8830941	0.0000020
2014-08-25	0.0000574	0.0010477	0.1050973	0.8830521	0.0000020
2014-08-26	0.0000529	0.0010713	0.1058080	0.8824428	0.0000020
2014-08-27	0.0000501	0.0010757	0.1063852	0.8819726	0.0000019
2014-08-28	0.0000472	0.0010813	0.1072704	0.8811358	0.0000019
2014-08-29	0.0000442	0.0010532	0.1072040	0.8812103	0.0000019
2014-09-01	0.0000448	0.0010447	0.1080724	0.8804573	0.0000019
2014-09-02	0.0000413	0.0010268	0.1097294	0.8792465	0.0000019
2014-09-03	0.0000381	0.0010323	0.1110287	0.8781990	0.0000019
2014-09-04	0.0000362	0.0010607	0.1090353	0.8795171	0.0000019
2014-09-05	0.0000432	0.0010465	0.1090295	0.8797314	0.0000019
2014-09-08	0.0000407	0.0010722	0.1102691	0.8789460	0.0000019
2014-09-09	0.0000377	0.0010691	0.1107240	0.8788052	0.0000018
2014-09-10	0.0000350	0.0010713	0.1114411	0.8784434	0.0000018
2014-09-11	0.0000327	0.0010444	0.1135509	0.8769997	0.0000017
2014-09-12	0.0000305	0.0010392	0.1137992	0.8771804	0.0000017
2014-09-15	0.0000290	0.0010378	0.1145197	0.8770406	0.0000016
2014-09-16	0.0000271	0.0010265	0.1147248	0.8770720	0.0000016

Table 18 The Estimated Volatility by GARCH(1,1) Model (Continued)

Date	GARCH Volatility	Coefficient			
		return_cons	ARCH L1	GARCH L1	ARCH_cons
2014-09-17	0.0000288	0.0009908	0.1118201	0.8778779	0.0000018
2014-09-18	0.0000380	0.0009898	0.1113196	0.8786410	0.0000017
2014-09-19	0.0000370	0.0010271	0.1118050	0.8779462	0.0000018
2014-09-22	0.0000394	0.0010372	0.1112446	0.8789848	0.0000017
2014-09-23	0.0000363	0.0010607	0.1116879	0.8790058	0.0000017
2014-09-24	0.0000341	0.0010713	0.1115831	0.8796362	0.0000016
2014-09-25	0.0000313	0.0010575	0.1115848	0.8802372	0.0000015
2014-09-26	0.0000289	0.0010648	0.1118881	0.8805755	0.0000015
2014-09-29	0.0000270	0.0010791	0.1117360	0.8808368	0.0000015
2014-09-30	0.0000300	0.0010015	0.1116421	0.8776507	0.0000018
2014-10-01	0.0000459	0.0009892	0.1093499	0.8803054	0.0000017
2014-10-02	0.0000417	0.0009894	0.1076227	0.8823844	0.0000017
2014-10-03	0.0000393	0.0009572	0.1087015	0.8805109	0.0000018
2014-10-06	0.0000479	0.0009482	0.1068873	0.8825283	0.0000017
2014-10-07	0.0000462	0.0009325	0.1119176	0.8759264	0.0000020
2014-10-08	0.0000706	0.0009206	0.1101105	0.8776805	0.0000019
2014-10-09	0.0000644	0.0008978	0.1080453	0.8798563	0.0000019
2014-10-10	0.0000595	0.0009270	0.1098370	0.8777470	0.0000019
2014-10-13	0.0000678	0.0009169	0.1101432	0.8772558	0.0000019
2014-10-14	0.0000677	0.0009068	0.1103763	0.8768845	0.0000020
2014-10-15	0.0000734	0.0009089	0.1101467	0.8768752	0.0000020
2014-10-16	0.0000667	0.0009099	0.1085921	0.8787130	0.0000019
2014-10-17	0.0000620	0.0009017	0.1096619	0.8775189	0.0000020
2014-10-20	0.0000806	0.0009008	0.1094040	0.8775048	0.0000020
2014-10-21	0.0000728	0.0009089	0.1081561	0.8790306	0.0000019
2014-10-22	0.0000658	0.0008845	0.1067286	0.8805500	0.0000019
2014-10-24	0.0000599	0.0008922	0.1059771	0.8812298	0.0000019
2014-10-27	0.0000555	0.0008990	0.1069967	0.8799464	0.0000019
2014-10-28	0.0000518	0.0009126	0.1058951	0.8812360	0.0000018
2014-10-29	0.0000485	0.0009354	0.1053637	0.8820242	0.0000018
2014-10-30	0.0000465	0.0009468	0.1065171	0.8807014	0.0000018
2014-10-31	0.0000435	0.0009680	0.1070082	0.8805634	0.0000018
2014-11-03	0.0000415	0.0009915	0.1027052	0.8843932	0.0000018
2014-11-04	0.0000589	0.0009873	0.1025654	0.8843983	0.0000018
2014-11-05	0.0000549	0.0009968	0.1029546	0.8838148	0.0000018
2014-11-06	0.0000521	0.0009743	0.1021010	0.8846330	0.0000018
2014-11-07	0.0000519	0.0009866	0.0995376	0.8874369	0.0000017
2014-11-10	0.0000481	0.0009844	0.1017637	0.8849126	0.0000018
2014-11-11	0.0000454	0.0009845	0.0986693	0.8887061	0.0000017
2014-11-12	0.0000500	0.0010019	0.0969684	0.8906085	0.0000016
2014-11-13	0.0000471	0.0009744	0.0936357	0.8943206	0.0000016
2014-11-14	0.0000465	0.0010027	0.0967134	0.8906476	0.0000017
2014-11-17	0.0000523	0.0009910	0.0974192	0.8897999	0.0000017
2014-11-18	0.0000497	0.0009378	0.0994776	0.8888263	0.0000016
2014-11-19	0.0000499	0.0009571	0.0998714	0.8882613	0.0000017
2014-11-20	0.0000533	0.0009562	0.0993250	0.8888703	0.0000016
2014-11-21	0.0000503	0.0009456	0.0994400	0.8886901	0.0000017
2014-11-24	0.0000525	0.0009486	0.0997003	0.8885028	0.0000017
2014-11-25	0.0000543	0.0009665	0.0997929	0.8883399	0.0000017
2014-11-26	0.0000536	0.0009720	0.0997515	0.8883713	0.0000016
2014-11-27	0.0000527	0.0009709	0.0996645	0.8884174	0.0000016
2014-11-28	0.0000491	0.0010008	0.1000624	0.8882540	0.0000016

Table 18 The Estimated Volatility by GARCH(1,1) Model (Continued)

Date	GARCH Volatility	Coefficient			
		return_cons	ARCH L1	GARCH L1	ARCH_cons
2014-12-01	0.0000472	0.0009932	0.1000040	0.8883092	0.0000016
2014-12-02	0.0000472	0.0009964	0.0999864	0.8883864	0.0000016
2014-12-03	0.0000436	0.0009922	0.1004845	0.8878859	0.0000016
2014-12-04	0.0000403	0.0009746	0.1006218	0.8880420	0.0000016
2014-12-08	0.0000375	0.0009738	0.1016902	0.8870200	0.0000015
2014-12-09	0.0000366	0.0009196	0.0974069	0.8899172	0.0000017
2014-12-11	0.0000577	0.0008854	0.1006222	0.8864275	0.0000018
2014-12-12	0.0000800	0.0008849	0.1126843	0.8736521	0.0000021
2014-12-15	0.0001306	0.0008815	0.1133398	0.8728480	0.0000021
2014-12-16	0.0001349	0.0008757	0.1181929	0.8679609	0.0000022
2014-12-17	0.0001647	0.0008775	0.1222900	0.8637794	0.0000023
2014-12-18	0.0001877	0.0008967	0.1213910	0.8647872	0.0000023
2014-12-19	0.0001893	0.0009102	0.1266422	0.8607031	0.0000023
2014-12-22	0.0002563	0.0009066	0.1255993	0.8611971	0.0000023
2014-12-23	0.0002243	0.0009295	0.1249487	0.8621735	0.0000023
2014-12-24	0.0002253	0.0009062	0.1224695	0.8646853	0.0000023
2014-12-25	0.0002007	0.0009049	0.1228429	0.8636624	0.0000023
2014-12-26	0.0001781	0.0008889	0.1237874	0.8628109	0.0000023
2014-12-29	0.0001863	0.0008987	0.1243755	0.8615595	0.0000024
2014-12-30	0.0001653	0.0009012	0.1252255	0.8603340	0.0000024
2015-01-05	0.0001568	0.0009073	0.1268954	0.8577639	0.0000025
2015-01-06	0.0001395	0.0009289	0.1255493	0.8612038	0.0000023
2015-01-07	0.0001487	0.0009206	0.1264293	0.8597741	0.0000024
2015-01-08	0.0001389	0.0009384	0.1275617	0.8589802	0.0000024
2015-01-09	0.0001584	0.0009760	0.1283571	0.8589270	0.0000024
2015-01-12	0.0001635	0.0009699	0.1280040	0.8587435	0.0000024
2015-01-13	0.0001449	0.0009468	0.1287834	0.8580770	0.0000024
2015-01-14	0.0001267	0.0009386	0.1284704	0.8578412	0.0000024
2015-01-15	0.0001116	0.0009268	0.1276596	0.8586183	0.0000024
2015-01-16	0.0001109	0.0009324	0.1277764	0.8580205	0.0000025
2015-01-19	0.0000981	0.0009091	0.1283056	0.8573488	0.0000025
2015-01-20	0.0000916	0.0009272	0.1259281	0.8604114	0.0000024
2015-01-21	0.0001033	0.0009208	0.1252616	0.8607069	0.0000024
2015-01-22	0.0000917	0.0009148	0.1251814	0.8603865	0.0000024
2015-01-23	0.0000837	0.0009323	0.1206380	0.8666906	0.0000023
2015-01-26	0.0001183	0.0009340	0.1236560	0.8666883	0.0000022
2015-01-27	0.0002219	0.0009318	0.1217084	0.8685399	0.0000022
2015-01-28	0.0002063	0.0009396	0.1196052	0.8703886	0.0000021
2015-01-29	0.0001817	0.0009453	0.1179948	0.8716295	0.0000021
2015-01-30	0.0001603	0.0009377	0.1171566	0.8721616	0.0000021
2015-02-02	0.0001465	0.0009329	0.1167818	0.8721781	0.0000021
2015-02-03	0.0001347	0.0009349	0.1168219	0.8715851	0.0000021
2015-02-04	0.0001201	0.0009461	0.1169079	0.8719127	0.0000021
2015-02-05	0.0001348	0.0009497	0.1171142	0.8711963	0.0000022
2015-02-06	0.0001209	0.0009638	0.1177573	0.8700586	0.0000022
2015-02-09	0.0001088	0.0009723	0.1189375	0.8682420	0.0000022
2015-02-10	0.0000976	0.0009792	0.1190466	0.8685905	0.0000022
2015-02-11	0.0001010	0.0009784	0.1195368	0.8678488	0.0000022
2015-02-12	0.0000956	0.0009690	0.1201190	0.8671780	0.0000023
2015-02-13	0.0000890	0.0009657	0.1208205	0.8661477	0.0000023
2015-02-16	0.0000815	0.0009668	0.1221348	0.8642851	0.0000023
2015-02-17	0.0000728	0.0009613	0.1229424	0.8632712	0.0000024

Table 18 The Estimated Volatility by GARCH(1,1) Model (Continued)

Date	GARCH Volatility	Coefficient			
		return_cons	ARCH L1	GARCH L1	ARCH_cons
2015-02-18	0.0000721	0.0009228	0.1205877	0.8664439	0.0000023
2015-02-19	0.0000886	0.0009331	0.1212916	0.8655601	0.0000023
2015-02-20	0.0000892	0.0009204	0.1218936	0.8646236	0.0000023
2015-02-23	0.0000833	0.0009250	0.1228566	0.8631997	0.0000024
2015-02-24	0.0000748	0.0008956	0.1228060	0.8634475	0.0000024
2015-02-25	0.0000774	0.0008994	0.1239251	0.8618934	0.0000024
2015-02-26	0.0000698	0.0008586	0.1242589	0.8621666	0.0000024
2015-02-27	0.0000693	0.0008636	0.1248354	0.8612898	0.0000024
2015-03-02	0.0000646	0.0008596	0.1248540	0.8613911	0.0000024
2015-03-03	0.0000677	0.0008331	0.1251420	0.8611895	0.0000024
2015-03-05	0.0000632	0.0008227	0.1243798	0.8621367	0.0000024
2015-03-06	0.0000748	0.0008093	0.1242883	0.8620836	0.0000024
2015-03-09	0.0000725	0.0008340	0.1246279	0.8616554	0.0000024
2015-03-10	0.0000757	0.0008227	0.1246415	0.8614606	0.0000024
2015-03-11	0.0000735	0.0008295	0.1266970	0.8604494	0.0000025
2015-03-12	0.0001278	0.0008252	0.1262887	0.8609074	0.0000025
2015-03-13	0.0001238	0.0008001	0.1247225	0.8625515	0.0000024
2015-03-16	0.0001100	0.0008016	0.1232626	0.8637694	0.0000024
2015-03-17	0.0000988	0.0007859	0.1243900	0.8630374	0.0000024
2015-03-18	0.0001212	0.0007851	0.1230809	0.8639933	0.0000024
2015-03-19	0.0001078	0.0008084	0.1239740	0.8630869	0.0000024
2015-03-20	0.0001152	0.0008065	0.1234035	0.8632411	0.0000025
2015-03-23	0.0001021	0.0008156	0.1232543	0.8631570	0.0000025
2015-03-24	0.0000915	0.0008231	0.1234645	0.8629347	0.0000025
2015-03-25	0.0000851	0.0008250	0.1240345	0.8619459	0.0000025
2015-03-26	0.0000762	0.0008117	0.1249409	0.8606837	0.0000025
2015-03-27	0.0000698	0.0007946	0.1252155	0.8603667	0.0000025
2015-03-30	0.0000765	0.0008003	0.1261745	0.8590526	0.0000026
2015-03-31	0.0000683	0.0008021	0.1278518	0.8569201	0.0000026
2015-04-01	0.0000614	0.0007908	0.1288220	0.8559656	0.0000026
2015-04-02	0.0000576	0.0008105	0.1280450	0.8569045	0.0000026
2015-04-03	0.0000689	0.0008293	0.1294403	0.8551321	0.0000027
2015-04-07	0.0000642	0.0008375	0.1311814	0.8529298	0.0000027
2015-04-08	0.0000581	0.0008795	0.1310819	0.8537760	0.0000027
2015-04-09	0.0000641	0.0008740	0.1319306	0.8525954	0.0000027
2015-04-10	0.0000601	0.0008976	0.1328162	0.8522267	0.0000027
2015-04-16	0.0000543	0.0009064	0.1337303	0.8510697	0.0000027
2015-04-17	0.0000506	0.0009114	0.1299477	0.8551314	0.0000027
2015-04-20	0.0000824	0.0009051	0.1287185	0.8561274	0.0000027
2015-04-21	0.0000766	0.0009023	0.1280579	0.8565871	0.0000027
2015-04-22	0.0000739	0.0009027	0.1274741	0.8571039	0.0000027
2015-04-23	0.0000706	0.0008719	0.1281348	0.8563625	0.0000028
2015-04-24	0.0000956	0.0008750	0.1271087	0.8573482	0.0000028
2015-04-27	0.0000896	0.0008922	0.1267127	0.8575619	0.0000028
2015-04-28	0.0000877	0.0008945	0.1259209	0.8583162	0.0000028
2015-04-29	0.0000826	0.0008746	0.1258449	0.8583414	0.0000028
2015-04-30	0.0000924	0.0008549	0.1252456	0.8588609	0.0000028
2015-05-06	0.0000927	0.0008619	0.1242054	0.8598059	0.0000028
2015-05-07	0.0000832	0.0008680	0.1239008	0.8601916	0.0000028
2015-05-08	0.0000765	0.0008500	0.1233517	0.8608926	0.0000028
2015-05-11	0.0000907	0.0008513	0.1229776	0.8612354	0.0000028
2015-05-12	0.0000919	0.0008311	0.1218344	0.8622249	0.0000027

Table 18 The Estimated Volatility by GARCH(1,1) Model (Continued)

