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The Profitability of Warrant Issuers: An Empirical Investigation of Single Stock and Index Warrants

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Abstract
This study examines the derivative warrant's profit of issuers compensated with the risk from issuing call and put derivative warrants because they have commitments in risk management and managing risk by hedging the underlying exposure. The average profit of issuers is a cumulative profit from the first trading day until the last trading day. Consistent with the imperfect competition for issuing put derivative warrants on single stock from different securities borrowing and lending advantages, the profit margin of a put warrant is higher than the call warrant. However, the profit margin from a put warrant is not necessarily higher than the call warrant from issuing derivative warrants on the index because all issuers issue put derivative warrants on the index at the same cost. Moreover, this study examines some risk factors from issuing derivative warrants on a single stock, including Delta risk, Gamma risk, Rho risk, Theta risk, and Vega risk, which could explain issuers' profit. Consistent with the results from previous studies, we find that Delta, Gamma and Theta risk can explain the profit of issuers from issuing call derivative warrants while Delta, Gamma, Theta and Vega risk can explain the profit for put derivative warrants.

Keywords: Derivative warrants, Profit of issuer, Risk factors of pricing, Delta-hedging

JEL Classification: G11, G23

1. Introduction

Derivative warrants (DW) are the rights of buyers to buy or sell the underlying securities at a pre-determined price, quantity and period as specified by the issuers. Third parties issued Derivative warrants, which are not related to the listed company issuing the underlying securities. There are two types of derivative warrants that provide the right to buy (Call derivative warrants) and the right to sell (Put derivative warrants) the underlying securities. The underlying securities can be single stock or index. The difference between derivative warrants on a single stock and derivative warrants on an index is that the unsystematic risk of derivative warrants on the index is lower than that of a single stock. The hedging of the derivative warrants

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index will be easier than derivative warrants on a single stock. Therefore, this paper conjectures that the return from derivative warrants on a single stock and derivative warrants on the index are incomparable.

Thailand has imitated the Hong Kong model in derivative warrants because Hong Kong is one of the most active derivative warrants markets. Both countries use Black-Scholes Model for pricing. The difference in the derivative warrants markets between these two countries is that Hong Kong's derivative warrants do not have indicative price Tables because implied volatility is not fixed. To calculate the underlying price, investors can access the Hong Kong exchange website, which provides the function for calculation. The derivative warrants in Thailand were initiated with the same pattern in which there is no price Table. However, derivative warrants are the new product that investors were not truly understood in its character. Therefore, the indicative price table is necessary by fixed the implied volatility. The example of warrants in the Stock Exchange of Thailand is shown in Figure 1. The indicative price Table shows the derivative warrants price guideline of each underlying price in the future until the last trading day.

The indicative price table shows the approximated theoretical market value of the derivatives warrants issued by issuers. However, the indicative price table may not reflect the price, if any, at which the market maker or any other person is willing to purchase or sell the derivatives warrants, which means that such approximated theoretical price may also differ from the price quoted on SET by the market maker of the derivatives warrants due to various factors, including but not limited to

a) Lack of market liquidity and significant market volatility of the underlying derivatives warrants

b) Supply and demand of the derivatives warrants at any point in time

c) During the auction market period (the pre-opening and pre-closing trading period) on the SET

d) Any event that may have a diluting or concentrative effect on the theoretical value of the shares of the underlying company or the component securities of the index (as applicable) of the derivatives warrants.

e) Delays in the market data feed and technical issues

f) Other factors that are beyond the control of the issuer or the market maker of the derivatives warrants.

Thus, investors exercise extra caution when trading any derivatives warrants during the auction market period on the SET or trading any derivatives warrants listed in the warning list. Moreover, the approximated theoretical market value of the derivatives warrants is the value at the first trading day that underlying stock of derivatives warrants has posted the exclusion of Corporate Action sign such as XD (excluding dividend), XR (excluding right), XW (excluding warrant), Par Change. The indicative price Table may be revised since the issuer may adjust the right of derivatives warrants.

According to terms and conditions of derivatives warrants, which applies to any derivative warrants issued by the issuer, including the market maker conditions, are subject to the terms and conditions of such derivative warrants, the rules of the Stock Exchange of Thailand (SET) and applicable laws and regulations.

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AAV01C1908A	Update: 22/05/2019 04:29 PM		
Underlying Price	ราคาเสนอซื้อเบื้องต้น		
BID | OFFER	22-May	23-May	24-May
3.96 | 3.98	0.28	0.28	0.28
3.98 | 4.00	0.29	0.29	0.29
4.00 | 4.02	0.30	0.30	0.29
4.02 | 4.04	0.31	0.31	0.30
4.04 | 4.06	0.32	0.31	0.31
4.06 | 4.08	0.33	0.32	0.32
4.08 | 4.10	0.33	0.33	0.33
4.10 | 4.12	0.34	0.34	0.34
4.12 | 4.14	0.35	0.35	0.35
4.14 | 4.16	0.36	0.36	0.36
4.16 | 4.18	0.37	0.37	0.37

AAV01P1908A	Update: 22/05/2019 04:29 PM		
Underlying Price	ราคาเสนอซื้อเบื้องต้น		
BID | OFFER	22-May	23-May	24-May
3.98 | 4.00	0.63	0.63	0.63
4.00 | 4.02	0.62	0.62	0.61
4.02 | 4.04	0.61	0.60	0.60
4.04 | 4.06	0.59	0.59	0.59
4.06 | 4.08	0.58	0.58	0.57
4.08 | 4.10	0.57	0.57	0.56
4.10 | 4.12	0.56	0.55	0.55
4.12 | 4.14	0.55	0.54	0.54
4.14 | 4.16	0.53	0.53	0.53
4.16 | 4.18	0.52	0.52	0.52
4.18 | 4.20	0.51	0.51	0.50

Figure 1 Indicative price Table of AAV01C1908A and AAV01P1908A

The issuer's profit is not the difference between the market price and the first price. When issuers issued derivative warrants, the company has commitments in risk management and managing risk by hedging underlying exposure. Derivative warrants profit of issuers is the cost until the maturity of the derivative warrants because issuers can also face many risks. Therefore, it implied that the issuer's profit is the issuer's compensation that bears the risk of issuing derivative warrants.

This paper examines derivative warrants' profit of issuers compensated with the risk from issuing call derivative warrants and putting derivative warrants by examining the following questions: First, is there a difference between the issuer's profit of derivative warrants on a single stock and derivative warrants on an index in Thailand? Second, how does the profit of derivative warrants' issuers in Thailand by historical data? Third, what are the risk factors explaining derivative warrants profit of issuers in Thailand?

2. Literature Review and Hypothesis Development

Limpiviriyajit, (2013) examines the delta hedging of derivative warrants' buyer in Thailand and reports a significant negative return which implied that the implied volatility is higher than the realized volatility, implying that the derivative warrants overpriced the Black Scholes model in Thailand. Mixon, (2009) tests the delta-hedge derivative warrants returns and the volatility of the underlying stock in the options markets and implied volatility of options over the past years in Chicago. This study compares historical samples and modern samples linked to economic models and financial institutions to economic behavior in seven hypotheses. It shows that differences in implied volatility relative to realized volatility have declined over the past years, which can be concluded that implied volatility can be predicted more efficiently. Chan and Pinder, (2000) discover that the derivative warrant premium over options is positive linked to the difference in liquidity. They use bid and ask spread, contract sizes, trading volumes, and turnover ratios as liquidity proxies. They find that warrants are more liquid than the corresponding options. Numpa, (2014) investigates the improvement of the option-pricing model to the data set of Derivative warrants of 10 stocks in Thailand when specific volatility features (Stochastic jump and GARCH type) are considered. He compares empirical pricing and delta-hedging performance of three models: Black-Scholes, (1973), Heston, (1993) and

Heston and Nandi, (2000) and reports that the Heston model outperforms the others for minimizing both pricing and hedging errors, which respond to jump risk in the emerging market. The pricing performance is worsening when the time to maturity increases. GARCH is the second-best pricing model, but it creates the highest positive hedging profit, beneficial to market makers. The Black-Scholes model is not too far behind those two specific feature volatility models.