Date	GARCH Volatility	Coefficient			
		return_cons	ARCH L1	GARCH L1	ARCH_cons
2015-05-13	0.0000862	0.0008244	0.1218613	0.8623101	0.0000028
2015-05-14	0.0000909	0.0008254	0.1213860	0.8626139	0.0000028
2015-05-15	0.0000877	0.0008077	0.1206129	0.8631499	0.0000027
2015-05-18	0.0000795	0.0008139	0.1208651	0.8627439	0.0000028
2015-05-19	0.0000812	0.0007950	0.1205610	0.8628762	0.0000028
2015-05-20	0.0000739	0.0008029	0.1209432	0.8624499	0.0000028
2015-05-21	0.0000802	0.0007842	0.1210617	0.8621354	0.0000028
2015-05-22	0.0000788	0.0007757	0.1210586	0.8620380	0.0000028
2015-05-25	0.0000728	0.0007485	0.1210737	0.8623075	0.0000028
2015-05-26	0.0000678	0.0007105	0.1203772	0.8631577	0.0000028
2015-05-27	0.0000795	0.0006987	0.1202286	0.8632125	0.0000028
2015-05-28	0.0000782	0.0006814	0.1197598	0.8636860	0.0000028
2015-05-29	0.0000708	0.0006708	0.1197481	0.8636417	0.0000028
2015-06-02	0.0000697	0.0006526	0.1196490	0.8636871	0.0000027
2015-06-03	0.0000636	0.0006106	0.1186631	0.8650496	0.0000027
2015-06-04	0.0000816	0.0006105	0.1178894	0.8657387	0.0000027
2015-06-05	0.0000750	0.0006106	0.1176230	0.8659040	0.0000027
2015-06-08	0.0000717	0.0006352	0.1182452	0.8651643	0.0000028
2015-06-09	0.0000816	0.0006234	0.1175345	0.8657933	0.0000027
2015-06-10	0.0000742	0.0005787	0.1179105	0.8658202	0.0000028
2015-06-11	0.0000868	0.0005957	0.1179636	0.8656877	0.0000028
2015-06-12	0.0000887	0.0006114	0.1176596	0.8659176	0.0000028
2015-06-15	0.0000857	0.0005961	0.1171808	0.8663005	0.0000027
2015-06-16	0.0000834	0.0005815	0.1168017	0.8665622	0.0000027
2015-06-17	0.0000795	0.0005765	0.1163974	0.8667845	0.0000027
2015-06-18	0.0000720	0.0005725	0.1167411	0.8667172	0.0000027
2015-06-19	0.0000739	0.0005712	0.1165110	0.8669824	0.0000027
2015-06-22	0.0000721	0.0005311	0.1161583	0.8675991	0.0000027
2015-06-23	0.0000852	0.0005518	0.1161684	0.8675658	0.0000027
2015-06-24	0.0000890	0.0005376	0.1146347	0.8691154	0.0000027
2015-06-25	0.0000810	0.0005620	0.1148303	0.8689224	0.0000027
2015-06-26	0.0000877	0.0005612	0.1134849	0.8702093	0.0000027
2015-06-29	0.0000791	0.0005531	0.1126305	0.8710148	0.0000026
2015-06-30	0.0000723	0.0005717	0.1138758	0.8699290	0.0000026
2015-07-02	0.0000674	0.0005474	0.1125508	0.8713758	0.0000026
2015-07-03	0.0000676	0.0005140	0.1114001	0.8727213	0.0000026
2015-07-06	0.0000718	0.0005093	0.1102033	0.8740193	0.0000025
2015-07-07	0.0000660	0.0004975	0.1094763	0.8749043	0.0000025
2015-07-08	0.0000744	0.0004976	0.1084238	0.8760517	0.0000025
2015-07-09	0.0000724	0.0004627	0.1081858	0.8764527	0.0000025
2015-07-10	0.0000796	0.0004526	0.1065619	0.8781970	0.0000024
2015-07-13	0.0000733	0.0004745	0.1064750	0.8782977	0.0000024
2015-07-14	0.0000771	0.0004674	0.1054849	0.8793324	0.0000024
2015-07-15	0.0000708	0.0004515	0.1049676	0.8798698	0.0000023
2015-07-16	0.0000660	0.0004379	0.1048140	0.8800419	0.0000023
2015-07-17	0.0000605	0.0004211	0.1049807	0.8798963	0.0000023
2015-07-20	0.0000564	0.0004078	0.1056397	0.8792186	0.0000023
2015-07-21	0.0000527	0.0003727	0.1047336	0.8801552	0.0000023
2015-07-22	0.0000576	0.0003646	0.1040924	0.8806891	0.0000023
2015-07-23	0.0000699	0.0003394	0.1039194	0.8811076	0.0000023
2015-07-24	0.0000639	0.0003178	0.1032621	0.8819219	0.0000023
2015-07-27	0.0000615	0.0003018	0.1029424	0.8823134	0.0000022

Table 18 The Estimated Volatility by GARCH(1,1) Model (Continued)

Date	GARCH Volatility	Coefficient			
		return_cons	ARCH L1	GARCH L1	ARCH_cons
2015-07-28	0.0000615	0.0003002	0.1036019	0.8810858	0.0000024
2015-07-29	0.0000908	0.0002909	0.1019064	0.8828791	0.0000023
2015-07-31	0.0000827	0.0003028	0.1018054	0.8829382	0.0000023
2015-08-03	0.0000819	0.0003636	0.1058556	0.8785691	0.0000025
2015-08-04	0.0001058	0.0003594	0.1043133	0.8800904	0.0000024
2015-08-05	0.0000965	0.0003230	0.1064310	0.8780561	0.0000025
2015-08-06	0.0000958	0.0003112	0.1046058	0.8799863	0.0000024
2015-08-07	0.0000872	0.0003057	0.1035676	0.8811152	0.0000024
2015-08-10	0.0000839	0.0002972	0.1020471	0.8827153	0.0000023
2015-08-11	0.0000771	0.0002735	0.1011772	0.8836880	0.0000023
2015-08-13	0.0000769	0.0002449	0.1007658	0.8842086	0.0000023
2015-08-14	0.0000818	0.0002588	0.1012195	0.8836327	0.0000023
2015-08-17	0.0000746	0.0002581	0.1003722	0.8845975	0.0000022
2015-08-18	0.0000724	0.0002567	0.1001426	0.8848506	0.0000022
2015-08-19	0.0000712	0.0002525	0.0991462	0.8863655	0.0000023
2015-08-20	0.0001485	0.0002323	0.1036473	0.8811340	0.0000025
2015-08-21	0.0001313	0.0002132	0.0986760	0.8867024	0.0000023
2015-08-24	0.0001231	0.0001933	0.0940162	0.8918588	0.0000022
2015-08-25	0.0001258	0.0002774	0.1198168	0.8706333	0.0000026
2015-08-26	0.0004356	0.0002791	0.1189565	0.8718100	0.0000026
2015-08-27	0.0004381	0.0002714	0.1144272	0.8761124	0.0000025
2015-08-28	0.0003966	0.0002883	0.1173281	0.8741365	0.0000025
2015-08-31	0.0004687	0.0002821	0.1146243	0.8764607	0.0000024
2015-09-01	0.0004176	0.0002852	0.1130012	0.8777925	0.0000024
2015-09-02	0.0003873	0.0002787	0.1127030	0.8779821	0.0000024
2015-09-03	0.0003807	0.0002783	0.1118219	0.8783382	0.0000024
2015-09-04	0.0003450	0.0002777	0.1110746	0.8784047	0.0000024
2015-09-07	0.0003091	0.0002755	0.1113958	0.8775690	0.0000025
2015-09-08	0.0002900	0.0002799	0.1105809	0.8775678	0.0000025
2015-09-09	0.0002558	0.0002876	0.1095192	0.8778705	0.0000025
2015-09-10	0.0002303	0.0003000	0.1105627	0.8763350	0.0000026
2015-09-11	0.0002248	0.0003398	0.1087878	0.8785768	0.0000025
2015-09-14	0.0002017	0.0003011	0.1088471	0.8789473	0.0000025
2015-09-15	0.0001959	0.0002852	0.1091877	0.8778878	0.0000025
2015-09-16	0.0001745	0.0002735	0.1100131	0.8762840	0.0000026
2015-09-17	0.0001575	0.0002920	0.1107074	0.8751302	0.0000026
2015-09-18	0.0001481	0.0002924	0.1118294	0.8732914	0.0000027
2015-09-21	0.0001347	0.0003008	0.1139814	0.8701079	0.0000028
2015-09-22	0.0001176	0.0003067	0.1172567	0.8656498	0.0000030
2015-09-23	0.0001082	0.0002989	0.1137498	0.8697975	0.0000029
2015-09-24	0.0001135	0.0002910	0.1162774	0.8664345	0.0000030
2015-09-25	0.0001057	0.0003446	0.1188601	0.8644937	0.0000030
2015-09-28	0.0000938	0.0003633	0.1207129	0.8620962	0.0000030
2015-09-29	0.0000909	0.0003122	0.1122593	0.8734067	0.0000027
2015-09-30	0.0001310	0.0002838	0.1132673	0.8723361	0.0000027
2015-10-01	0.0001197	0.0002694	0.1130708	0.8720375	0.0000028
2015-10-02	0.0001071	0.0002646	0.1132648	0.8713611	0.0000028
2015-10-05	0.0000963	0.0002524	0.1138150	0.8703177	0.0000028
2015-10-06	0.0000882	0.0002676	0.1119787	0.8729923	0.0000027
2015-10-07	0.0001049	0.0002632	0.1120232	0.8727893	0.0000027
2015-10-08	0.0001010	0.0002969	0.1104442	0.8760275	0.0000026
2015-10-09	0.0001454	0.0002891	0.1091256	0.8770074	0.0000026

Table 18 The Estimated Volatility by GARCH(1,1) Model (Continued)

Date	GARCH Volatility	Coefficient			
		return_cons	ARCH L1	GARCH L1	ARCH_cons
2015-10-12	0.0001312	0.0002863	0.1101687	0.8763649	0.0000026
2015-10-13	0.0001420	0.0002797	0.1087737	0.8774539	0.0000026
2015-10-14	0.0001273	0.0002724	0.1077088	0.8782486	0.0000026
2015-10-15	0.0001171	0.0002529	0.1072718	0.8785137	0.0000026
2015-10-16	0.0001121	0.0002748	0.1067715	0.8794696	0.0000025
2015-10-19	0.0001250	0.0002792	0.1059991	0.8799905	0.0000025
2015-10-20	0.0001150	0.0002556	0.1085673	0.8771290	0.0000026
2015-10-21	0.0001048	0.0002431	0.1080216	0.8774130	0.0000026
2015-10-22	0.0000949	0.0002363	0.1068942	0.8783268	0.0000026
2015-10-26	0.0000865	0.0002387	0.1060061	0.8790048	0.0000026
2015-10-27	0.0000788	0.0002568	0.1052026	0.8797854	0.0000025
2015-10-28	0.0000769	0.0002581	0.1048874	0.8798723	0.0000025
2015-10-29	0.0000712	0.0002253	0.1026241	0.8823289	0.0000025
2015-10-30	0.0000800	0.0002050	0.1009033	0.8843424	0.0000024
2015-11-02	0.0000947	0.0002013	0.0999260	0.8850642	0.0000024
2015-11-03	0.0000872	0.0002264	0.0996777	0.8857296	0.0000024
2015-11-04	0.0001093	0.0002261	0.0981510	0.8869740	0.0000024
2015-11-05	0.0001000	0.0002440	0.0977214	0.8872252	0.0000024
2015-11-06	0.0000984	0.0002405	0.0982858	0.8864661	0.0000024
2015-11-09	0.0000979	0.0002466	0.0976171	0.8867629	0.0000024
2015-11-10	0.0000896	0.0002159	0.0983808	0.8858442	0.0000024
2015-11-11	0.0000942	0.0002118	0.0980737	0.8857995	0.0000024
2015-11-12	0.0000891	0.0002050	0.0978316	0.8856858	0.0000025
2015-11-13	0.0000849	0.0001983	0.0976144	0.8854949	0.0000025
2015-11-16	0.0000797	0.0001925	0.0972576	0.8853921	0.0000025
2015-11-17	0.0000735	0.0001992	0.0967783	0.8854537	0.0000025
2015-11-18	0.0000704	0.0001898	0.0946227	0.8872014	0.0000025
2015-11-19	0.0000658	0.0001525	0.0898914	0.8915340	0.0000024
2015-11-20	0.0000729	0.0001598	0.0819662	0.8990418	0.0000023
2015-11-23	0.0000709	0.0001899	0.0852665	0.8949944	0.0000024
2015-11-24	0.0000714	0.0002683	0.0906642	0.8910476	0.0000024
2015-11-25	0.0000663	0.0002498	0.0891791	0.8921688	0.0000024
2015-11-26	0.0000674	0.0002391	0.0868630	0.8940918	0.0000023
2015-11-27	0.0000638	0.0001539	0.0860901	0.8956357	0.0000023
2015-11-30	0.0000738	0.0001501	0.0875990	0.8937272	0.0000023
2015-12-01	0.0000692	0.0001645	0.0898223	0.8918191	0.0000024
2015-12-02	0.0000655	0.0001588	0.0897404	0.8916795	0.0000024
2015-12-03	0.0000616	0.0001498	0.0874887	0.8938059	0.0000024
2015-12-04	0.0000766	0.0001551	0.0880457	0.8929706	0.0000024
2015-12-08	0.0000729	0.0001689	0.0876541	0.8935091	0.0000024
2015-12-09	0.0000724	0.0001486	0.0865999	0.8941714	0.0000025
2015-12-11	0.0001086	0.0001173	0.0882696	0.8921525	0.0000026
2015-12-14	0.0001058	0.0000948	0.0898091	0.8901215	0.0000026
2015-12-15	0.0001160	0.0000802	0.0894855	0.8903040	0.0000026
2015-12-16	0.0001197	0.0001557	0.0976350	0.8824877	0.0000028
2015-12-17	0.0001778	0.0001565	0.0938857	0.8858042	0.0000028
2015-12-18	0.0001594	0.0001586	0.0925000	0.8867476	0.0000028
2015-12-21	0.0001500	0.0001455	0.0974249	0.8820723	0.0000029
2015-12-22	0.0001837	0.0001572	0.0855757	0.8940622	0.0000026
2015-12-23	0.0001965	0.0001495	0.0879523	0.8908396	0.0000027
2015-12-24	0.0001804	0.0001531	0.0920087	0.8858370	0.0000028
2015-12-25	0.0001776	0.0001030	0.1008856	0.8759307	0.0000032

Table 18 The Estimated Volatility by GARCH(1,1) Model (Continued)

Date	GARCH Volatility	Coefficient			
		return_cons	ARCH L1	GARCH L1	ARCH_cons
2015-12-28	0.0001627	0.0000972	0.0997528	0.8766755	0.0000032
2015-12-29	0.0001458	0.0000959	0.0993159	0.8765278	0.0000032
2015-12-30	0.0001307	0.0000911	0.0994808	0.8756437	0.0000032
2016-01-04	0.0001191	0.0000893	0.1001565	0.8739915	0.0000033
2016-01-05	0.0001103	0.0000513	0.0966790	0.8801005	0.0000031
2016-01-06	0.0001509	0.0000431	0.0971062	0.8793015	0.0000031
2016-01-07	0.0001477	0.0000161	0.0942367	0.8816303	0.0000031
2016-01-08	0.0001400	0.0000192	0.0979664	0.8821458	0.0000029
2016-01-11	0.0002627	0.0000635	0.1035204	0.8768452	0.0000030
2016-01-12	0.0002760	0.0000375	0.1025577	0.8772315	0.0000030
2016-01-13	0.0002592	0.0000665	0.1047815	0.8751228	0.0000031
2016-01-14	0.0002779	0.0000943	0.1069205	0.8731955	0.0000031
2016-01-15	0.0002974	0.0000923	0.1064189	0.8738073	0.0000031
2016-01-18	0.0002967	0.0000720	0.1071566	0.8731198	0.0000031
2016-01-19	0.0003066	0.0000777	0.1056802	0.8738587	0.0000031
2016-01-20	0.0002737	0.0000922	0.1063137	0.8741876	0.0000030
2016-01-21	0.0003026	0.0000837	0.1063047	0.8743063	0.0000030
2016-01-22	0.0003040	0.0000833	0.1052874	0.8744811	0.0000031
2016-01-25	0.0002704	0.0000916	0.1056429	0.8747229	0.0000030
2016-01-26	0.0002937	0.0000958	0.1035457	0.8758081	0.0000030
2016-01-27	0.0002567	0.0000733	0.0993826	0.8784993	0.0000031
2016-01-28	0.0002277	0.0000833	0.1012127	0.8758819	0.0000032
2016-01-29	0.0002122	0.0000942	0.1025886	0.8738782	0.0000032
2016-02-01	0.0002053	0.0001071	0.1042631	0.8718393	0.0000033
2016-02-02	0.0002060	0.0001299	0.1103143	0.8645118	0.0000035
2016-02-03	0.0001846	0.0001322	0.1110929	0.8632844	0.0000036
2016-02-04	0.0001818	0.0001471	0.1115156	0.8616996	0.0000037
2016-02-05	0.0001645	0.0001533	0.1119134	0.8602618	0.0000037
2016-02-08	0.0001479	0.0001681	0.1121237	0.8591029	0.0000038
2016-02-09	0.0001370	0.0001694	0.1132276	0.8564880	0.0000039
2016-02-10	0.0001205	0.0001864	0.1163478	0.8512772	0.0000042
2016-02-11	0.0001082	0.0001940	0.1177584	0.8479894	0.0000043
2016-02-12	0.0001030	0.0001585	0.1099805	0.8607553	0.0000038
2016-02-15	0.0001420	0.0001534	0.1104920	0.8590423	0.0000039
2016-02-16	0.0001256	0.0001497	0.1118454	0.8562514	0.0000041
2016-02-17	0.0001224	0.0001504	0.1119711	0.8549902	0.0000041
2016-02-18	0.0001086	0.0001497	0.1121158	0.8533897	0.0000042
2016-02-19	0.0000969	0.0001631	0.1122081	0.8525762	0.0000043
2016-02-23	0.0001008	0.0002061	0.1003526	0.8706419	0.0000036
2016-02-24	0.0001627	0.0001819	0.1034815	0.8670077	0.0000037
2016-02-25	0.0001466	0.0001852	0.1030302	0.8666310	0.0000038
2016-02-26	0.0001313	0.0001865	0.1015623	0.8670199	0.0000038
2016-02-29	0.0001176	0.0002008	0.0989923	0.8691604	0.0000038
2016-03-01	0.0001145	0.0001870	0.1018284	0.8652058	0.0000039
2016-03-02	0.0001145	0.0001876	0.0944324	0.8744164	0.0000036
2016-03-03	0.0001296	0.0002005	0.0981129	0.8706293	0.0000037
2016-03-04	0.0001427	0.0002081	0.1000589	0.8678020	0.0000038
2016-03-07	0.0001416	0.0001428	0.0926710	0.8765118	0.0000036
2016-03-08	0.0001285	0.0001618	0.0961979	0.8729656	0.0000036
2016-03-09	0.0001457	0.0001701	0.0988160	0.8723007	0.0000036
2016-03-10	0.0001680	0.0001925	0.0981828	0.8729842	0.0000035
2016-03-11	0.0001685	0.0001673	0.0971048	0.8739480	0.0000035