Wongsirikul, (2013) finds that derivative warrants pricing is affected by the branding effect. However, Prasertkijaphan, (2016) tests the risk factor of derivative warrants profit for issuers and reports that credit rating of issuers is not statistically significantly correlated with issuer's profit for both call derivative warrants and put derivative warrants. This result is not consistent with the previous study (Wongsirikul, 2013). Prasertkijaphan, (2016) examines profit for retail investors by assuming that a retail investor will buy derivative warrants on the first trading day and then hold the derivative warrants until they are mature. Moreover, he examines the number of days retail investors must hold derivative warrants for a profit before selling. Building on past literature, we develop hypotheses as follows.

Hypothesis 1: Regarding issuing derivative warrants on a single stock, the profit of put derivative warrants is mostly higher than the call derivative warrants. However, issuing derivative warrants on index put derivative warrants is not necessarily higher than the call derivative warrants.

As an imperfect competition for issuing put derivative warrants on single stock because issuers must have that underlying stock before issuing derivative warrants on a single stock for hedging, regular issuers that has many underlying stocks for securities borrowing and lending (SBL) have an advantage for issuing put derivative warrants on a single stock. For this reason, some issuers only issue derivative call warrants. To gain some abnormal profit return, the issuer must have some advantage over others if the market is perfect. We should observe an abnormal return in put derivative warrants on a single stock in the market. Consequently, it was assumed that put derivative warrants more profitability than call derivative warrants from issuing derivative warrants. However, issuing derivative warrants on an index can be hedged by short index future, which all issuer issues put derivative warrants on the index at the same cost. Thus, the market of issuing put derivative warrants should be more efficient. Consequently, it was assumed that put derivative warrants are not necessary to be higher than call derivative warrants from issuing derivative warrants.

Hypothesis 2: Some risk factors from issuing derivative warrants can explain the derivative warrants' profit.

Prasertkijaphan, (2016) shows that some risk factors correlated with derivative warrants profit of issuers for both call derivative warrants and put derivative warrants. This paper uses the same methodology from Prasertkijaphan, (2016), which has constraint includes 1) Do not include year effect in the formula because the data that observed is limited in one- year period 2) The data is not separate underlying between derivative warrants on a single stock and derivative warrants on index 3) Formula of derivative warrants profit of issuers is calculated Delta for hedging only at last trading day 4) Delta for hedging derivative warrants of the issuer is not multiply exercise ratio. Therefore, this paper intends to examine derivative warrants' profit of issuers compensated with the risk of issuing call derivative warrants and putting derivative warrants by dividing the underlying into two groups, including derivative warrants single stock and derivative warrants on the index, by developing methodology. Moreover, this paper compares the issuer's profit between issuing call derivative warrants and put derivative warrants.

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3. Data and Methodology

This study uses derivative warrants price obtained from the Stock Exchange Thailand for 2014 to 2018 (derivative warrants on the index have been issued since 2014). This study collects derivative warrants data including strike price (K), exercise ratio (XR), issuing share, first trading day and last trading day was obtained from www.blswarrants.com for the period of the collected data is between 2014 to 2018. All samples of data in this period have 8,721 DWs. Table 1 and 2 show derivative warrants for single stock and index, respectively. Underlying for derivative warrants on the index have four underlying include SET50 index, SET50 Index Futures, SET100 index and SET index.

Table 1. Number of call derivative warrants and put derivative warrants on single stock 8,097 DWs, divided by issuers and year of last trading day

Issuer Number	Issuer	2014		2015		2016		2017		2018	
		Call	Put	Call	Put	Call	Put	Call	Put	Call	Put
01	BLS	125	114	181	157	202	169	208	171	342	166
06	PTSEC	29	7	55	16	65	22	56	7	81	8
07	CGS-CIMB	13	0	9	0	0	0	4	0	62	0
08	ASPS	59	11	95	11	130	33	147	36	212	23
11	KS	48	14	112	39	126	54	137	33	93	16
13	KGI	133	40	178	41	140	7	179	28	332	30
16	TNS	22	0	30	0	28	0	8	0	5	0
19	YUANTA	0	0	0	0	0	0	0	0	37	0
23	SCBS	53	5	49	20	70	20	75	14	145	13
24	FSS	0	0	0	0	34	0	145	0	242	11
27	RHBS	12	0	92	10	59	12	71	17	86	28
28	MACQ	121	30	203	22	173	18	218	14	351	30
42	MBKET	56	6	122	21	130	49	139	52	69	24
	Total	**671**	**227**	**1,126**	**337**	**1,157**	**414**	**1,387**	**372**	**2057**	**349**