Table 18 The Estimated Volatility by GARCH(1,1) Model (Continued)

Date	GARCH Volatility	Coefficient			
		return_cons	ARCH L1	GARCH L1	ARCH_cons
2016-03-14	0.0001700	0.0001834	0.0968284	0.8740620	0.0000035
2016-03-15	0.0001678	0.0001884	0.0970357	0.8727764	0.0000036
2016-03-16	0.0001508	0.0002243	0.0978559	0.8722793	0.0000036
2016-03-17	0.0001485	0.0001946	0.0982307	0.8708279	0.0000037
2016-03-18	0.0001374	0.0001969	0.0981930	0.8701037	0.0000038
2016-03-21	0.0001240	0.0001788	0.0987907	0.8680307	0.0000039
2016-03-22	0.0001126	0.0001946	0.0987745	0.8683776	0.0000039
2016-03-23	0.0001130	0.0002118	0.0990586	0.8671378	0.0000039
2016-03-24	0.0001035	0.0002058	0.0995147	0.8665195	0.0000040
2016-03-25	0.0001092	0.0001996	0.0993974	0.8664821	0.0000040
2016-03-28	0.0001037	0.0001669	0.0994383	0.8660799	0.0000040
2016-03-29	0.0001062	0.0001597	0.0993786	0.8657889	0.0000040
2016-03-30	0.0000982	0.0001644	0.0999448	0.8646155	0.0000040
2016-03-31	0.0000903	0.0001807	0.0988167	0.8670534	0.0000039
2016-04-01	0.0001038	0.0001851	0.0989570	0.8662534	0.0000040
2016-04-04	0.0000950	0.0001774	0.0999243	0.8646764	0.0000040
2016-04-05	0.0000915	0.0001650	0.0994626	0.8643009	0.0000040
2016-04-07	0.0000862	0.0001489	0.0984661	0.8687138	0.0000039
2016-04-08	0.0001450	0.0001317	0.0992563	0.8681886	0.0000039
2016-04-11	0.0001556	0.0001385	0.0990476	0.8684881	0.0000039
2016-04-12	0.0001524	0.0001419	0.0976943	0.8694171	0.0000039
2016-04-18	0.0001376	0.0001613	0.0983033	0.8689192	0.0000039
2016-04-19	0.0001397	0.0001723	0.0987864	0.8681265	0.0000039
2016-04-20	0.0001374	0.0001980	0.0981542	0.8693100	0.0000038
2016-04-21	0.0001462	0.0001912	0.0969651	0.8697191	0.0000038
2016-04-22	0.0001311	0.0002033	0.0963047	0.8697413	0.0000039
2016-04-25	0.0001229	0.0002292	0.0973429	0.8695586	0.0000038
2016-04-26	0.0001252	0.0001989	0.0970684	0.8689522	0.0000039
2016-04-27	0.0001136	0.0001819	0.0973175	0.8680325	0.0000040
2016-04-28	0.0001086	0.0001843	0.0973379	0.8676107	0.0000040
2016-04-29	0.0001028	0.0001909	0.0985082	0.8660436	0.0000041
2016-05-03	0.0001047	0.0001957	0.0981187	0.8662919	0.0000040
2016-05-04	0.0000970	0.0001848	0.0979990	0.8661778	0.0000040
2016-05-09	0.0000916	0.0001875	0.0982391	0.8654395	0.0000041
2016-05-10	0.0000861	0.0001842	0.0985473	0.8646249	0.0000041
2016-05-11	0.0000813	0.0001733	0.0989906	0.8637980	0.0000041
2016-05-12	0.0000769	0.0001573	0.0988708	0.8641277	0.0000041
2016-05-13	0.0000807	0.0002058	0.0974452	0.8673957	0.0000040
2016-05-16	0.0001037	0.0002066	0.0972065	0.8674074	0.0000040
2016-05-17	0.0000970	0.0002360	0.1005756	0.8622078	0.0000042
2016-05-18	0.0000894	0.0002750	0.1023159	0.8601796	0.0000043
2016-05-19	0.0000942	0.0002739	0.1012100	0.8616190	0.0000042
2016-05-23	0.0000887	0.0002486	0.1002494	0.8633239	0.0000041
2016-05-24	0.0000963	0.0002299	0.0999187	0.8631835	0.0000041
2016-05-25	0.0000882	0.0002434	0.1003588	0.8621707	0.0000042
2016-05-26	0.0000807	0.0002515	0.0998038	0.8631924	0.0000041
2016-05-27	0.0000844	0.0002531	0.0983558	0.8653287	0.0000040
2016-05-30	0.0000778	0.0002643	0.0975178	0.8667482	0.0000039
2016-05-31	0.0000813	0.0002872	0.0968107	0.8680008	0.0000039
2016-06-01	0.0000829	0.0002992	0.0971721	0.8669323	0.0000039
2016-06-02	0.0000763	0.0002799	0.0958241	0.8689635	0.0000038
2016-06-03	0.0000775	0.0002887	0.0945410	0.8710919	0.0000037

Table 18 The Estimated Volatility by GARCH(1,1) Model (Continued)

Date	GARCH Volatility	Coefficient			
		return_cons	ARCH L1	GARCH L1	ARCH_cons
2016-06-06	0.0000730	0.0003132	0.0947990	0.8702172	0.0000038
2016-06-07	0.0000771	0.0003311	0.0957396	0.8678309	0.0000039
2016-06-08	0.0000725	0.0003381	0.0954326	0.8678794	0.0000039
2016-06-09	0.0000668	0.0003449	0.0950104	0.8684794	0.0000038
2016-06-10	0.0000627	0.0003201	0.0940590	0.8686278	0.0000038
2016-06-13	0.0000673	0.0003086	0.0935143	0.8697773	0.0000037
2016-06-14	0.0000652	0.0002905	0.0933904	0.8700458	0.0000037
2016-06-15	0.0000664	0.0002905	0.0914738	0.8708590	0.0000037
2016-06-16	0.0000633	0.0003032	0.0931520	0.8689530	0.0000037
2016-06-17	0.0000620	0.0002566	0.0926462	0.8673613	0.0000040
2016-06-20	0.0000903	0.0002286	0.0770366	0.8837731	0.0000036
2016-06-21	0.0000873	0.0002094	0.0763030	0.8832735	0.0000036
2016-06-22	0.0000815	0.0003306	0.0772835	0.8891229	0.0000032
2016-06-23	0.0000794	0.0003218	0.0779640	0.8880585	0.0000032
2016-06-24	0.0000769	0.0003376	0.0781299	0.8875944	0.0000032
2016-06-27	0.0000834	0.0002707	0.0780630	0.8878218	0.0000033
2016-06-28	0.0001181	0.0002750	0.0780865	0.8876382	0.0000033
2016-06-29	0.0001103	0.0002826	0.0789548	0.8863121	0.0000033
2016-06-30	0.0001064	0.0002871	0.0795051	0.8850751	0.0000034
2016-07-04	0.0000988	0.0002540	0.0776969	0.8878359	0.0000033
2016-07-05	0.0000913	0.0002597	0.0777619	0.8875024	0.0000033
2016-07-06	0.0000898	0.0002766	0.0764400	0.8892763	0.0000032
2016-07-07	0.0000857	0.0002492	0.0759851	0.8893596	0.0000032
2016-07-08	0.0000795	0.0002586	0.0762825	0.8887073	0.0000033
2016-07-11	0.0000741	0.0002667	0.0768463	0.8876353	0.0000033
2016-07-12	0.0000692	0.0002853	0.0772739	0.8871289	0.0000033
2016-07-13	0.0000733	0.0002982	0.0783031	0.8853661	0.0000033
2016-07-14	0.0000705	0.0002853	0.0768884	0.8872865	0.0000033
2016-07-15	0.0000667	0.0002996	0.0777542	0.8858458	0.0000033
2016-07-20	0.0000681	0.0003351	0.0769270	0.8884469	0.0000032
2016-07-21	0.0000645	0.0003776	0.0752389	0.8913293	0.0000031
2016-07-22	0.0000801	0.0003735	0.0754782	0.8906952	0.0000031
2016-07-25	0.0000767	0.0003935	0.0755569	0.8904366	0.0000031
2016-07-26	0.0000733	0.0003859	0.0753562	0.8905922	0.0000031
2016-07-27	0.0000688	0.0003513	0.0744827	0.8921231	0.0000031
2016-07-28	0.0000688	0.0003970	0.0741774	0.8934317	0.0000030
2016-07-29	0.0000686	0.0004057	0.0747169	0.8924893	0.0000030
2016-08-01	0.0000678	0.0003855	0.0745061	0.8929989	0.0000030
2016-08-02	0.0000646	0.0003641	0.0749817	0.8919936	0.0000030
2016-08-03	0.0000667	0.0003467	0.0752325	0.8913153	0.0000031
2016-08-04	0.0000727	0.0003524	0.0758347	0.8901989	0.0000031
2016-08-05	0.0000721	0.0003328	0.0747928	0.8923063	0.0000030
2016-08-08	0.0000676	0.0003520	0.0756294	0.8908603	0.0000031
2016-08-09	0.0000704	0.0003481	0.0759865	0.8914779	0.0000031
2016-08-10	0.0000971	0.0003637	0.0753378	0.8921320	0.0000031
2016-08-11	0.0000902	0.0003748	0.0749466	0.8923254	0.0000031
2016-08-15	0.0000836	0.0004188	0.0751492	0.8932402	0.0000030
2016-08-16	0.0000788	0.0004160	0.0748653	0.8932019	0.0000030
2016-08-17	0.0000740	0.0004037	0.0748837	0.8927994	0.0000030
2016-08-18	0.0000736	0.0003891	0.0749695	0.8922266	0.0000031
2016-08-19	0.0000712	0.0004034	0.0753198	0.8914025	0.0000031
2016-08-22	0.0000751	0.0003727	0.0752644	0.8918023	0.0000031

Table 18 The Estimated Volatility by GARCH(1,1) Model (Continued)

Date	GARCH Volatility	Coefficient			
		return_cons	ARCH L1	GARCH L1	ARCH_cons
2016-08-23	0.0000737	0.0003634	0.0752217	0.8916019	0.0000031
2016-08-24	0.0000691	0.0003409	0.0754248	0.8916810	0.0000031
2016-08-25	0.0000651	0.0003428	0.0755847	0.8912076	0.0000031
2016-08-26	0.0000629	0.0003297	0.0758821	0.8905697	0.0000031
2016-08-29	0.0000599	0.0003406	0.0764199	0.8896257	0.0000031
2016-08-30	0.0000575	0.0003277	0.0769225	0.8885891	0.0000032
2016-08-31	0.0000562	0.0003375	0.0777526	0.8875230	0.0000032
2016-09-01	0.0000531	0.0003163	0.0785821	0.8873563	0.0000031
2016-09-02	0.0000504	0.0003154	0.0789595	0.8869760	0.0000032
2016-09-05	0.0000514	0.0002544	0.0769852	0.8882924	0.0000032
2016-09-06	0.0000653	0.0002306	0.0774575	0.8859535	0.0000034
2016-09-07	0.0000808	0.0002206	0.0763006	0.8875030	0.0000034
2016-09-08	0.0000754	0.0002129	0.0759742	0.8877077	0.0000034
2016-09-09	0.0000753	0.0002076	0.0775786	0.8846887	0.0000036
2016-09-12	0.0000914	0.0001990	0.0769388	0.8852816	0.0000036
2016-09-13	0.0000908	0.0001967	0.0826222	0.8763913	0.0000040
2016-09-14	0.0001399	0.0002683	0.0926403	0.8633775	0.0000045
2016-09-15	0.0001940	0.0002573	0.0906428	0.8654911	0.0000044
2016-09-16	0.0001736	0.0002457	0.0888038	0.8670495	0.0000044
2016-09-19	0.0001554	0.0002569	0.0890167	0.8662094	0.0000044
2016-09-20	0.0001520	0.0002424	0.0885127	0.8669744	0.0000044
2016-09-21	0.0001423	0.0002170	0.0888454	0.8664926	0.0000044
2016-09-22	0.0001445	0.0002086	0.0885501	0.8666432	0.0000045
2016-09-23	0.0001386	0.0002076	0.0886408	0.8667563	0.0000045
2016-09-26	0.0001395	0.0002075	0.0882315	0.8668693	0.0000045
2016-09-27	0.0001335	0.0002035	0.0874918	0.8664117	0.0000045
2016-09-28	0.0001210	0.0002219	0.0877836	0.8650700	0.0000046
2016-09-29	0.0001096	0.0002083	0.0874089	0.8645285	0.0000047
2016-09-30	0.0001036	0.0002076	0.0872475	0.8643968	0.0000047
2016-10-03	0.0001009	0.0001996	0.0871274	0.8635185	0.0000048
2016-10-04	0.0000950	0.0001887	0.0877680	0.8617480	0.0000049
2016-10-05	0.0000912	0.0002016	0.0860873	0.8663961	0.0000046
2016-10-06	0.0000998	0.0002027	0.0857565	0.8659409	0.0000047
2016-10-07	0.0000912	0.0002009	0.0859794	0.8645655	0.0000048
2016-10-10	0.0000839	0.0001909	0.0861628	0.8638228	0.0000048
2016-10-11	0.0000866	0.0001321	0.0782914	0.8851865	0.0000038
2016-10-12	0.0001544	0.0001263	0.0783319	0.8849178	0.0000038
2016-10-13	0.0001539	0.0001352	0.0814220	0.8826617	0.0000038
2016-10-14	0.0001816	0.0001388	0.0811691	0.8827634	0.0000038
2016-10-17	0.0001857	0.0001973	0.0917551	0.8750592	0.0000038
2016-10-18	0.0003042	0.0001918	0.0902501	0.8761394	0.0000038
2016-10-19	0.0002699	0.0001838	0.0890822	0.8764937	0.0000038
2016-10-20	0.0002393	0.0002018	0.0875255	0.8778723	0.0000038
2016-10-21	0.0002132	0.0002059	0.0875797	0.8761622	0.0000039
2016-10-25	0.0001924	0.0002399	0.0868981	0.8768992	0.0000039
2016-10-26	0.0001715	0.0002388	0.0873075	0.8743032	0.0000041
2016-10-27	0.0001540	0.0002308	0.0879689	0.8726565	0.0000042
2016-10-28	0.0001492	0.0002074	0.0883252	0.8708051	0.0000043
2016-10-31	0.0001327	0.0002017	0.0896835	0.8661873	0.0000046
2016-11-01	0.0001180	0.0001817	0.0913692	0.8608251	0.0000049
2016-11-02	0.0001049	0.0001818	0.0934966	0.8549705	0.0000053

Table 18 The Estimated Volatility by GARCH(1,1) Model (Continued)

Date	GARCH Volatility	Coefficient			
		return_cons	ARCH L1	GARCH L1	ARCH_cons
2016-11-03	0.0000969	0.0001980	0.0957098	0.8496273	0.0000056
2016-11-04	0.0000891	0.0001785	0.0977087	0.8440001	0.0000059
2016-11-07	0.0000835	0.0001636	0.0996874	0.8387301	0.0000062
2016-11-08	0.0000825	0.0001997	0.0975014	0.8452266	0.0000058
2016-11-09	0.0000901	0.0002209	0.0984153	0.8430417	0.0000060
2016-11-10	0.0000864	0.0002124	0.1008934	0.8365165	0.0000063
2016-11-11	0.0000788	0.0002047	0.1028440	0.8315098	0.0000066
2016-11-14	0.0000740	0.0001669	0.1019771	0.8333018	0.0000065
2016-11-15	0.0000880	0.0001288	0.1038307	0.8307233	0.0000067
2016-11-16	0.0001233	0.0001073	0.1010571	0.8413410	0.0000060
2016-11-17	0.0001136	0.0000803	0.1004229	0.8420952	0.0000060
2016-11-18	0.0001030	0.0000839	0.1002855	0.8405331	0.0000061
2016-11-21	0.0000929	0.0000737	0.1010198	0.8368738	0.0000064
2016-11-22	0.0000844	0.0000655	0.1024513	0.8320955	0.0000067
2016-11-23	0.0000778	0.0000774	0.1039432	0.8275729	0.0000069
2016-11-24	0.0000761	0.0000763	0.1043258	0.8266966	0.0000070
2016-11-25	0.0000772	0.0000745	0.1055743	0.8229789	0.0000072
2016-11-28	0.0000746	0.0000992	0.1064841	0.8205696	0.0000074
2016-11-29	0.0000754	0.0000986	0.1085364	0.8146566	0.0000077
2016-11-30	0.0000699	0.0000733	0.1086096	0.8164758	0.0000076
2016-12-01	0.0000665	0.0000981	0.1094455	0.8119379	0.0000079
2016-12-02	0.0000752	0.0001447	0.1091523	0.8173599	0.0000075
2016-12-06	0.0000718	0.0001118	0.1093282	0.8158888	0.0000076
2016-12-07	0.0000733	0.0001194	0.1096644	0.8127457	0.0000079
2016-12-08	0.0000792	0.0001186	0.1091582	0.8121541	0.0000080
2016-12-09	0.0000733	0.0001348	0.1090157	0.8124155	0.0000079
2016-12-13	0.0000687	0.0001228	0.1090421	0.8123333	0.0000079
2016-12-14	0.0000645	0.0001141	0.1091708	0.8126571	0.0000079
2016-12-15	0.0000621	0.0000830	0.1087188	0.8123175	0.0000080
2016-12-16	0.0000644	0.0000684	0.1079414	0.8138907	0.0000079
2016-12-19	0.0000620	0.0000589	0.1072963	0.8161672	0.0000077
2016-12-20	0.0000588	0.0000593	0.1068383	0.8184398	0.0000075
2016-12-21	0.0000565	0.0000444	0.1065499	0.8198557	0.0000074
2016-12-22	0.0000559	0.0000214	0.1063176	0.8217775	0.0000072
2016-12-23	0.0000550	0.0000062	0.1059215	0.8250304	0.0000070
2016-12-26	0.0000527	0.0000120	0.1056173	0.8281741	0.0000067
2016-12-27	0.0000512	0.0000117	0.1055724	0.8302417	0.0000065
2016-12-28	0.0000510	0.0000008	0.1053402	0.8342906	0.0000061
2016-12-29	0.0000490	0.0000247	0.1050106	0.8359993	0.0000060
2016-12-30	0.0000525	0.0000421	0.1055505	0.8297707	0.0000066
2017-01-04	0.0000619	0.0000498	0.1046375	0.8335643	0.0000063
2017-01-05	0.0000628	0.0000660	0.1089208	0.8151380	0.0000077
2017-01-06	0.0000865	0.0000775	0.1080870	0.8173828	0.0000075
2017-01-09	0.0000801	0.0001017	0.1061801	0.8231065	0.0000071
2017-01-10	0.0000740	0.0000695	0.1058937	0.8251395	0.0000070
2017-01-11	0.0000715	0.0000818	0.1055569	0.8263785	0.0000069
2017-01-12	0.0000691	0.0000849	0.1056425	0.8270004	0.0000068
2017-01-13	0.0000647	0.0000905	0.1061045	0.8270685	0.0000067
2017-01-16	0.0000613	0.0001178	0.1060520	0.8288729	0.0000066
2017-01-17	0.0000595	0.0001075	0.1077883	0.8259150	0.0000067
2017-01-18	0.0000573	0.0001267	0.1069786	0.8303285	0.0000063