Table 2. Number of call derivative warrants and put derivative warrants on index 624 DWs, divided by issuers and year of last trading day

Issuer Number	Issuer	2014		2015		2016		2017		2018	
		Call	Put	Call	Put	Call	Put	Call	Put	Call	Put
01	BLS	4	4	11	11	28	28	31	31	33	32
06	PTSEC	2	2	6	6	5	6	7	7	11	11
08	ASPS	1	1	0	0	0	0	3	2	8	7
13	KGI	3	2	15	13	20	20	22	22	22	22
28	MACQ	8	7	16	14	25	25	17	19	17	17
	Total	**18**	**16**	**48**	**44**	**78**	**79**	**80**	**81**	**91**	**89**

We divide data into two groups: derivative warrants on the index and derivative warrants on a single stock. Derivative warrants profit of issuers based on these two assumptions. First, investors will buy derivative warrants on the first trading day and hold to the last trading day. Second, the closing price is used for daily hedges by issuers. Issuer's profit of call derivative warrants and put derivative warrants are determined from these two parts.

- The first part of the profit is hedging the underlying stock by adjusting the daily Delta.

If Delta's current is greater than the previous of Delta, we will buy the underlying stock into the portfolios. However, if the current of Delta is less than or equal to the previous of Delta, we will sell the underlying stock from the portfolios.

- The second part of the profit comes from issuing the derivative warrants of the issuer at the first trading date.

$$Profit\ of\ call\ DW_T = \sum_{t=0}^{T-1}(\triangle_{t+1} - \triangle_t)(S_{t+1} - S_t)XRe^{r(T-t)} + (C_0 - C_T)e^{r(T)} \text{ ---- } 1$$

$$Profit\ of\ put\ DW_T = \sum_{t=0}^{T-1}(\triangle_{t+1} - \triangle_t)(S_{t+1} - S_t)XRe^{r(T-t)} + (P_0 - P_T)e^{r(T)} \text{ ---- } 2$$

Given $\triangle t$ is Delta at time t for call derivative warrants and put derivative warrants as the following formula

$$For\ call\ derivative\ warrants: N(d) = N\left(\frac{\ln\left(\frac{S}{K}\right) + \left(r + \frac{\sigma^2}{2}\right)(T-t)}{\sigma\sqrt{T-t}}\right) \text{ ----------- } 3$$

$$For\ put\ derivative\ warrants: N(d) - 1 = N\left(\frac{\ln\left(\frac{S}{K}\right) + \left(r + \frac{\sigma^2}{2}\right)(T-t)}{\sigma\sqrt{T-t}}\right) - 1 \text{ ----------- } 4$$

where C_0, P_0 is the price of call/put derivative warrants at the first trading day C_T, P_T is the price of call/put derivative warrants at maturity, S_t is the spot at time t (baht per share), K is the strike price (baht per share, XR is exercise ratio (per 1 derivative warrants), r is continuously compounded risk-free interest rate (% p.a.), σ is implied volatility, T is the lifetime of derivative warrants (% of year),t is the current date (% of the year, $\triangle_t$ is a delta at time t for call derivative warrants and put derivative warrants as the following formula, $N(d_1)$ is the cumulative function of normal distribution

If the profit derivative warrants issuance, we examine risk factors that explain derivative warrants' profit in Thailand by testing using the regression approach.

Regression on risk factors affect derivative warrants profit of issuers:

$$Profit = \beta_0 + \beta_1[Delta\ risk] + \beta_2[Gamma\ risk] + \beta_3[Rho\ risk] + \beta_4[Theta\ risk] + \beta_5[Vega\ risk] \text{ ------------- } 5$$

where Delta risk, Gamma risk, Rho risk, Theta risk and Vega risk for call derivative warrants and put derivative warrants as the below formula Table 3.

To compare the effects of each risk factor in the same unit, all risk factors include Delta risk, Gamma risk, Rho risk, Theta risk and Vega risk, are divided by the standard deviation of each risk factor.

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Table 3. Risks of derivative warrants issuance formula

Type of	Call Derivative Warrants	Put Derivative Warrants Risk
Delta risk	$N(d_1)$	$N(d_1) - 1$
Gamma risk	$\frac{N'(d_1)}{S\sigma\sqrt{T-t}}$ where	$N'(d_1) = e^{-\frac{(d_1)^2}{2}} * \frac{1}{\sqrt{2\pi}}$
Rho risk	$Kte^{r(T-t)}N(d_2)$ —	$\underline{Kte^{r(T-t)}}\left(1 - N(d_2)\right)$
Theta risk	$-\frac{SN'(d_1)\sigma}{2\sqrt{T-t}} - rKe^{-r(T-t)}N(d_2)$	$-\frac{SN'(d_1)\sigma}{2\sqrt{T-t}} - rKe^{-r(T-t)}N(-d_2)$
Vega risk	$S\sqrt{T-t}N'(d_1)$ where	$N'(d_1) = e^{-\frac{(d_1)^2}{2}} * \frac{1}{\sqrt{2\pi}}$

where
- S_t is spot at time t (baht per share)
- K is strike price (baht per share)
- XR is exercise ratio (per 1 derivative warrants)
- d_1 is $\frac{\ln\left(\frac{S}{K}\right)+\left(r+\frac{\sigma^2}{2}\right)(T-t)}{\sigma\sqrt{T-t}}$
- d_2 is $d_1 - \sigma\sqrt{T-t} = \frac{\ln\left(\frac{S}{K}\right)+\left(r-\frac{\sigma^2}{2}\right)(T-t)}{\sigma\sqrt{T-t}}$
- r is continuously compounded risk-free interest rate (% p.a.)
- σ is implied volatility
- T is the lifetime of derivative warrants (% of the year)
- t is the current date (% of the year)

4. Empirical Results

This section reports the empirical results of 8,721 derivative warrants listed in the Stock Exchange of Thailand from 2014 to 2018 (8,097 call derivative warrants and 624 put derivative warrants). The profit margin of issuing derivative warrants comes from two parts. The first part is hedging of the underlying stock by adjusting the daily Delta and the second part comes from issuing the derivative warrants of the issuer at the first trading date. This paper found that the average profit margin of put derivative warrants is higher than call derivative warrants from issuing derivative warrants on the single stock over the past year from the following figure and Table. Table 4 shows that the average profit margin of put derivative warrants is 0.86 baht, 0.52 baht, 0.72 baht, 0.70 baht and 0.61 baht from 2014 to 2018, which is higher than the average profit margin of call derivative warrants which is 0.36 baht, 0.47 baht, 0.36 baht, 0.33 baht and 0.43 baht in each year from 2014 to 2018 because there is the risk that issuer might be faced with the shortage of borrowing stock for hedging. In addition, this paper tests the profit by each of the issuers separately. Table 4 shows the issuer's profit of derivative warrants on a single stock. It shows that profit of put derivative warrants mostly higher than the profit of call derivative warrants from 2014 to 2018.

We run regression tests on risk factors that affect derivative warrants profit of issuers at significant at 95% confidence level. Table 5 shows that Delta, Gamma and Theta are statistically significantly correlated to the issuer’s profit of call derivative warrants a single stock for risk factors evaluating call derivative warrants on a single stock. At the same time, the Rho and Vega are not statistically significantly correlated to the issuer’s profit for call derivative warrants on a single stock. The explanation of each factor that affects the direction of the call derivative warrants’ profit is shown below.

- Delta is the rate of change of derivative warrants price for the rate of change of underlying price. Delta is a negative sign that implied that the issuer has to buy more underlying if the underlying price tends to be higher, resulting in lower profit.

- Gamma is the rate of change in Delta for the rate of change in the underlying price. The result showed that Gamma has a positive sign which can be implied that the change in derivative warrants price can reflect the change in underlying price instantly.

- Theta is the absolute value because it is the amount that the investor paid to the issuer. So, with the increase of Theta's absolute value, the issuer's profit is higher.