Table 18 The Estimated Volatility by GARCH(1,1) Model (Continued)

Date	GARCH Volatility	Coefficient			
		return_cons	ARCH L1	GARCH L1	ARCH_cons
2017-01-19	0.0000556	0.0001121	0.1091206	0.8263490	0.0000065
2017-01-20	0.0000543	0.0000846	0.1078209	0.8322665	0.0000061
2017-01-23	0.0000531	0.0000808	0.1091607	0.8308698	0.0000061
2017-01-24	0.0000520	0.0000919	0.1111333	0.8281310	0.0000062
2017-01-25	0.0000521	0.0001047	0.1140593	0.8196529	0.0000067
2017-01-26	0.0000580	0.0001177	0.1166581	0.8134818	0.0000071
2017-01-27	0.0000573	0.0001068	0.1162688	0.8251334	0.0000061
2017-01-30	0.0000609	0.0001085	0.1154427	0.8257461	0.0000061
2017-01-31	0.0000578	0.0001008	0.1149525	0.8261344	0.0000061
2017-02-01	0.0000564	0.0000703	0.1159869	0.8187469	0.0000067
2017-02-02	0.0000661	0.0000674	0.1149518	0.8197133	0.0000067
2017-02-03	0.0000615	0.0000475	0.1144745	0.8207319	0.0000067
2017-02-06	0.0000593	0.0000648	0.1148251	0.8169122	0.0000070
2017-02-07	0.0000644	0.0000692	0.1146159	0.8158683	0.0000071
2017-02-08	0.0000638	0.0000464	0.1144895	0.8151761	0.0000072
2017-02-09	0.0000630	0.0000610	0.1142727	0.8145114	0.0000072
2017-02-10	0.0000623	0.0000381	0.1146026	0.8122457	0.0000074
2017-02-14	0.0000625	0.0000535	0.1141303	0.8136443	0.0000073
2017-02-15	0.0000607	0.0000195	0.1152724	0.8058545	0.0000080
2017-02-16	0.0000704	0.0000180	0.1146691	0.8060761	0.0000080
2017-02-17	0.0000666	0.0000170	0.1144156	0.8058524	0.0000080
2017-02-20	0.0000627	-0.0000010	0.1144138	0.8090672	0.0000077
2017-02-21	0.0000596	0.0000074	0.1133357	0.8115439	0.0000076
2017-02-22	0.0000576	-0.0000225	0.1131068	0.8085505	0.0000079
2017-02-23	0.0000635	-0.0000071	0.1120308	0.8099282	0.0000079
2017-02-24	0.0000639	-0.0000135	0.1109479	0.8120154	0.0000077
2017-02-27	0.0000621	-0.0000130	0.1097042	0.8155506	0.0000075
2017-02-28	0.0000591	-0.0000232	0.1093442	0.8160881	0.0000075
2017-03-01	0.0000592	-0.0000172	0.1084576	0.8192741	0.0000073
2017-03-02	0.0000574	0.0000075	0.1083759	0.8184377	0.0000073
2017-03-03	0.0000599	0.0000308	0.1068145	0.8252593	0.0000068
2017-03-06	0.0000563	0.0000185	0.1055245	0.8300971	0.0000065
2017-03-07	0.0000550	-0.0000201	0.1059459	0.8281993	0.0000067
2017-03-08	0.0000581	-0.0000197	0.1036666	0.8354270	0.0000062
2017-03-09	0.0000551	-0.0000083	0.1027386	0.8383386	0.0000060
2017-03-10	0.0000551	-0.0000112	0.1017392	0.8424796	0.0000057
2017-03-13	0.0000530	-0.0000212	0.1016393	0.8438755	0.0000055
2017-03-14	0.0000522	-0.0000115	0.1015383	0.8462221	0.0000053
2017-03-15	0.0000499	-0.0000108	0.1015572	0.8486789	0.0000051
2017-03-16	0.0000471	0.0000073	0.1010063	0.8533553	0.0000047
2017-03-17	0.0000479	0.0000366	0.1023101	0.8446307	0.0000054
2017-03-20	0.0000578	0.0000475	0.1020343	0.8468422	0.0000052
2017-03-21	0.0000538	0.0000723	0.1010049	0.8514971	0.0000049
2017-03-22	0.0000510	0.0000895	0.1018569	0.8509316	0.0000048
2017-03-23	0.0000491	0.0001208	0.1007202	0.8573065	0.0000044
2017-03-24	0.0000465	0.0001332	0.1008696	0.8591216	0.0000042
2017-03-27	0.0000444	0.0001494	0.1015128	0.8587404	0.0000042
2017-03-28	0.0000441	0.0001242	0.1012765	0.8618081	0.0000039
2017-03-29	0.0000427	0.0001549	0.1013460	0.8629434	0.0000038
2017-03-30	0.0000423	0.0001706	0.1011677	0.8657352	0.0000036
2017-03-31	0.0000408	0.0001808	0.1012518	0.8670791	0.0000034

Table 18 The Estimated Volatility by GARCH(1,1) Model (Continued)

Date	GARCH Volatility	Coefficient			
		return_cons	ARCH L1	GARCH L1	ARCH_cons
2017-04-03	0.0000404	0.0001668	0.1015695	0.8668850	0.0000034
2017-04-04	0.0000403	0.0002147	0.1021329	0.8696064	0.0000032
2017-04-05	0.0000382	0.0002173	0.1014050	0.8729459	0.0000029
2017-04-07	0.0000355	0.0002168	0.1009482	0.8760390	0.0000027
2017-04-10	0.0000331	0.0002289	0.1007129	0.8784026	0.0000025
2017-04-11	0.0000312	0.0002237	0.1005882	0.8812786	0.0000022
2017-04-12	0.0000285	0.0002254	0.1005464	0.8843790	0.0000019
2017-04-17	0.0000277	0.0002412	0.1003887	0.8838673	0.0000020
2017-04-18	0.0000333	0.0001697	0.1010741	0.8768690	0.0000026
2017-04-19	0.0000401	0.0001581	0.1001742	0.8796041	0.0000024
2017-04-20	0.0000381	0.0001371	0.0998848	0.8804728	0.0000023
2017-04-21	0.0000376	0.0001120	0.1008325	0.8816232	0.0000022
2017-04-24	0.0000344	0.0001244	0.0992999	0.8854181	0.0000020
2017-04-25	0.0000321	0.0001047	0.0983172	0.8879519	0.0000018
2017-04-26	0.0000302	0.0001183	0.0970987	0.8915551	0.0000016
2017-04-27	0.0000278	0.0001306	0.0958914	0.8943536	0.0000014
2017-04-28	0.0000261	0.0001280	0.0945411	0.8978245	0.0000012
2017-05-02	0.0000238	0.0001348	0.0938693	0.9005749	0.0000010
2017-05-03	0.0000211	0.0001224	0.0926293	0.9040213	0.0000008
2017-05-04	0.0000184	0.0001298	0.0914121	0.9075547	0.0000006
2017-05-05	0.0000185	0.0001491	0.0919984	0.9056280	0.0000007
2017-05-08	0.0000188	0.0001454	0.0905162	0.9087423	0.0000006
2017-05-09	0.0000165	0.0001483	0.0892721	0.9117654	0.0000004
2017-05-11	0.0000151	0.0001146	0.0891433	0.9124315	0.0000003
2017-05-12	0.0000152	0.0000888	0.0885221	0.9128066	0.0000003
2017-05-15	0.0000172	0.0000645	0.0890153	0.9104153	0.0000005
2017-05-16	0.0000189	0.0000349	0.0883427	0.9118259	0.0000004
2017-05-17	0.0000182	0.0000505	0.0878815	0.9124088	0.0000004
2017-05-18	0.0000174	0.0000343	0.0867599	0.9145191	0.0000003
2017-05-19	0.0000159	0.0000130	0.0861001	0.9155161	0.0000003
2017-05-22	0.0000149	0.0000109	0.0852424	0.9171541	0.0000002
2017-05-23	0.0000149	0.0000589	0.0855746	0.9158215	0.0000003
2017-05-24	0.0000160	0.0000806	0.0852673	0.9162871	0.0000002
2017-05-25	0.0000151	0.0000873	0.0846376	0.9175568	0.0000002
2017-05-26	0.0000134	0.0000946	0.0841934	0.9186663	0.0000001
2017-05-29	0.0000117	0.0000908	0.0839259	0.9196658	0.0000000
2017-05-30	0.0000100	0.0000976	0.0828174	0.9216163	0.0000000
2017-05-31	0.0000083	0.0000994	0.0815882	0.9237058	-0.0000001
2017-06-01	0.0000096	0.0000651	0.0820022	0.9211675	0.0000001
2017-06-02	0.0000110	0.0000797	0.0811584	0.9223916	0.0000000
2017-06-05	0.0000100	0.0001125	0.0798122	0.9240170	0.0000000
2017-06-06	0.0000092	0.0001081	0.0781116	0.9260587	-0.0000001
2017-06-07	0.0000083	0.0001150	0.0765796	0.9278898	-0.0000001
2017-06-08	0.0000075	0.0000651	0.0776370	0.9278297	-0.0000001
2017-06-09	0.0000072	0.0000971	0.0777980	0.9275616	-0.0000001
2017-06-12	0.0000074	0.0000469	0.0784617	0.9268402	-0.0000001
2017-06-13	0.0000076	0.0000212	0.0784480	0.9268338	-0.0000001
2017-06-14	0.0000096	0.0001077	0.0807028	0.9226045	0.0000001
2017-06-15	0.0000118	0.0001345	0.0800866	0.9235397	0.0000000
2017-06-16	0.0000113	0.0001028	0.0803446	0.9231393	0.0000000
2017-06-19	0.0000114	0.0001264	0.0798357	0.9237485	0.0000000

Table 18 The Estimated Volatility by GARCH(1,1) Model (Continued)

Date	GARCH Volatility	Coefficient			
		return_cons	ARCH L1	GARCH L1	ARCH_cons
2017-06-20	0.0000112	0.0001525	0.0802355	0.9232088	0.0000000
2017-06-21	0.0000111	0.0001560	0.0792786	0.9243954	0.0000000
2017-06-22	0.0000102	0.0001459	0.0788855	0.9249112	0.0000000
2017-06-23	0.0000096	0.0001532	0.0782710	0.9258144	0.0000000
2017-06-26	0.0000089	0.0001561	0.0775418	0.9268692	0.0000000
2017-06-27	0.0000079	0.0001662	0.0771158	0.9275243	-0.0000001
2017-06-28	0.0000072	0.0001874	0.0771588	0.9276083	-0.0000001
2017-06-29	0.0000069	0.0001611	0.0775469	0.9272163	-0.0000001
2017-06-30	0.0000067	0.0001414	0.0773720	0.9273868	-0.0000001
2017-07-03	0.0000062	0.0001322	0.0774938	0.9275580	-0.0000001
2017-07-04	0.0000067	0.0001833	0.0789623	0.9251069	0.0000000
2017-07-05	0.0000081	0.0001379	0.0784829	0.9252042	0.0000000
2017-07-06	0.0000085	0.0001424	0.0786888	0.9252170	0.0000000
2017-07-07	0.0000078	0.0001191	0.0795685	0.9244044	0.0000000
2017-07-11	0.0000073	0.0001015	0.0755693	0.9282722	-0.0000001
2017-07-12	0.0000065	0.0000519	0.0781068	0.9273009	-0.0000001
2017-07-13	0.0000065	0.0001063	0.0790398	0.9259490	-0.0000001
2017-07-14	0.0000074	0.0001355	0.0791805	0.9256791	0.0000000
2017-07-17	0.0000073	0.0001382	0.0784523	0.9265260	-0.0000001
2017-07-18	0.0000067	0.0001171	0.0784770	0.9264493	-0.0000001
2017-07-19	0.0000065	0.0001172	0.0779029	0.9271840	-0.0000001
2017-07-20	0.0000063	0.0001538	0.0786691	0.9260333	-0.0000001
2017-07-21	0.0000069	0.0001226	0.0793673	0.9258046	-0.0000001
2017-07-24	0.0000063	0.0001236	0.0785020	0.9267550	-0.0000001
2017-07-25	0.0000058	0.0001473	0.0784437	0.9267319	-0.0000001
2017-07-26	0.0000063	0.0001794	0.0793864	0.9252300	0.0000000
2017-07-27	0.0000072	0.0002058	0.0789867	0.9257861	-0.0000001
2017-07-31	0.0000065	0.0002160	0.0782522	0.9266275	-0.0000001
2017-08-01	0.0000062	0.0001730	0.0786140	0.9260616	-0.0000001
2017-08-02	0.0000064	0.0001607	0.0781055	0.9266183	-0.0000001
2017-08-03	0.0000059	0.0001817	0.0779022	0.9268226	-0.0000001
2017-08-04	0.0000057	0.0001630	0.0778904	0.9267967	-0.0000001
2017-08-07	0.0000055	0.0001671	0.0776453	0.9273515	-0.0000001
2017-08-08	0.0000051	0.0001318	0.0777800	0.9271895	-0.0000001
2017-08-09	0.0000052	0.0001619	0.0778509	0.9270373	-0.0000001
2017-08-10	0.0000053	0.0001291	0.0781873	0.9264812	-0.0000001
2017-08-11	0.0000054	0.0001403	0.0777011	0.9270955	-0.0000001
2017-08-15	0.0000058	0.0000912	0.0794365	0.9244901	0.0000000
2017-08-16	0.0000079	0.0001291	0.0804165	0.9234396	0.0000000
2017-08-17	0.0000084	0.0001206	0.0797408	0.9240822	0.0000000
2017-08-18	0.0000077	0.0001178	0.0790695	0.9247655	0.0000000
2017-08-21	0.0000070	0.0001093	0.0788430	0.9250183	0.0000000
2017-08-22	0.0000066	0.0001352	0.0785972	0.9252665	0.0000000
2017-08-23	0.0000065	0.0001581	0.0788184	0.9250423	0.0000000
2017-08-24	0.0000063	0.0001491	0.0781221	0.9257986	0.0000000
2017-08-25	0.0000058	0.0001691	0.0783328	0.9256407	0.0000000
2017-08-28	0.0000054	0.0001815	0.0784793	0.9261096	-0.0000001
2017-08-29	0.0000063	0.0002277	0.0802134	0.9230121	0.0000000
2017-08-30	0.0000167	0.0001694	0.1119338	0.8901883	0.0000006
2017-08-31	0.0000760	0.0001764	0.1095752	0.8919480	0.0000006
2017-09-01	0.0000675	0.0001998	0.1077250	0.8936466	0.0000006

Table 18 The Estimated Volatility by GARCH(1,1) Model (Continued)

Date	GARCH Volatility	Coefficient			
		return_cons	ARCH L1	GARCH L1	ARCH_cons
2017-09-04	0.0000602	0.0002021	0.1056907	0.8951735	0.0000006
2017-09-05	0.0000545	0.0001908	0.1050084	0.8958637	0.0000006
2017-09-06	0.0000490	0.0001935	0.1031829	0.8972374	0.0000006
2017-09-07	0.0000443	0.0001988	0.1017712	0.8982697	0.0000006
2017-09-08	0.0000405	0.0002148	0.1018292	0.8982095	0.0000006
2017-09-11	0.0000423	0.0002246	0.1011677	0.8986310	0.0000006
2017-09-12	0.0000402	0.0002321	0.1004555	0.8990569	0.0000006
2017-09-13	0.0000367	0.0002502	0.0998998	0.8994894	0.0000006
2017-09-14	0.0000342	0.0002501	0.0998282	0.8993895	0.0000006
2017-09-15	0.0000318	0.0002613	0.1002148	0.8992627	0.0000006
2017-09-18	0.0000439	0.0002646	0.0995832	0.8996348	0.0000006
2017-09-19	0.0000405	0.0002644	0.1001988	0.8993104	0.0000006
2017-09-20	0.0000450	0.0002680	0.0995482	0.8996984	0.0000006
2017-09-21	0.0000413	0.0002646	0.0995869	0.8994991	0.0000006
2017-09-22	0.0000388	0.0002562	0.0991549	0.8998230	0.0000006
2017-09-25	0.0000363	0.0002363	0.1002248	0.8989733	0.0000006
2017-09-26	0.0000412	0.0002459	0.1006937	0.8984495	0.0000006
2017-09-27	0.0000408	0.0002489	0.1008315	0.8981317	0.0000006
2017-09-28	0.0000375	0.0002306	0.1011297	0.8981172	0.0000006
2017-09-29	0.0000344	0.0002280	0.1013261	0.8978427	0.0000006
2017-10-02	0.0000333	0.0002395	0.1013594	0.8976682	0.0000006
2017-10-03	0.0000313	0.0002566	0.1007221	0.8984521	0.0000006
2017-10-04	0.0000419	0.0002714	0.1003613	0.8988941	0.0000006
2017-10-05	0.0000383	0.0002721	0.1001057	0.8990052	0.0000006
2017-10-06	0.0000365	0.0002673	0.0999076	0.8990915	0.0000006
2017-10-09	0.0000334	0.0002807	0.0998036	0.8990502	0.0000006
2017-10-10	0.0000316	0.0002885	0.0999623	0.8989349	0.0000006
2017-10-11	0.0000296	0.0003175	0.0987665	0.9002072	0.0000006
2017-10-12	0.0000390	0.0003257	0.0984090	0.9003731	0.0000006
2017-10-16	0.0000371	0.0003280	0.0981572	0.9004380	0.0000006
2017-10-17	0.0000348	0.0003537	0.0986215	0.9003249	0.0000006
2017-10-18	0.0000414	0.0003464	0.0981473	0.9006992	0.0000006
2017-10-19	0.0000383	0.0003200	0.0996492	0.8996518	0.0000006
2017-10-20	0.0000494	0.0002946	0.1055650	0.8953748	0.0000006
2017-10-24	0.0000751	0.0002915	0.1042172	0.8964125	0.0000006
2017-10-25	0.0000692	0.0002976	0.1028438	0.8973631	0.0000006
2017-10-27	0.0000637	0.0002922	0.1018853	0.8980983	0.0000006
2017-10-30	0.0000584	0.0003000	0.1010789	0.8985841	0.0000006
2017-10-31	0.0000545	0.0002919	0.1006860	0.8988901	0.0000006
2017-11-01	0.0000500	0.0003017	0.1000446	0.8992639	0.0000006
2017-11-02	0.0000457	0.0002913	0.1000942	0.8991289	0.0000006
2017-11-03	0.0000448	0.0002807	0.1005250	0.8988439	0.0000006
2017-11-06	0.0000494	0.0002886	0.1001620	0.8991147	0.0000006
2017-11-07	0.0000452	0.0003060	0.1000016	0.8992322	0.0000006
2017-11-08	0.0000460	0.0003069	0.0997546	0.8992221	0.0000006
2017-11-09	0.0000421	0.0003140	0.0996477	0.8991324	0.0000006
2017-11-10	0.0000386	0.0003015	0.0999718	0.8988360	0.0000006
2017-11-13	0.0000406	0.0003018	0.1005020	0.8986615	0.0000006
2017-11-14	0.0000439	0.0002948	0.1002651	0.8986692	0.0000006
2017-11-15	0.0000404	0.0003120	0.1002110	0.8988937	0.0000006
2017-11-16	0.0000480	0.0002871	0.1011374	0.8983235	0.0000006

Table 18 The Estimated Volatility by GARCH(1,1) Model (Continued)

Date	GARCH Volatility	Coefficient			
		return_cons	ARCH L1	GARCH L1	ARCH_cons
2017-11-17	0.0000507	0.0002897	0.1003806	0.8987493	0.0000006
2017-11-20	0.0000467	0.0003193	0.1014617	0.8981947	0.0000006
2017-11-21	0.0000555	0.0003122	0.1008311	0.8986530	0.0000006
2017-11-22	0.0000505	0.0003053	0.1002286	0.8990350	0.0000006
2017-11-23	0.0000461	0.0003165	0.0996743	0.8993624	0.0000006
2017-11-24	0.0000427	0.0003186	0.0993419	0.8994958	0.0000006
2017-11-27	0.0000398	0.0003080	0.0992465	0.8995287	0.0000006
2017-11-28	0.0000404	0.0003001	0.0993361	0.8993388	0.0000006
2017-11-29	0.0000370	0.0003160	0.0990494	0.8995221	0.0000006
2017-11-30	0.0000371	0.0003278	0.0999504	0.8987322	0.0000006
2017-12-01	0.0000340	0.0003050	0.1007614	0.8981435	0.0000006
2017-12-04	0.0000344	0.0003127	0.1002918	0.8983843	0.0000006
2017-12-06	0.0000322	0.0002992	0.1019203	0.8970165	0.0000006
2017-12-07	0.0000295	0.0003009	0.1017473	0.8969958	0.0000006
2017-12-08	0.0000273	0.0003216	0.1001822	0.8982880	0.0000006
2017-12-12	0.0000291	0.0003318	0.0999080	0.8983762	0.0000006
2017-12-13	0.0000271	0.0003397	0.1003003	0.8979255	0.0000006
2017-12-14	0.0000248	0.0003535	0.1011954	0.8971029	0.0000006
2017-12-15	0.0000236	0.0003735	0.0993748	0.8985979	0.0000006
2017-12-18	0.0000256	0.0003875	0.1005700	0.8975485	0.0000006
2017-12-19	0.0000237	0.0003947	0.1004026	0.8976241	0.0000006
2017-12-20	0.0000231	0.0004150	0.1014972	0.8967007	0.0000006
2017-12-21	0.0000226	0.0004258	0.1007641	0.8972148	0.0000006
2017-12-22	0.0000218	0.0004155	0.1020159	0.8961619	0.0000006
2017-12-25	0.0000205	0.0004280	0.1012737	0.8966877	0.0000006
2017-12-26	0.0000200	0.0004479	0.0992648	0.8982690	0.0000006
2017-12-27	0.0000220	0.0004558	0.0986873	0.8986321	0.0000006
2017-12-28	0.0000202	0.0004641	0.0985243	0.8986490	0.0000006
2017-12-29	0.0000191	0.0004331	0.0964590	0.9002911	0.0000006
2018-01-03	0.0000227	0.0004510	0.0960903	0.9005015	0.0000006
2018-01-04	0.0000242	0.0004713	0.0966664	0.8999332	0.0000007
2018-01-05	0.0000537	0.0004804	0.0971344	0.8994205	0.0000007
2018-01-08	0.0000559	0.0004879	0.0943941	0.9015427	0.0000007
2018-01-09	0.0000506	0.0004896	0.0926242	0.9028630	0.0000007
2018-01-10	0.0000479	0.0005059	0.0946975	0.9009947	0.0000007
2018-01-11	0.0000436	0.0005071	0.0926559	0.9025233	0.0000007
2018-01-12	0.0000401	0.0005154	0.0915975	0.9032322	0.0000007
2018-01-15	0.0000391	0.0005170	0.0945468	0.9005671	0.0000007
2018-01-16	0.0000374	0.0005283	0.0942708	0.9007659	0.0000007
2018-01-17	0.0000438	0.0005324	0.0926852	0.9018840	0.0000007
2018-01-18	0.0000402	0.0005400	0.0914016	0.9027002	0.0000007
2018-01-19	0.0000373	0.0005269	0.0910757	0.9027883	0.0000007
2018-01-22	0.0000382	0.0005294	0.0905541	0.9028896	0.0000007
2018-01-23	0.0000350	0.0005334	0.0896684	0.9033104	0.0000007
2018-01-24	0.0000324	0.0005438	0.0876885	0.9047865	0.0000007
2018-01-25	0.0000324	0.0005496	0.0895055	0.9027267	0.0000007
2018-01-26	0.0000305	0.0005110	0.0899206	0.9023994	0.0000007
2018-01-29	0.0000419	0.0005166	0.0907731	0.9012368	0.0000007
2018-01-30	0.0000387	0.0005569	0.0644777	0.9256388	0.0000006
2018-01-31	0.0000382	0.0005373	0.0697429	0.9202948	0.0000006
2018-02-01	0.0000403	0.0005279	0.0686280	0.9208509	0.0000006

Table 18 The Estimated Volatility by GARCH(1,1) Model (Continued)

Date	GARCH Volatility	Coefficient			
		return_cons	ARCH L1	GARCH L1	ARCH_cons
2018-02-02	0.0000380	0.0005247	0.0728844	0.9162546	0.0000006
2018-02-05	0.0000371	0.0005783	0.0742519	0.9168138	0.0000006
2018-02-06	0.0000356	0.0005600	0.0685246	0.9227105	0.0000006
2018-02-07	0.0000426	0.0005384	0.0714786	0.9199256	0.0000006
2018-02-08	0.0000512	0.0004971	0.0734905	0.9189140	0.0000006
2018-02-09	0.0000480	0.0004883	0.0727294	0.9194856	0.0000006
2018-02-12	0.0000448	0.0004740	0.0716957	0.9204128	0.0000006
2018-02-13	0.0000426	0.0005015	0.0725755	0.9198614	0.0000006
2018-02-14	0.0000435	0.0004942	0.0720864	0.9202108	0.0000006
2018-02-15	0.0000406	0.0004820	0.0719682	0.9202265	0.0000006
2018-02-16	0.0000396	0.0005046	0.0720906	0.9201955	0.0000006
2018-02-19	0.0000406	0.0005084	0.0717357	0.9203428	0.0000006
2018-02-20	0.0000381	0.0005075	0.0715601	0.9203552	0.0000006
2018-02-21	0.0000361	0.0004853	0.0718120	0.9201759	0.0000006
2018-02-22	0.0000359	0.0004935	0.0717857	0.9200364	0.0000006
2018-02-23	0.0000344	0.0004982	0.0718828	0.9199098	0.0000006
2018-02-26	0.0000328	0.0005222	0.0714131	0.9204451	0.0000006
2018-02-27	0.0000380	0.0005515	0.0732136	0.9194463	0.0000006
2018-02-28	0.0000601	0.0005477	0.0719368	0.9205138	0.0000006
2018-03-02	0.0000557	0.0005457	0.0710268	0.9211974	0.0000006
2018-03-05	0.0000523	0.0005303	0.0725534	0.9198022	0.0000006
2018-03-06	0.0000571	0.0005266	0.0723016	0.9198409	0.0000006
2018-03-07	0.0000539	0.0005280	0.0713587	0.9207316	0.0000006
2018-03-08	0.0000537	0.0005180	0.0725098	0.9197039	0.0000006
2018-03-09	0.0000584	0.0005173	0.0724168	0.9195471	0.0000006
2018-03-12	0.0000543	0.0005171	0.0725064	0.9192112	0.0000006
2018-03-13	0.0000514	0.0005621	0.0743507	0.9182358	0.0000006
2018-03-14	0.0000644	0.0005696	0.0736641	0.9186913	0.0000006
2018-03-15	0.0000606	0.0005681	0.0732829	0.9188071	0.0000006
2018-03-16	0.0000562	0.0005680	0.0730903	0.9187362	0.0000006
2018-03-19	0.0000522	0.0005630	0.0733003	0.9182928	0.0000006
2018-03-20	0.0000492	0.0005462	0.0723957	0.9192395	0.0000006
2018-03-21	0.0000494	0.0005403	0.0723191	0.9190819	0.0000006
2018-03-22	0.0000463	0.0005149	0.0742097	0.9175516	0.0000006
2018-03-23	0.0000431	0.0005133	0.0743679	0.9171671	0.0000006
2018-03-26	0.0000402	0.0004948	0.0756111	0.9159775	0.0000006
2018-03-27	0.0000374	0.0005034	0.0756115	0.9158252	0.0000006
2018-03-28	0.0000363	0.0005063	0.0760102	0.9152238	0.0000006
2018-03-29	0.0000341	0.0004975	0.0750383	0.9163631	0.0000006
2018-03-30	0.0000383	0.0004639	0.0760968	0.9159634	0.0000006
2018-04-02	0.0000471	0.0004769	0.0756028	0.9163500	0.0000006
2018-04-03	0.0000465	0.0004832	0.0749089	0.9168272	0.0000006
2018-04-04	0.0000437	0.0004734	0.0749485	0.9168559	0.0000006
2018-04-05	0.0000482	0.0004626	0.0805766	0.9132847	0.0000006
2018-04-09	0.0000951	0.0004691	0.0800689	0.9136294	0.0000006
2018-04-10	0.0000935	0.0004714	0.0799984	0.9136354	0.0000006
2018-04-11	0.0000929	0.0004761	0.0787653	0.9145576	0.0000006
2018-04-12	0.0000864	0.0004845	0.0773019	0.9157699	0.0000006
2018-04-17	0.0000797	0.0004982	0.0767492	0.9161993	0.0000006
2018-04-18	0.0000738	0.0004901	0.0767587	0.9161090	0.0000006
2018-04-19	0.0000745	0.0004739	0.0802544	0.9131370	0.0000006

Table 18 The Estimated Volatility by GARCH(1,1) Model (Continued)

Date	GARCH Volatility	Coefficient			
		return_cons	ARCH L1	GARCH L1	ARCH_cons
2018-04-20	0.0000781	0.0004898	0.0813305	0.9124601	0.0000006
2018-04-23	0.0000901	0.0004866	0.0804722	0.9130915	0.0000006
2018-04-24	0.0000848	0.0004887	0.0806077	0.9129642	0.0000006
2018-04-25	0.0000832	0.0004908	0.0790225	0.9141926	0.0000006
2018-04-26	0.0000772	0.0004943	0.0796904	0.9135005	0.0000006
2018-04-27	0.0000741	0.0004967	0.0787971	0.9141490	0.0000006
2018-04-30	0.0000698	0.0005066	0.0780200	0.9146744	0.0000006
2018-05-02	0.0000658	0.0005108	0.0771722	0.9152035	0.0000006
2018-05-03	0.0000609	0.0005215	0.0763881	0.9158353	0.0000006
2018-05-04	0.0000603	0.0005181	0.0759043	0.9160223	0.0000006
2018-05-07	0.0000561	0.0005105	0.0753743	0.9164768	0.0000006
2018-05-08	0.0000568	0.0005172	0.0760045	0.9156342	0.0000006
2018-05-09	0.0000530	0.0005001	0.0751099	0.9169370	0.0000006
2018-05-10	0.0000624	0.0004923	0.0746876	0.9170915	0.0000006
2018-05-11	0.0000581	0.0004878	0.0742583	0.9172888	0.0000006
2018-05-14	0.0000564	0.0005093	0.0740006	0.9177585	0.0000006
2018-05-15	0.0000632	0.0005145	0.0734028	0.9180294	0.0000006
2018-05-16	0.0000593	0.0005158	0.0734582	0.9177847	0.0000006
2018-05-17	0.0000562	0.0005063	0.0734864	0.9178428	0.0000006
2018-05-18	0.0000605	0.0005085	0.0730857	0.9178938	0.0000006
2018-05-21	0.0000561	0.0005098	0.0730887	0.9175408	0.0000006
2018-05-22	0.0000524	0.0005258	0.0723744	0.9181793	0.0000006
2018-05-23	0.0000530	0.0005180	0.0726321	0.9177002	0.0000006
2018-05-24	0.0000516	0.0005099	0.0725478	0.9176732	0.0000006
2018-05-25	0.0000532	0.0005100	0.0737537	0.9172847	0.0000006
2018-05-28	0.0000650	0.0005172	0.0730501	0.9177080	0.0000006
2018-05-30	0.0000627	0.0005182	0.0710431	0.9194831	0.0000006
2018-05-31	0.0000609	0.0005125	0.0697956	0.9204730	0.0000006
2018-06-01	0.0000603	0.0004824	0.0695648	0.9208694	0.0000006
2018-06-04	0.0000561	0.0004766	0.0703497	0.9198298	0.0000006
2018-06-05	0.0000538	0.0004765	0.0706827	0.9191315	0.0000006
2018-06-06	0.0000505	0.0004952	0.0723223	0.9178479	0.0000006
2018-06-07	0.0000516	0.0005046	0.0722416	0.9177020	0.0000006
2018-06-08	0.0000487	0.0004983	0.0726805	0.9170234	0.0000007
2018-06-11	0.0000470	0.0004855	0.0717889	0.9178952	0.0000006
2018-06-12	0.0000500	0.0004838	0.0717417	0.9175652	0.0000007
2018-06-13	0.0000464	0.0004850	0.0727621	0.9162072	0.0000007
2018-06-14	0.0000434	0.0004758	0.0740271	0.9147385	0.0000007
2018-06-15	0.0000431	0.0004657	0.0747337	0.9138129	0.0000007
2018-06-18	0.0000430	0.0004581	0.0764029	0.9117889	0.0000007
2018-06-19	0.0000421	0.0004614	0.0681337	0.9209427	0.0000006
2018-06-20	0.0000588	0.0004612	0.0710089	0.9195489	0.0000006
2018-06-21	0.0001087	0.0004755	0.0765478	0.9140877	0.0000007
2018-06-22	0.0001348	0.0005019	0.0900670	0.9026397	0.0000007
2018-06-25	0.0001579	0.0004943	0.0871734	0.9054032	0.0000007
2018-06-26	0.0001414	0.0004957	0.0844724	0.9077359	0.0000007
2018-06-27	0.0001329	0.0004900	0.0799512	0.9120432	0.0000007
2018-06-28	0.0001211	0.0004717	0.0778096	0.9142179	0.0000007
2018-06-29	0.0001117	0.0004780	0.0746945	0.9172591	0.0000006
2018-07-02	0.0001086	0.0005013	0.0704619	0.9213369	0.0000006
2018-07-03	0.0001006	0.0005015	0.0710407	0.9204369	0.0000006

Table 18 The Estimated Volatility by GARCH(1,1) Model (Continued)