- Vega is a negative sign because if the volatility of the underlying increases, adjusting the Delta is also increased, which cost to buy the underlying will increase.

Table 4 Average profit issuers’ profit of call derivative warrants and put derivative warrants by issuers

Issuer	**2014**		**2015**		**2016**		**2017**		**2018**	
	Call	**Put**	**Call**	**Put**	**Call**	**Put**	**Call**	**Put**	**Call**	**Put**
ASPS	0.54	0.75	0.52	0.83	0.38	1.02	0.41	0.83	0.43	0.80
BLS	0.18	**0.75**	*0.42*	***0.28***	0.21	**0.58**	0.19	**0.54**	0.40	**0.41**
CGS-CIMB	0.39	-	0.16	-	-	-	0.20	-	0.46	-
FSS	-	-	-	-	0.59	-	0.60	-	0.56	1.15
KGI	0.51	1.16	0.61	0.83	0.44	0.98	0.49	1.00	0.46	0.94
KS	0.19	0.88	***0.56***	***0.54***	0.30	0.78	0.16	0.82	0.35	0.87
MBKET	0.23	0.84	0.48	0.52	0.50	0.83	0.36	0.77	0.37	0.64
MACQ	0.43	0.85	0.44	0.50	0.37	0.45	0.36	0.82	0.37	0.68
PTSEC	0.30	0.72	0.27	1.32	0.32	0.40	-0.18	1.44	0.52	1.24
RHBS	0.30	-	0.49	0.54	0.27	1.30	0.22	0.76	0.33	0.69
SCBS	0.39	1.20	0.30	0.90	0.45	0.75	0.56	0.64	0.46	0.58
TNS	0.45	-	0.53	-	0.58	-	0.29	-	0.32	-
YUANTA	-	-	-	-	-	-	-	-	0.55	-
Total	**0.36**	**0.86**	**0.48**	**0.52**	**0.37**	**0.72**	**0.33**	**0.70**	**0.43**	**0.61**

Table 5 shows that Delta, Gamma, Theta and Vega are statistically significant for issuing issuers' profit for putting derivative warrants on a single stock. At the same time, the Rho is not statistically significantly correlated to the profit of issuers for put derivative warrants on a single stock. The possible explanation of each factor that affects the direction of the put derivative warrants’ profit will be shown below.

- Delta of put derivative warrants is a positive sign which implied that if theunderlying price tends to be higher, the amount of underlying for hedging will be less, resulting in a higher profit.

- Gamma is a positive sign. It is the same reason of call derivative warrants’Gamma. It can be implied that the change in derivative warrants price can reflect the change in underlying price instantly.

- Theta is implied as to the absolute value. The same reason of call derivative warrants’

Theta because it is the amount that the investor paid to the issuer. So, as the increase of Theta's absolute value, the issuer's profit is higher.

- Vega is a negative sign. It is the same reason of call derivative warrants' Vega.
- If the volatility of the underlying increases, the frequency in adjusting the Delta is also increased, which means the cost of borrowing the underlying will increase as well.

This paper focuses on the gap premium between Theta of call derivative warrants and Theta of put derivative warrants. The result showed that Theta's coefficient for put derivative warrants (0.6666) is higher than Theta's coefficient for call derivative warrants (0.2636). It means that put derivative warrants are more effect on the issuer profit than call derivative warrants. This supports Hypothesis 1 because the profit of put derivative warrants on a single stock is mostly higher than the call derivative warrants on a single stock.

Table 5 Regression output of risk factors evaluation to profit for call derivative warrants and put derivative warrants on a single stock

	Call Derivative warrants		Put Derivative warrants	
Variables	**Coefficient**	**P Value**	**Coefficient**	**P Value**
Intercept	0.8177092	0.000*	1.408236	0.000*
Delta	-0.4777506	0.000*	0.562267	0.000*
Gamma	0.0746716	0.000*	0.0781044	0.000*
Rho	-0.023024	0.084	-0.0303761	0.18
|Theta|	0.2636	0.000*	0.6665943	0.000*
Vega	-0.1001283	0.016*	-0.4425251	0.000*
No. of obs	5,890**		1,662**	
R-Square	0.2515		0.3879	
Adj R-Sq	0.2508		0.386	