Date	GARCH Volatility	Coefficient			
		return_cons	ARCH L1	GARCH L1	ARCH_cons
2018-07-04	0.0000956	0.0004927	0.0701676	0.9216953	0.0000006
2018-07-05	0.0000956	0.0005178	0.0672409	0.9244758	0.0000006
2018-07-06	0.0000903	0.0005051	0.0695111	0.9227020	0.0000006
2018-07-09	0.0001071	0.0004887	0.0724572	0.9201687	0.0000006
2018-07-10	0.0001032	0.0004907	0.0718445	0.9204674	0.0000006
2018-07-11	0.0000979	0.0004986	0.0724258	0.9200180	0.0000006
2018-07-12	0.0001042	0.0004903	0.0717228	0.9204959	0.0000006
2018-07-13	0.0000991	0.0004832	0.0706525	0.9212871	0.0000006
2018-07-16	0.0000917	0.0004702	0.0702385	0.9214900	0.0000006
2018-07-17	0.0000852	0.0004661	0.0703644	0.9213753	0.0000006
2018-07-18	0.0000868	0.0004740	0.0694248	0.9219881	0.0000006
2018-07-19	0.0000807	0.0004766	0.0693331	0.9219161	0.0000006
2018-07-20	0.0000792	0.0004795	0.0695233	0.9214737	0.0000006
2018-07-23	0.0000772	0.0004900	0.0689590	0.9225858	0.0000006
2018-07-24	0.0000899	0.0004942	0.0692041	0.9219814	0.0000006
2018-07-25	0.0000839	0.0004951	0.0694015	0.9213858	0.0000006
2018-07-26	0.0000781	0.0005017	0.0706622	0.9200296	0.0000006
2018-07-31	0.0000797	0.0005342	0.0690799	0.9216848	0.0000006
2018-08-01	0.0000772	0.0005347	0.0699601	0.9203896	0.0000006
2018-08-02	0.0000720	0.0005421	0.0685448	0.9220894	0.0000006
2018-08-03	0.0000795	0.0005308	0.0700246	0.9205458	0.0000006
2018-08-06	0.0000807	0.0005300	0.0712664	0.9188653	0.0000007
2018-08-07	0.0000749	0.0005206	0.0705372	0.9195322	0.0000006
2018-08-08	0.0000774	0.0005012	0.0774534	0.9131232	0.0000007
2018-08-09	0.0000749	0.0005054	0.0771473	0.9133140	0.0000007
2018-08-10	0.0000746	0.0005048	0.0770081	0.9130260	0.0000007
2018-08-14	0.0000691	0.0004915	0.0770246	0.9132072	0.0000007
2018-08-15	0.0000745	0.0004830	0.0765441	0.9134547	0.0000007
2018-08-16	0.0000719	0.0004780	0.0757565	0.9146117	0.0000007
2018-08-17	0.0000799	0.0004709	0.0743682	0.9158605	0.0000007
2018-08-20	0.0000742	0.0004636	0.0736300	0.9165120	0.0000007
2018-08-21	0.0000702	0.0004642	0.0724785	0.9175752	0.0000007
2018-08-22	0.0000691	0.0004602	0.0734020	0.9162968	0.0000007
2018-08-23	0.0000657	0.0004487	0.0715129	0.9180724	0.0000007
2018-08-24	0.0000616	0.0004708	0.0725791	0.9170610	0.0000007
2018-08-27	0.0000584	0.0004567	0.0729778	0.9164370	0.0000007
2018-08-28	0.0000546	0.0004790	0.0732452	0.9162693	0.0000007
2018-08-29	0.0000552	0.0004678	0.0747394	0.9144894	0.0000007
2018-08-30	0.0000509	0.0004721	0.0755691	0.9132596	0.0000007
2018-08-31	0.0000472	0.0004780	0.0771535	0.9114120	0.0000007
2018-09-03	0.0000446	0.0004837	0.0785276	0.9095969	0.0000008
2018-09-04	0.0000408	0.0004789	0.0803181	0.9073588	0.0000008
2018-09-05	0.0000379	0.0004674	0.0805383	0.9070156	0.0000008
2018-09-06	0.0000417	0.0004405	0.0687349	0.9210938	0.0000006
2018-09-07	0.0000615	0.0004425	0.0686446	0.9209040	0.0000007
2018-09-10	0.0000585	0.0004287	0.0679183	0.9214677	0.0000007
2018-09-11	0.0000555	0.0004321	0.0676142	0.9214360	0.0000007
2018-09-12	0.0000524	0.0004256	0.0660970	0.9237503	0.0000006
2018-09-13	0.0000650	0.0004310	0.0659769	0.9235958	0.0000006
2018-09-14	0.0000641	0.0004696	0.0723310	0.9194070	0.0000006
2018-09-17	0.0001093	0.0004643	0.0662688	0.9252329	0.0000006

Table 18 The Estimated Volatility by GARCH(1,1) Model (Continued)

Date	GARCH Volatility	Coefficient			
		return_cons	ARCH L1	GARCH L1	ARCH_cons
2018-09-18	0.0001018	0.0004638	0.0662912	0.9249060	0.0000006
2018-09-19	0.0000969	0.0004747	0.0681622	0.9232349	0.0000006
2018-09-20	0.0001092	0.0004780	0.0687017	0.9223251	0.0000006
2018-09-21	0.0001019	0.0005086	0.0680190	0.9235993	0.0000006
2018-09-24	0.0000944	0.0005318	0.0669005	0.9247128	0.0000006
2018-09-25	0.0000878	0.0005203	0.0661524	0.9253510	0.0000006
2018-09-26	0.0000830	0.0005234	0.0658367	0.9253271	0.0000006
2018-09-27	0.0000774	0.0005131	0.0652128	0.9257940	0.0000006
2018-09-28	0.0000721	0.0005065	0.0647458	0.9260469	0.0000006
2018-10-01	0.0000677	0.0004876	0.0657951	0.9249121	0.0000006
2018-10-02	0.0000630	0.0004925	0.0660620	0.9242851	0.0000006
2018-10-03	0.0000592	0.0004768	0.0658442	0.9246222	0.0000006
2018-10-04	0.0000610	0.0004864	0.0666416	0.9236482	0.0000006
2018-10-05	0.0000577	0.0004800	0.0663991	0.9239479	0.0000006
2018-10-08	0.0000592	0.0004658	0.0665029	0.9237518	0.0000006
2018-10-09	0.0000588	0.0004601	0.0655787	0.9253964	0.0000006
2018-10-10	0.0000692	0.0004714	0.0654209	0.9253451	0.0000006
2018-10-11	0.0000652	0.0004863	0.0656065	0.9257756	0.0000006
2018-10-12	0.0000795	0.0004707	0.0712717	0.9219360	0.0000006
2018-10-16	0.0001225	0.0004789	0.0702136	0.9227999	0.0000006
2018-10-17	0.0001165	0.0004747	0.0686967	0.9240202	0.0000006
2018-10-18	0.0001074	0.0004775	0.0675563	0.9248571	0.0000006
2018-10-19	0.0000997	0.0004822	0.0665924	0.9257055	0.0000006
2018-10-22	0.0000976	0.0004553	0.0683726	0.9242007	0.0000006
2018-10-24	0.0000962	0.0004576	0.0675219	0.9247820	0.0000006
2018-10-25	0.0000922	0.0004450	0.0711421	0.9225667	0.0000006
2018-10-26	0.0001293	0.0004403	0.0725149	0.9214395	0.0000006
2018-10-29	0.0001357	0.0004398	0.0727346	0.9212220	0.0000006
2018-10-30	0.0001373	0.0004568	0.0726214	0.9212461	0.0000006
2018-10-31	0.0001287	0.0004589	0.0710522	0.9224771	0.0000006
2018-11-01	0.0001213	0.0004708	0.0738779	0.9203979	0.0000006
2018-11-02	0.0001463	0.0004603	0.0727683	0.9212930	0.0000006
2018-11-05	0.0001355	0.0004627	0.0721001	0.9217477	0.0000006
2018-11-06	0.0001306	0.0004498	0.0716944	0.9220164	0.0000006
2018-11-07	0.0001243	0.0004405	0.0709839	0.9224508	0.0000006
2018-11-08	0.0001148	0.0004457	0.0704432	0.9226924	0.0000006
2018-11-09	0.0001081	0.0004558	0.0700200	0.9228166	0.0000006
2018-11-12	0.0001011	0.0004475	0.0700563	0.9226702	0.0000006
2018-11-13	0.0000998	0.0004328	0.0699994	0.9226068	0.0000006
2018-11-14	0.0000964	0.0004327	0.0700847	0.9221797	0.0000006
2018-11-15	0.0000902	0.0004299	0.0706725	0.9212680	0.0000006
2018-11-16	0.0000855	0.0004239	0.0714166	0.9202922	0.0000006
2018-11-19	0.0000831	0.0004283	0.0711295	0.9202142	0.0000006
2018-11-20	0.0000767	0.0004323	0.0722218	0.9186437	0.0000007
2018-11-21	0.0000727	0.0004282	0.0696634	0.9218801	0.0000006
2018-11-22	0.0000819	0.0004261	0.0707317	0.9203633	0.0000006
2018-11-23	0.0000761	0.0004171	0.0716782	0.9192694	0.0000007
2018-11-26	0.0000769	0.0004489	0.0711468	0.9204097	0.0000006
2018-11-27	0.0000800	0.0004475	0.0711318	0.9201733	0.0000006
2018-11-28	0.0000762	0.0004467	0.0723981	0.9184534	0.0000007
2018-11-29	0.0000703	0.0004450	0.0730127	0.9174315	0.0000007

Table 18 The Estimated Volatility by GARCH(1,1) Model (Continued)

Date	GARCH Volatility	Coefficient			
		return_cons	ARCH L1	GARCH L1	ARCH_cons
2018-11-30	0.0000655	0.0004450	0.0740862	0.9159105	0.0000007
2018-12-03	0.0000615	0.0004403	0.0722449	0.9174578	0.0000007
2018-12-04	0.0000615	0.0005105	0.0690100	0.9240339	0.0000006
2018-12-06	0.0000943	0.0005056	0.0681494	0.9246179	0.0000006
2018-12-07	0.0000883	0.0004854	0.0688083	0.9243073	0.0000006
2018-12-11	0.0000947	0.0004776	0.0680555	0.9248313	0.0000006
2018-12-12	0.0000896	0.0004662	0.0680919	0.9249283	0.0000006
2018-12-13	0.0000931	0.0004584	0.0676756	0.9251099	0.0000006
2018-12-14	0.0000873	0.0004543	0.0680398	0.9250838	0.0000006
2018-12-17	0.0000948	0.0004504	0.0673153	0.9255232	0.0000006
2018-12-18	0.0000885	0.0004446	0.0668745	0.9256852	0.0000006
2018-12-19	0.0000834	0.0004346	0.0670475	0.9256760	0.0000006
2018-12-20	0.0000884	0.0004342	0.0673992	0.9254769	0.0000006
2018-12-21	0.0000909	0.0004268	0.0669196	0.9256750	0.0000006
2018-12-24	0.0000849	0.0004226	0.0666654	0.9256100	0.0000006
2018-12-25	0.0000789	0.0004124	0.0665262	0.9254922	0.0000006
2018-12-26	0.0000757	0.0003994	0.0662020	0.9273965	0.0000006
2018-12-27	0.0001073	0.0003794	0.0676419	0.9259717	0.0000006
2018-12-28	0.0000997	0.0003797	0.0670498	0.9263909	0.0000006
2019-01-02	0.0000961	0.0003821	0.0668466	0.9265664	0.0000006
2019-01-03	0.0000962	0.0003818	0.0660228	0.9270724	0.0000006
2019-01-04	0.0000897	0.0003843	0.0657137	0.9271739	0.0000006
2019-01-07	0.0000858	0.0003873	0.0657776	0.9272262	0.0000006
2019-01-08	0.0000893	0.0003901	0.0658412	0.9272348	0.0000006
2019-01-09	0.0000918	0.0003925	0.0653249	0.9274300	0.0000006
2019-01-10	0.0000855	0.0003981	0.0649837	0.9274930	0.0000006
2019-01-11	0.0000801	0.0004081	0.0649091	0.9272984	0.0000006
2019-01-14	0.0000749	0.0004068	0.0648553	0.9271368	0.0000006
2019-01-15	0.0000720	0.0003964	0.0649418	0.9271602	0.0000006
2019-01-16	0.0000748	0.0003864	0.0647441	0.9271166	0.0000006
2019-01-17	0.0000706	0.0003552	0.0731193	0.9187653	0.0000006
2019-01-18	0.0000655	0.0003540	0.0724824	0.9191020	0.0000006
2019-01-21	0.0000609	0.0003570	0.0719786	0.9193118	0.0000006
2019-01-22	0.0000569	0.0003571	0.0719575	0.9190543	0.0000007
2019-01-23	0.0000539	0.0003697	0.0707398	0.9202979	0.0000006
2019-01-24	0.0000551	0.0003855	0.0705941	0.9204226	0.0000006
2019-01-25	0.0000554	0.0003925	0.0707862	0.9199038	0.0000006
2019-01-28	0.0000511	0.0003840	0.0730437	0.9173459	0.0000007
2019-01-29	0.0000473	0.0003915	0.0741011	0.9159441	0.0000007
2019-01-30	0.0000438	0.0003923	0.0744585	0.9152645	0.0000007
2019-01-31	0.0000406	0.0004014	0.0745600	0.9149232	0.0000007
2019-02-01	0.0000389	0.0004070	0.0748071	0.9144673	0.0000007
2019-02-04	0.0000377	0.0004184	0.0748822	0.9141840	0.0000007
2019-02-05	0.0000364	0.0004198	0.0762164	0.9124944	0.0000007
2019-02-06	0.0000334	0.0004256	0.0780499	0.9102777	0.0000007
2019-02-07	0.0000306	0.0004333	0.0798913	0.9080799	0.0000008
2019-02-08	0.0000286	0.0004291	0.0816372	0.9060693	0.0000008
2019-02-11	0.0000272	0.0004312	0.0841790	0.9031866	0.0000008
2019-02-12	0.0000271	0.0004120	0.0769692	0.9107581	0.0000007
2019-02-13	0.0000318	0.0004219	0.0780583	0.9094624	0.0000007
2019-02-14	0.0000300	0.0004399	0.0764048	0.9111257	0.0000007

Table 18 The Estimated Volatility by GARCH(1,1) Model (Continued)

Date	GARCH Volatility	Coefficient			
		return_cons	ARCH L1	GARCH L1	ARCH_cons
2019-02-15	0.0000335	0.0004374	0.0763403	0.9108741	0.0000007
2019-02-18	0.0000326	0.0004245	0.0705446	0.9170330	0.0000007
2019-02-20	0.0000382	0.0004226	0.0701435	0.9170741	0.0000007
2019-02-21	0.0000362	0.0004625	0.0645913	0.9229025	0.0000007
2019-02-22	0.0000362	0.0004324	0.0742457	0.9135603	0.0000007
2019-02-25	0.0000339	0.0004432	0.0735466	0.9142523	0.0000007
2019-02-26	0.0000362	0.0004547	0.0733291	0.9144030	0.0000007
2019-02-27	0.0000380	0.0004368	0.0736360	0.9140351	0.0000007
2019-02-28	0.0000381	0.0004356	0.0730645	0.9143593	0.0000007
2019-03-01	0.0000359	0.0004263	0.0740507	0.9135113	0.0000007
2019-03-04	0.0000409	0.0004108	0.0740548	0.9134328	0.0000007
2019-03-05	0.0000421	0.0003945	0.0747393	0.9125146	0.0000008
2019-03-06	0.0000406	0.0004002	0.0742480	0.9126656	0.0000008
2019-03-07	0.0000381	0.0003881	0.0744362	0.9126386	0.0000008
2019-03-08	0.0000433	0.0003954	0.0741927	0.9126739	0.0000008
2019-03-11	0.0000420	0.0003923	0.0731092	0.9134842	0.0000008
2019-03-12	0.0000395	0.0003859	0.0715731	0.9147355	0.0000007
2019-03-13	0.0000374	0.0003840	0.0712966	0.9146737	0.0000007
2019-03-14	0.0000351	0.0004019	0.0714551	0.9143594	0.0000008
2019-03-15	0.0000376	0.0003968	0.0631463	0.9226663	0.0000007
2019-03-18	0.0000356	0.0003860	0.0663649	0.9190665	0.0000007
2019-03-19	0.0000367	0.0003785	0.0703931	0.9144722	0.0000008
2019-03-20	0.0000363	0.0003911	0.0699241	0.9147020	0.0000008
2019-03-21	0.0000392	0.0004186	0.0675321	0.9187655	0.0000007
2019-03-22	0.0000370	0.0004288	0.0617100	0.9247413	0.0000007
2019-03-25	0.0000366	0.0004757	0.0453111	0.9428512	0.0000005
2019-03-26	0.0000397	0.0004582	0.0413109	0.9475123	0.0000005
2019-03-27	0.0000485	0.0003929	0.0429140	0.9481923	0.0000004
2019-03-28	0.0000472	0.0003949	0.0426643	0.9483469	0.0000004
2019-03-29	0.0000456	0.0004011	0.0425228	0.9483497	0.0000004
2019-04-01	0.0000438	0.0004010	0.0425187	0.9481952	0.0000004
2019-04-02	0.0000420	0.0004010	0.0425798	0.9480020	0.0000004
2019-04-03	0.0000407	0.0004051	0.0428003	0.9476407	0.0000004
2019-04-04	0.0000397	0.0004010	0.0431136	0.9471266	0.0000005
2019-04-05	0.0000383	0.0004093	0.0428399	0.9474582	0.0000004
2019-04-09	0.0000372	0.0004077	0.0432143	0.9468792	0.0000005
2019-04-10	0.0000358	0.0004244	0.0432641	0.9468527	0.0000005
2019-04-11	0.0000369	0.0004319	0.0436778	0.9462410	0.0000005
2019-04-12	0.0000357	0.0004206	0.0438914	0.9458987	0.0000005
2019-04-17	0.0000346	0.0004260	0.0442476	0.9453542	0.0000005
2019-04-18	0.0000332	0.0004428	0.0442564	0.9453090	0.0000005
2019-04-19	0.0000333	0.0004521	0.0444715	0.9449437	0.0000005
2019-04-22	0.0000321	0.0004359	0.0436231	0.9459127	0.0000005
2019-04-23	0.0000308	0.0004281	0.0439484	0.9454377	0.0000005
2019-04-24	0.0000293	0.0004271	0.0450956	0.9440107	0.0000005
2019-04-25	0.0000280	0.0004293	0.0463785	0.9424264	0.0000005
2019-04-26	0.0000273	0.0004434	0.0446061	0.9444946	0.0000005
2019-04-29	0.0000265	0.0004738	0.0453096	0.9445338	0.0000005
2019-04-30	0.0000265	0.0004612	0.0460154	0.9437013	0.0000005
2019-05-02	0.0000255	0.0004758	0.0461303	0.9435458	0.0000005
2019-05-03	0.0000254	0.0004811	0.0467333	0.9427940	0.0000005