**Significant at 95% confidence level*
*** number of observations lost from the error of implied volatility*

Table 6 Regression output of risk factors evaluation to profit for call derivative warrants and put derivative warrants on index

	Call Derivative warrants		Put Derivative warrants	
Variables	**Coefficient**	**P Value**	**Coefficient**	**P Value**
Intercept	1.281235	0.000*	1.377748	0.000*
Delta	-1.054035	0.000*	-0.0403229	0.895
Gamma	-0.010332	0.959	-0.0875226	0.691
Rho	0.3985465	0.009*	0.6928407	0.025*
|Theta|	0.0459797	0.662	0.3105369	0.13
Vega	0.2595653	0.33	0.0675507	0.858
No. of obs	315**		308**	
R-Square	0.5713		0.5327	
Adj R-Sq	0.5644		0.5249	

**Significant at 95% confidence level*
*** number of observations lost from the error of implied volatility*

Table 6 shows that Delta and Rho are statistically significantly correlated to the profit of issuers for call derivative warrants on the index for risk factors evaluation of call derivative warrants on the index. While the Gamma, Theta and Vega are not statistically significantly correlated to the profit of issuers for call derivative warrants on the index. In terms of putting derivative warrants on the index, Rho is statistically significant in the profit of issuers for putting derivative warrants on the index. While Delta, Gamma, Theta and Vega are not statistically significantly correlated to the profit of issuers for put derivative warrants on the index. To explain factors that affect the profit of put derivative warrants on the index, Rho is a positive sign. Because of the rising interest rate, the price of call derivative warrants and put derivative warrants on the index has higher follows Black– Scholes model theory. Therefore, issuers have higher profits from call derivative warrants and put derivative warrants on the index.

5. Conclusion

This paper examines the profit of issuers compensated with the risk of issuing call derivative warrants and put derivative warrants of issuers in Thailand and studies some risk factors from issuing derivative warrants that can explain the profit of issuers using daily transactions of 8,721 DWs in 2014 to 2018. Derivative warrants profit of issuers is based on these two assumptions. First, investors will buy derivative warrants on the first trading day and hold to the last trading day. Second, the closing price is used for daily hedges by issuers, which the profit of call derivative warrants and put derivative warrants of issuers determine from two parts. The first part is hedging of the underlying stock by adjusting the daily Delta and the second part comes from issuing the derivative warrants of the issuer at the first trading date, which the profit from issuing derivative warrants is separated by derivative warrants on single stock and index because it has the difference in risk and hedging. Consistent with the imperfect competition for issuing put derivative warrants on a single stock. The average profit margin of put derivative warrants is higher than call derivative warrants from issuing derivative warrants on the single stock over the past year. There is the risk that the issuer might be faced with a shortage of borrowing stock for hedging.

However, put derivative warrants are not necessary to be higher than call derivative warrants from issuing derivative warrants. Due to issuing derivative warrants on the index is efficient due to issuing derivative warrants on the index can hedge by short index future, all issuers can issue put derivative warrants on the index at the same cost. The profit of derivative warrants on the index depends on the strategy for design the specification of derivative warrants of each issuer. Moreover, consistent with prior studies, some risk factors such as Delta, Gamma and Theta, affect the profit of issuers from issuing call derivative warrants on a single stock. In terms of putting derivative warrants on a single stock, some risk factors such as Delta, Gamma, Theta and Vega are affected by the profit of issuers for put derivative warrants on a single stock. For derivative warrants on a single stock, this paper focuses on the coefficient of Theta of put derivative warrants is the higher effect on the issuer profit than call derivative warrants at three times. This point is supporting the imperfect competition for issuing put derivative warrants on a single stock. In terms of derivative warrants on the index, Rho risk only affects the profit of issuers from issuing call derivative warrants and putting derivative warrants on the index. These results contribute to policymakers' concern when establishing the rules or regulations related to the derivative warrant issues and investors' and market participants' trading the derivative warrant. This is especially important following the COVID-19 pandemic, which significantly affects financial markets around the world (Karabag (2020)). Therefore, in the future study, it is suggested to consider more areas or details on derivative warrant and other factors that may influence the profitability, and investigate each industry in different periods after the COVID-19 pandemic.

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