Table 18 The Estimated Volatility by GARCH(1,1) Model (Continued)

Date	GARCH Volatility	Coefficient			
		return_cons	ARCH L1	GARCH L1	ARCH_cons
2019-05-07	0.0000247	0.0004808	0.0476857	0.9416482	0.0000005
2019-05-08	0.0000239	0.0004601	0.0469507	0.9424664	0.0000005
2019-05-09	0.0000257	0.0004315	0.0454971	0.9442071	0.0000005
2019-05-10	0.0000290	0.0004096	0.0454810	0.9442863	0.0000005
2019-05-13	0.0000292	0.0004199	0.0456520	0.9440527	0.0000005
2019-05-14	0.0000282	0.0003989	0.0456994	0.9440452	0.0000005
2019-05-15	0.0000281	0.0003910	0.0460486	0.9435932	0.0000005
2019-05-16	0.0000277	0.0003806	0.0460467	0.9436110	0.0000005
2019-05-17	0.0000294	0.0003547	0.0460370	0.9437883	0.0000005
2019-05-21	0.0000295	0.0003384	0.0461904	0.9435977	0.0000005
2019-05-22	0.0000294	0.0003533	0.0462068	0.9436039	0.0000005
2019-05-23	0.0000287	0.0003649	0.0461368	0.9439285	0.0000005
2019-05-24	0.0000326	0.0003465	0.0470165	0.9431536	0.0000005
2019-05-27	0.0000378	0.0003435	0.0464979	0.9436162	0.0000005
2019-05-28	0.0000363	0.0003521	0.0466459	0.9434093	0.0000005
2019-05-29	0.0000363	0.0003556	0.0466663	0.9433212	0.0000005
2019-05-30	0.0000360	0.0003534	0.0473037	0.9427804	0.0000005
2019-05-31	0.0000384	0.0003592	0.0469200	0.9431008	0.0000005
2019-06-04	0.0000368	0.0003549	0.0468267	0.9430845	0.0000005
2019-06-05	0.0000357	0.0003751	0.0481779	0.9417677	0.0000005
2019-06-06	0.0000408	0.0003900	0.0483958	0.9415042	0.0000005
2019-06-07	0.0000408	0.0003975	0.0479935	0.9418346	0.0000005
2019-06-10	0.0000389	0.0003967	0.0479914	0.9416946	0.0000005
2019-06-11	0.0000374	0.0004026	0.0485483	0.9410428	0.0000005
2019-06-12	0.0000378	0.0004028	0.0486947	0.9407941	0.0000005
2019-06-13	0.0000370	0.0004012	0.0490230	0.9402665	0.0000005
2019-06-14	0.0000352	0.0003954	0.0490494	0.9401319	0.0000005
2019-06-17	0.0000337	0.0003785	0.0481794	0.9412042	0.0000005
2019-06-18	0.0000324	0.0003683	0.0487986	0.9404144	0.0000005
2019-06-19	0.0000320	0.0003590	0.0489116	0.9412549	0.0000005
2019-06-20	0.0000383	0.0003683	0.0513512	0.9390775	0.0000005
2019-06-21	0.0000486	0.0003807	0.0517419	0.9386210	0.0000005
2019-06-24	0.0000490	0.0003900	0.0508807	0.9394730	0.0000005
2019-06-25	0.0000466	0.0003835	0.0501695	0.9401301	0.0000005
2019-06-26	0.0000443	0.0003930	0.0498020	0.9403672	0.0000005
2019-06-27	0.0000424	0.0003991	0.0494941	0.9405367	0.0000005
2019-06-28	0.0000405	0.0004024	0.0496796	0.9402834	0.0000005
2019-07-01	0.0000402	0.0004084	0.0495759	0.9402422	0.0000005
2019-07-02	0.0000384	0.0004239	0.0499601	0.9398028	0.0000005
2019-07-03	0.0000393	0.0004212	0.0502517	0.9394780	0.0000005
2019-07-04	0.0000396	0.0004310	0.0502747	0.9392941	0.0000005
2019-07-05	0.0000380	0.0004082	0.0510610	0.9385502	0.0000005
2019-07-08	0.0000409	0.0004090	0.0512908	0.9381385	0.0000005
2019-07-09	0.0000395	0.0003934	0.0509269	0.9385555	0.0000005
2019-07-10	0.0000381	0.0003710	0.0512693	0.9382949	0.0000005
2019-07-11	0.0000399	0.0003751	0.0519906	0.9379289	0.0000005
2019-07-12	0.0000456	0.0003799	0.0519385	0.9377815	0.0000005
2019-07-15	0.0000434	0.0003747	0.0526644	0.9368966	0.0000005
2019-07-17	0.0000434	0.0003918	0.0515097	0.9383696	0.0000005
2019-07-18	0.0000413	0.0003870	0.0519186	0.9377376	0.0000005
2019-07-19	0.0000399	0.0003932	0.0522482	0.9371682	0.0000005

Table 18 The Estimated Volatility by GARCH(1,1) Model (Continued)

Date	GARCH Volatility	Coefficient			
		return_cons	ARCH L1	GARCH L1	ARCH_cons
2019-07-22	0.0000381	0.0003880	0.0520553	0.9375405	0.0000005
2019-07-23	0.0000383	0.0003696	0.0524148	0.9371712	0.0000005
2019-07-24	0.0000387	0.0003772	0.0525019	0.9369612	0.0000005
2019-07-25	0.0000369	0.0003677	0.0528993	0.9363888	0.0000005
2019-07-26	0.0000352	0.0003821	0.0531153	0.9360906	0.0000005
2019-07-30	0.0000339	0.0003646	0.0535250	0.9357187	0.0000006
2019-07-31	0.0000369	0.0003766	0.0529551	0.9367554	0.0000005
2019-08-01	0.0000362	0.0003771	0.0534032	0.9361069	0.0000005
2019-08-02	0.0000351	0.0003639	0.0539900	0.9353770	0.0000006
2019-08-05	0.0000355	0.0003472	0.0546036	0.9348443	0.0000006
2019-08-06	0.0000401	0.0003341	0.0567779	0.9328172	0.0000006
2019-08-07	0.0000483	0.0003529	0.0557238	0.9341387	0.0000006
2019-08-08	0.0000461	0.0003379	0.0552789	0.9345386	0.0000006
2019-08-09	0.0000438	0.0003401	0.0553109	0.9344168	0.0000006
2019-08-13	0.0000428	0.0003329	0.0563146	0.9333133	0.0000006
2019-08-14	0.0000460	0.0003415	0.0621540	0.9283493	0.0000006
2019-08-15	0.0000683	0.0003344	0.0610172	0.9292460	0.0000006
2019-08-16	0.0000643	0.0003116	0.0616755	0.9288138	0.0000006
2019-08-19	0.0000692	0.0003418	0.0698714	0.9207817	0.0000007
2019-08-20	0.0000859	0.0003484	0.0685361	0.9218552	0.0000007
2019-08-21	0.0000808	0.0003585	0.0685622	0.9221444	0.0000007
2019-08-22	0.0000815	0.0003673	0.0695930	0.9208964	0.0000007
2019-08-23	0.0000809	0.0003533	0.0682407	0.9221305	0.0000007
2019-08-26	0.0000762	0.0003667	0.0693941	0.9208469	0.0000007
2019-08-27	0.0000789	0.0003648	0.0739573	0.9167051	0.0000007
2019-08-28	0.0000918	0.0003550	0.0737834	0.9165753	0.0000007
2019-08-29	0.0000873	0.0003503	0.0729787	0.9169495	0.0000007
2019-08-30	0.0000823	0.0003668	0.0773351	0.9128007	0.0000008
2019-09-02	0.0000955	0.0003489	0.0787332	0.9123697	0.0000007
2019-09-03	0.0000977	0.0003461	0.0770446	0.9135993	0.0000007
2019-09-04	0.0000902	0.0003393	0.0773877	0.9129947	0.0000008
2019-09-05	0.0000897	0.0003394	0.0790455	0.9114736	0.0000008
2019-09-06	0.0000948	0.0003508	0.0790475	0.9111275	0.0000008
2019-09-09	0.0000914	0.0003512	0.0784155	0.9111773	0.0000008
2019-09-10	0.0000839	0.0003439	0.0780706	0.9111193	0.0000008
2019-09-11	0.0000771	0.0003501	0.0783903	0.9102662	0.0000008
2019-09-12	0.0000717	0.0003473	0.0790286	0.9093841	0.0000008
2019-09-13	0.0000698	0.0003452	0.0797100	0.9087423	0.0000008
2019-09-16	0.0000731	0.0003391	0.0802945	0.9075640	0.0000009
2019-09-17	0.0000670	0.0003538	0.0811741	0.9062116	0.0000009
2019-09-18	0.0000613	0.0003518	0.0831698	0.9033648	0.0000009
2019-09-19	0.0000561	0.0003441	0.0846371	0.9014014	0.0000010
2019-09-20	0.0000557	0.0003380	0.0849340	0.9010701	0.0000010
2019-09-23	0.0000585	0.0003324	0.0871499	0.8979478	0.0000010
2019-09-24	0.0000538	0.0003265	0.0874418	0.8976713	0.0000010
2019-09-25	0.0000575	0.0003332	0.0897242	0.8945236	0.0000011
2019-09-26	0.0000547	0.0003174	0.0914439	0.8923463	0.0000011
2019-09-27	0.0000511	0.0003441	0.0928823	0.8917133	0.0000011
2019-09-30	0.0000499	0.0003590	0.0935760	0.8903488	0.0000011
2019-10-01	0.0000481	0.0003667	0.0947812	0.8887435	0.0000011
2019-10-02	0.0000462	0.0003543	0.0922556	0.8914443	0.0000011

Table 18 The Estimated Volatility by GARCH(1,1) Model (Continued)

Date	GARCH Volatility	Coefficient			
		return_cons	ARCH L1	GARCH L1	ARCH_cons
2019-10-03	0.0000511	0.0003428	0.0922202	0.8910286	0.0000012
2019-10-04	0.0000519	0.0003490	0.0924117	0.8902146	0.0000012
2019-10-07	0.0000475	0.0003436	0.0932301	0.8884718	0.0000012
2019-10-08	0.0000443	0.0003448	0.0938851	0.8872545	0.0000012
2019-10-09	0.0000432	0.0003472	0.0953543	0.8848041	0.0000013
2019-10-10	0.0000399	0.0003587	0.0969684	0.8822526	0.0000013
2019-10-11	0.0000384	0.0003499	0.0953926	0.8836531	0.0000014
2019-10-15	0.0000431	0.0003826	0.0931472	0.8866300	0.0000013
2019-10-16	0.0000592	0.0003725	0.0915074	0.8880096	0.0000013
2019-10-17	0.0000540	0.0003864	0.0915497	0.8871554	0.0000014
2019-10-18	0.0000516	0.0003910	0.0915291	0.8861199	0.0000014
2019-10-21	0.0000472	0.0003994	0.0922269	0.8845066	0.0000015
2019-10-22	0.0000436	0.0003991	0.0924853	0.8839487	0.0000015
2019-10-24	0.0000456	0.0004255	0.0931738	0.8834279	0.0000015
2019-10-25	0.0000463	0.0004247	0.0930046	0.8829263	0.0000015
2019-10-28	0.0000461	0.0003933	0.0929336	0.8838190	0.0000015
2019-10-29	0.0000657	0.0003977	0.0899585	0.8861176	0.0000015
2019-10-30	0.0000608	0.0004002	0.0881990	0.8873433	0.0000015
2019-10-31	0.0000572	0.0004078	0.0883710	0.8863075	0.0000016
2019-11-01	0.0000583	0.0003907	0.0867290	0.8876033	0.0000016
2019-11-04	0.0000540	0.0003764	0.0855703	0.8880335	0.0000016
2019-11-05	0.0000524	0.0004177	0.0890401	0.8858768	0.0000016
2019-11-06	0.0000871	0.0004197	0.0848399	0.8894449	0.0000016
2019-11-07	0.0000790	0.0004191	0.0817351	0.8917886	0.0000017
2019-11-08	0.0000735	0.0004328	0.0836682	0.8886624	0.0000017
2019-11-11	0.0000764	0.0004331	0.0814052	0.8899613	0.0000018
2019-11-12	0.0000708	0.0004372	0.0827298	0.8885164	0.0000018
2019-11-13	0.0000728	0.0004346	0.0805556	0.8896075	0.0000018
2019-11-14	0.0000669	0.0004213	0.0800035	0.8890874	0.0000019
2019-11-15	0.0000651	0.0004223	0.0792191	0.8885471	0.0000019
2019-11-18	0.0000603	0.0004134	0.0791302	0.8868782	0.0000020
2019-11-19	0.0000564	0.0004229	0.0801414	0.8839539	0.0000021
2019-11-20	0.0000525	0.0004138	0.0818106	0.8797759	0.0000022
2019-11-21	0.0000489	0.0004089	0.0811035	0.8799798	0.0000022
2019-11-22	0.0000505	0.0004099	0.0826778	0.8760098	0.0000024
2019-11-25	0.0000472	0.0003988	0.0844367	0.8729311	0.0000024
2019-11-26	0.0000457	0.0004124	0.0797341	0.8789519	0.0000024
2019-11-27	0.0000516	0.0004128	0.0794862	0.8781383	0.0000024
2019-11-28	0.0000504	0.0004055	0.0793073	0.8763130	0.0000025
2019-11-29	0.0000470	0.0003840	0.0784565	0.8761705	0.0000026
2019-12-02	0.0000473	0.0003756	0.0775060	0.8758894	0.0000026
2019-12-03	0.0000484	0.0003594	0.0730329	0.8825004	0.0000025
2019-12-04	0.0000601	0.0003468	0.0692275	0.8865799	0.0000025
2019-12-06	0.0000557	0.0003370	0.0668328	0.8884785	0.0000025
2019-12-09	0.0000522	0.0003243	0.0659335	0.8880233	0.0000026
2019-12-11	0.0000503	0.0003129	0.0659235	0.8859739	0.0000027
2019-12-12	0.0000475	0.0003188	0.0675266	0.8812349	0.0000028
2019-12-13	0.0000453	0.0003389	0.0660823	0.8826439	0.0000028
2019-12-16	0.0000473	0.0003535	0.0656936	0.8817527	0.0000029
2019-12-17	0.0000506	0.0002942	0.0390882	0.9347152	0.0000015
2019-12-18	0.0000605	0.0003001	0.0361174	0.9399315	0.0000014

Table 18 The Estimated Volatility by GARCH(1,1) Model (Continued)

Date	GARCH Volatility	Coefficient			
		return_cons	ARCH L1	GARCH L1	ARCH_cons
2019-12-19	0.0000584	0.0003155	0.0353976	0.9413874	0.0000013
2019-12-20	0.0000609	0.0003251	0.0337980	0.9440507	0.0000013
2019-12-23	0.0000593	0.0003217	0.0322596	0.9464105	0.0000012
2019-12-24	0.0000573	0.0003230	0.0312193	0.9478921	0.0000012
2019-12-25	0.0000555	0.0003051	0.0305112	0.9488690	0.0000012
2019-12-26	0.0000544	0.0002996	0.0299039	0.9496362	0.0000012
2019-12-27	0.0000529	0.0003016	0.0293768	0.9502675	0.0000011
2019-12-30	0.0000516	0.0003023	0.0290477	0.9505963	0.0000011
2020-01-02	0.0000503	0.0003011	0.0287625	0.9508243	0.0000011
2020-01-03	0.0000493	0.0003108	0.0281017	0.9522183	0.0000011
2020-01-06	0.0000515	0.0003107	0.0278314	0.9524662	0.0000011
2020-01-07	0.0000507	0.0002825	0.0269616	0.9542518	0.0000011
2020-01-08	0.0000555	0.0002927	0.0269007	0.9544506	0.0000011
2020-01-09	0.0000573	0.0002586	0.0273234	0.9543049	0.0000011
2020-01-10	0.0000790	0.0002722	0.0797885	0.8008773	0.0000067
2020-01-13	0.0000661	0.0002723	0.0272092	0.9544722	0.0000011
2020-01-14	0.0000640	0.0002806	0.0267889	0.9549327	0.0000011
2020-01-15	0.0000622	0.0002803	0.0263714	0.9553068	0.0000011
2020-01-16	0.0000604	0.0002660	0.0261531	0.9554667	0.0000011
2020-01-17	0.0000599	0.0002853	0.0263787	0.9552402	0.0000011
2020-01-20	0.0000608	0.0002876	0.0261397	0.9553257	0.0000011
2020-01-21	0.0000593	0.0002781	0.0261917	0.9552220	0.0000011
2020-01-22	0.0000599	0.0002590	0.0262418	0.9550883	0.0000011
2020-01-23	0.0000603	0.0002638	0.0260993	0.9550361	0.0000011
2020-01-24	0.0000586	0.0002594	0.0260352	0.9547998	0.0000011
2020-01-27	0.0000570	0.0002634	0.0260343	0.9546063	0.0000011
2020-01-28	0.0000579	0.0002155	0.0269354	0.9567019	0.0000010
2020-01-29	0.0000869	0.0002059	0.0267804	0.9566330	0.0000010
2020-01-30	0.0000860	0.0002161	0.0270357	0.9561353	0.0000010
2020-01-31	0.0000849	0.0002111	0.0264711	0.9563922	0.0000011
2020-02-03	0.0000821	0.0001963	0.0262978	0.9562524	0.0000011
2020-02-04	0.0000813	0.0001802	0.0270757	0.9552450	0.0000011
2020-02-05	0.0000852	0.0002107	0.0295941	0.9526325	0.0000011
2020-02-06	0.0000914	0.0002145	0.0298412	0.9519451	0.0000011
2020-02-07	0.0000897	0.0002101	0.0294658	0.9517002	0.0000012
2020-02-11	0.0000858	0.0001938	0.0287076	0.9522432	0.0000012
2020-02-12	0.0000856	0.0001541	0.0309117	0.9526243	0.0000011
2020-02-13	0.0000852	0.0001666	0.0311108	0.9523985	0.0000011
2020-02-14	0.0000859	0.0001566	0.0306293	0.9526011	0.0000011
2020-02-17	0.0000839	0.0001485	0.0300178	0.9528024	0.0000011
2020-02-18	0.0000811	0.0001477	0.0294572	0.9528499	0.0000011
2020-02-19	0.0000786	0.0001349	0.0294354	0.9527258	0.0000011
2020-02-20	0.0000785	0.0001264	0.0290200	0.9525524	0.0000011
2020-02-21	0.0000765	0.0000995	0.0291472	0.9527508	0.0000011
2020-02-24	0.0000774	0.0000920	0.0287763	0.9525973	0.0000012
2020-02-25	0.0000828	0.0000930	0.0354043	0.9542705	0.0000008
2020-02-26	0.0001400	0.0000862	0.0345928	0.9546914	0.0000008
2020-02-27	0.0001728	0.0001359	0.0548827	0.9384692	0.0000008
2020-02-28	0.0003258	0.0001231	0.0562199	0.9376144	0.0000008
2020-03-02	0.0003729	0.0001291	0.0657445	0.9278172	0.0000010
2020-03-03	0.0004663	0.0001061	0.0635793	0.9302366	0.0000009

Table 18 The Estimated Volatility by GARCH(1,1) Model (Continued)

Date	GARCH Volatility	Coefficient			
		return_cons	ARCH L1	GARCH L1	ARCH_cons
2020-03-04	0.0004483	0.0001179	0.0667113	0.9269177	0.0000010
2020-03-05	0.0004804	0.0001196	0.0650450	0.9282562	0.0000010
2020-03-06	0.0004412	0.0001217	0.0639068	0.9288848	0.0000010
2020-03-09	0.0004165	0.0001332	0.0644436	0.9285544	0.0000010
2020-03-10	0.0005193	0.0001565	0.0904612	0.9119855	0.0000008
2020-03-11	0.0013498	0.0001513	0.0888320	0.9131827	0.0000008
2020-03-12	0.0012399	0.0001450	0.0879935	0.9135090	0.0000009
2020-03-13	0.0013567	0.0001754	0.1112266	0.8943698	0.0000010
2020-03-16	0.0029272	0.0001709	0.1103745	0.8946071	0.0000010
2020-03-17	0.0027990	0.0001570	0.1149746	0.8907409	0.0000011
2020-03-18	0.0032548	0.0001551	0.1136012	0.8912809	0.0000011
2020-03-19	0.0028884	0.0001584	0.1127658	0.8912475	0.0000011
2020-03-20	0.0025754	0.0001562	0.1122398	0.8906223	0.0000012
2020-03-23	0.0023378	0.0001634	0.1171092	0.8867931	0.0000012
2020-03-24	0.0030730	0.0001696	0.1240506	0.8806448	0.0000013
2020-03-25	0.0040860	0.0001558	0.1228166	0.8815877	0.0000013
2020-03-26	0.0036308	0.0001554	0.1240249	0.8796227	0.0000014
2020-03-27	0.0035086	0.0001590	0.1240825	0.8782559	0.0000014
2020-03-30	0.0030812	0.0001477	0.1237412	0.8777982	0.0000015
2020-03-31	0.0026690	0.0001502	0.1246151	0.8752672	0.0000016
2020-04-01	0.0023537	0.0001658	0.1253395	0.8742381	0.0000016
2020-04-02	0.0022393	0.0001866	0.1260157	0.8743625	0.0000016
2020-04-03	0.0019981	0.0001831	0.1267520	0.8726990	0.0000017
2020-04-07	0.0018650	0.0001783	0.1276150	0.8698302	0.0000018
2020-04-08	0.0016899	0.0001778	0.1270307	0.8735043	0.0000016
2020-04-09	0.0021369	0.0001727	0.1274038	0.8716133	0.0000017
2020-04-10	0.0018473	0.0001707	0.1282227	0.8689104	0.0000018
2020-04-13	0.0015668	0.0001721	0.1295615	0.8655786	0.0000020
2020-04-14	0.0013441	0.0001804	0.1313488	0.8616121	0.0000021
2020-04-15	0.0011303	0.0001940	0.1332652	0.8580860	0.0000023
2020-04-16	0.0009632	0.0001928	0.1351991	0.8540998	0.0000024
2020-04-17	0.0008823	0.0001786	0.1355316	0.8539693	0.0000024
2020-04-20	0.0009081	0.0001799	0.1357721	0.8543149	0.0000024
2020-04-21	0.0009649	0.0001809	0.1370258	0.8517929	0.0000025
2020-04-22	0.0008975	0.0001869	0.1384096	0.8488801	0.0000027
2020-04-23	0.0007776	0.0001969	0.1400497	0.8454561	0.0000028
2020-04-24	0.0006433	0.0001961	0.1419559	0.8409150	0.0000030
2020-04-27	0.0005393	0.0001795	0.1433825	0.8384559	0.0000031
2020-04-28	0.0004692	0.0001906	0.1454551	0.8344514	0.0000033
2020-04-29	0.0003858	0.0001868	0.1473475	0.8298022	0.0000035
2020-04-30	0.0003188	0.0001735	0.1500094	0.8254073	0.0000037
2020-05-05	0.0002720	0.0001730	0.1488586	0.8266953	0.0000036
2020-05-07	0.0002812	0.0001591	0.1473013	0.8286863	0.0000036
2020-05-08	0.0002931	0.0001429	0.1465493	0.8289669	0.0000036
2020-05-11	0.0002818	0.0001423	0.1467340	0.8269910	0.0000037
2020-05-12	0.0002468	0.0001523	0.1457067	0.8289261	0.0000037
2020-05-13	0.0002555	0.0001473	0.1451472	0.8282369	0.0000038
2020-05-14	0.0002260	0.0001312	0.1449718	0.8271013	0.0000038
2020-05-15	0.0001972	0.0001141	0.1437162	0.8281238	0.0000038
2020-05-18	0.0001897	0.0001127	0.1437284	0.8267550	0.0000039
2020-05-19	0.0001602	0.0001034	0.1435544	0.8256581	0.0000040

Table 18 The Estimated Volatility by GARCH(1,1) Model (Continued)

Date	GARCH Volatility	Coefficient			
		return_cons	ARCH L1	GARCH L1	ARCH_cons
2020-05-20	0.0001466	0.0001055	0.1398321	0.8323045	0.0000037
2020-05-21	0.0001746	0.0001032	0.1389148	0.8326569	0.0000038
2020-05-22	0.0001586	0.0000905	0.1387225	0.8319430	0.0000038
2020-05-25	0.0001394	0.0000644	0.1367234	0.8354948	0.0000037
2020-05-26	0.0001560	0.0000649	0.1360697	0.8362678	0.0000037
2020-05-27	0.0001528	0.0000650	0.1356037	0.8368225	0.0000036
2020-05-28	0.0001499	0.0000598	0.1354892	0.8365020	0.0000037
2020-05-29	0.0001362	0.0000486	0.1353910	0.8359740	0.0000037
2020-06-01	0.0001242	0.0000479	0.1356105	0.8352954	0.0000037
2020-06-02	0.0001157	0.0000473	0.1360496	0.8341509	0.0000038
2020-06-04	0.0001074	0.0000510	0.1353061	0.8372360	0.0000036
2020-06-05	0.0001460	0.0000527	0.1380634	0.8383772	0.0000035
2020-06-08	0.0002457	0.0000530	0.1395522	0.8370104	0.0000035
2020-06-09	0.0002600	0.0000463	0.1387236	0.8370053	0.0000035
2020-06-10	0.0002241	0.0000239	0.1412066	0.8354788	0.0000035
2020-06-11	0.0002738	0.0000230	0.1410077	0.8348123	0.0000036
2020-06-12	0.0002441	0.0000170	0.1420753	0.8339755	0.0000036
2020-06-15	0.0002564	0.0000021	0.1422870	0.8332420	0.0000037
2020-06-16	0.0002472	-0.0000259	0.1466595	0.8334308	0.0000035
2020-06-17	0.0003746	-0.0000311	0.1471197	0.8335140	0.0000035
2020-06-18	0.0003813	-0.0000336	0.1452704	0.8345478	0.0000035
2020-06-19	0.0003242	-0.0000354	0.1438919	0.8350286	0.0000035
2020-06-22	0.0002754	-0.0000423	0.1429402	0.8349420	0.0000036
2020-06-23	0.0002353	-0.0000504	0.1427135	0.8350218	0.0000036
2020-06-24	0.0002314	-0.0000576	0.1423184	0.8344046	0.0000036
2020-06-25	0.0002004	-0.0000726	0.1421407	0.8354436	0.0000036
2020-06-26	0.0002219	-0.0000904	0.1419393	0.8351540	0.0000036
2020-06-29	0.0001930	-0.0000884	0.1416574	0.8343940	0.0000037
2020-06-30	0.0001662	-0.0000928	0.1418251	0.8330016	0.0000037
2020-07-01	0.0001420	-0.0000801	0.1423297	0.8318498	0.0000038
2020-07-02	0.0001294	-0.0000731	0.1427695	0.8307286	0.0000038
2020-07-03	0.0001247	-0.0000525	0.1403866	0.8363584	0.0000036
2020-07-07	0.0001749	-0.0000587	0.1400125	0.8359847	0.0000036
2020-07-08	0.0001518	-0.0000584	0.1399356	0.8350803	0.0000037
2020-07-09	0.0001312	-0.0000538	0.1402775	0.8350122	0.0000037
2020-07-10	0.0001280	-0.0000596	0.1402911	0.8342307	0.0000037
2020-07-13	0.0001125	-0.0000804	0.1393510	0.8363467	0.0000037
2020-07-14	0.0001323	-0.0000794	0.1391336	0.8363806	0.0000037
2020-07-15	0.0001228	-0.0000812	0.1387109	0.8360938	0.0000037
2020-07-16	0.0001072	-0.0000720	0.1384196	0.8366783	0.0000037
2020-07-17	0.0001106	-0.0000758	0.1380940	0.8366376	0.0000037
2020-07-20	0.0001027	-0.0000523	0.1382809	0.8369123	0.0000036
2020-07-21	0.0001038	-0.0000418	0.1384613	0.8366845	0.0000036
2020-07-22	0.0000924	-0.0000224	0.1373111	0.8391911	0.0000035
2020-07-23	0.0001156	-0.0000440	0.1372183	0.8400820	0.0000035
2020-07-24	0.0001365	-0.0000455	0.1360878	0.8407353	0.0000035
2020-07-29	0.0001195	-0.0000720	0.1366145	0.8411222	0.0000035
2020-07-30	0.0001432	-0.0000830	0.1357976	0.8414123	0.0000035
2020-07-31	0.0001279	-0.0000930	0.1371734	0.8411217	0.0000035
2020-08-03	0.0001648	-0.0000960	0.1370789	0.8410564	0.0000035
2020-08-04	0.0001569	-0.0001101	0.1373436	0.8405397	0.0000035

Table 18 The Estimated Volatility by GARCH(1,1) Model (Continued)

Date	GARCH Volatility	Coefficient			
		return_cons	ARCH L1	GARCH L1	ARCH_cons
2020-08-05	0.0001547	-0.0001086	0.1374827	0.8399135	0.0000035
2020-08-06	0.0001446	-0.0001024	0.1376288	0.8391753	0.0000035
2020-08-07	0.0001299	-0.0001102	0.1378225	0.8381094	0.0000036
2020-08-10	0.0001130	-0.0001198	0.1384910	0.8368902	0.0000037
2020-08-11	0.0001075	-0.0001356	0.1388727	0.8359569	0.0000037
2020-08-13	0.0000965	-0.0001331	0.1393699	0.8374879	0.0000036
2020-08-14	0.0001160	-0.0001165	0.1396773	0.8375186	0.0000036
2020-08-17	0.0001277	-0.0001334	0.1403637	0.8374346	0.0000036
2020-08-18	0.0001508	-0.0001253	0.1395261	0.8381057	0.0000036
2020-08-19	0.0001312	-0.0001153	0.1388719	0.8385593	0.0000036
2020-08-20	0.0001231	-0.0001290	0.1393916	0.8395108	0.0000035
2020-08-21	0.0001619	-0.0001274	0.1390915	0.8401751	0.0000035
2020-08-24	0.0001588	-0.0001329	0.1370152	0.8419250	0.0000034
2020-08-25	0.0001379	-0.0001207	0.1363630	0.8432236	0.0000034
2020-08-26	0.0001485	-0.0001383	0.1365250	0.8431525	0.0000034
2020-08-27	0.0001293	-0.0001389	0.1344761	0.8451108	0.0000033
2020-08-28	0.0001143	-0.0001336	0.1328162	0.8465832	0.0000033
2020-08-31	0.0001011	-0.0001353	0.1317389	0.8474311	0.0000032
2020-09-01	0.0000917	-0.0001488	0.1304229	0.8494012	0.0000032
2020-09-02	0.0001024	-0.0001466	0.1298967	0.8496331	0.0000032
2020-09-03	0.0000916	-0.0001359	0.1296838	0.8497069	0.0000031
2020-09-08	0.0000875	-0.0001385	0.1297464	0.8491719	0.0000032
2020-09-09	0.0000796	-0.0001564	0.1293029	0.8500449	0.0000031
2020-09-10	0.0000949	-0.0001599	0.1294760	0.8492686	0.0000032
2020-09-11	0.0000842	-0.0001675	0.1299843	0.8481651	0.0000032
2020-09-14	0.0000750	-0.0001794	0.1307216	0.8470090	0.0000032
2020-09-15	0.0000748	-0.0001845	0.1313773	0.8460196	0.0000033
2020-09-16	0.0000722	-0.0001515	0.1318169	0.8458760	0.0000033
2020-09-17	0.0000804	-0.0001453	0.1326178	0.8447340	0.0000033
2020-09-18	0.0000776	-0.0001601	0.1336012	0.8433409	0.0000034
2020-09-21	0.0000786	-0.0001528	0.1341901	0.8423569	0.0000034
2020-09-22	0.0000708	-0.0001440	0.1347651	0.8437052	0.0000033
2020-09-23	0.0000867	-0.0001679	0.1348221	0.8436322	0.0000033
2020-09-24	0.0000861	-0.0001925	0.1348291	0.8436724	0.0000033
2020-09-25	0.0000851	-0.0002085	0.1364243	0.8426817	0.0000034
2020-09-28	0.0001221	-0.0002169	0.1355208	0.8431029	0.0000034
2020-09-29	0.0001084	-0.0001769	0.1385117	0.8410088	0.0000034
2020-09-30	0.0001507	-0.0001773	0.1378966	0.8413861	0.0000034
2020-10-01	0.0001380	-0.0002017	0.1399444	0.8402228	0.0000034
2020-10-02	0.0001709	-0.0002152	0.1398700	0.8408029	0.0000034
2020-10-05	0.0001588	-0.0002299	0.1397411	0.8410208	0.0000034
2020-10-06	0.0001618	-0.0002178	0.1388817	0.8417032	0.0000034
2020-10-07	0.0001446	-0.0002097	0.1382069	0.8420367	0.0000034
2020-10-08	0.0001336	-0.0001899	0.1383330	0.8421250	0.0000034
2020-10-09	0.0001376	-0.0001758	0.1381210	0.8421592	0.0000034
2020-10-12	0.0001318	-0.0001838	0.1376556	0.8421292	0.0000034
2020-10-14	0.0001179	-0.0001758	0.1375260	0.8417208	0.0000034
2020-10-15	0.0001066	-0.0001978	0.1375483	0.8419116	0.0000034
2020-10-16	0.0001134	-0.0002107	0.1378739	0.8420885	0.0000034
2020-10-19	0.0001338	-0.0002103	0.1375817	0.8421052	0.0000034
2020-10-20	0.0001235	-0.0002211	0.1387214	0.8419877	0.0000034

Table 18 The Estimated Volatility by GARCH(1,1) Model (Continued)

Date	GARCH Volatility	Coefficient			
		return_cons	ARCH L1	GARCH L1	ARCH_cons
2020-10-21	0.0001621	-0.0002120	0.1380089	0.8426364	0.0000034
2020-10-22	0.0001401	-0.0002074	0.1374066	0.8427950	0.0000034
2020-10-26	0.0001264	-0.0002081	0.1369352	0.8427479	0.0000034
2020-10-27	0.0001114	-0.0002315	0.1370076	0.8426534	0.0000034
2020-10-28	0.0001024	-0.0002346	0.1366483	0.8424819	0.0000034
2020-10-29	0.0000902	-0.0002371	0.1366215	0.8420852	0.0000034
2020-10-30	0.0000812	-0.0002370	0.1368278	0.8419032	0.0000034

Table 18 The Estimated Volatility by GARCH(1,1) Model (Continued)

VITA

NAME	Sarunporn Thupthong
DATE OF BIRTH	21 June 1997
PLACE OF BIRTH	Bangkok, Thailand
INSTITUTIONS ATTENDED	Bachelor of Economics, Kasetsart University
HOME ADDRESS	92/321 M.5 Rattanathibet Rd., Bangraknoi Sub-district, Muang Nonthaburi District, Nonthaburi 11000