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CONSTRUCTION AND PROPERTIES OF VOLATILITY INDEX FOR WARSAW STOCK EXCHANGE

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Abstract: Volatility indices became a important factors on capital markets and are considered as fear factors. First volatility index VIX, was defined for Chicago Board of Trade in 1993, and was developed in 2003. In next years we observed growing numbers of volatility indices on main capital market around of the world. There were more than 20 volatility indices on capital markets at the end of 2012. The aim of this study is construction of the volatility index considering to Warsaw Stock Exchange trading rules and market participants. We also test the "fear factor" properties of this index.

Keywords: option, capital market, stock market index, volatility index

INTRODUCTION

The first volatility index - VIX, introduced by the CBOE in 1993, was a weighted measure of the implied volatility of eight S&P 100 at-the-money put and call options and it was constructed according to proposal of Whaley[1]. Ten years later Goldman Sachs analyst proposed modification based methodology of VIX, and expanded to use options based on a broader index, the S&P 500, which allows for a more accurate view of investors' expectations on future market volatility[2].

[1] Whaley R. (1993)
[2] Demeterfi K., Derman E., Kamal M., Zou J. (1999)

VIX values greater than 30 are generally associated with a large amount of volatility as a result of investor fear or uncertainty, while values below 20 generally correspond to less stressful, even complacent, times in the markets.

OPTION MARKET ON WARSAW STOCK EXCHANGE

Options have been traded on Warsaw Stock Exchange since September 22, 2003. This day saw the first appearance of European style options on the WIG20 index. There are no price variation limits applied to trading in options. The WSE offers European style options, which means that they can be exercised only on the expiry date. As is the case with futures, trading in options is supported by market makers: under a contract signed with the WSE they are obliged to place their own sell/buy orders in the order book. The reference price for options is the theoretical price calculated according to the Black-Scholes model. Given the nature of the instrument, margins are required only from option writers (those opening short positions). Option buyers do not pay margins. Table 1 contains basic characteristics of option on WIG20 index.

Table 1. WIG20 options – key characteristics

Position	Description
Multiplier	PLN 10 per index point
Option value	Product of option price and multiplier
Quotation unit	Index points
Expiry months	Four nearest months of the following cycle: March, June, September, December
Expiry date	The third Friday of the expiry month for the series. If there is no trading session on that date, the last trading session day preceding the third Friday of the expiry month is taken
Last trading day	The same as expiry date
Exercise price	Equal to the value of the underlying instrument, with respect to which the settlement balance will be determined taking the multiplier into account
Exercise value	Product of exercise price and multiplier
Settlement price	Settlement price is determined on the expiry date as the arithmetic mean of all WIG20 values during the last hour of continuous trading and the WIG20 value as determined at the session close, having rejected 5 top and 5 bottom index values
Settlement value	Product of settlement price and multiplier
Settlement date	First business day following the date on which settlement price is determined
Settlement method	Cash settlement in PLN

Source: Warsaw Stock Exchange Factbook, 2013

Due to Warsaw Stock Exchange rules, option are traded in continuous system. Each issue expiry in three months cycle on the third Friday of March, June, September and December. Price on settlement day is determined as the arithmetic mean of WIG20 index values from last hour of trading, the WIG20 values at the day closing, without 5 top and 5 bottom values of underlying index.

At the end of 2012 a total of 120 series of options were traded (all of them were WIG20 options). The trading volume for these instruments reached 715,400. The open interest at the end of 2012 amounted to 14,500. WIG20 options held the 13th position in 2012 in terms of trading volume among index options in Europe. Table 2 contain basic data of option on WIG20 for last 5 years.

Table 2. Option on WIG20 – key figures, annual data (2012 – 2008)

Position	2012	2011	2010	2009	2008
Total turnover value (PLN mill)	15 672	21 819	13 653	7 878	8 261
Average turnover value (per session, PLN mill)	62.94	86.93	53.97	31.27	32.92
Turnover value by premium (PLN mill)	179.47	276.72	158.31	192.09	231.59
Total volume of trades (thousand)	680 064	832 106	546 842	399 708	325 203
Average volume of transaction (per session)	2 731	3 315	2 161	1 586	1 296
Average number of trades (per session)	650	789	688	590	485
Open interest (year end)	14 462	17 517	43 583	20 850	6 925
Liquidity ratio (%)	10.49	11.37	8.98	6.34	6.60
Number of series (year end)	120	122	106	110	138

Source: Warsaw Stock Exchange Factbook, 2013

Option trading on Warsaw Stock Exchange is open for all type of investors: foreign (all type of investors registered outside of Poland), domestic institutional (brokerage houses, investment funds or banks) and domestic retail (all individuals investors, Polish citizens). Domestic retail investors play main role in trading of option on WIG20 index. In last 5 years domestic retail investors account for more than 50% of option trading: from 50% in 2012 to 65% in 2009. Table 3 contains investors structure in trading of option on WIG20 index.

Table 3. Investors structure in option trading on Warsaw Stock Exchange (in %)

Investors	2012	2011	2010	2009	2008
Foreign	11	24	12	4	12
Domestic institutional	39	12	28	31	30
Domestic retail	50	64	60	65	58

Source: Warsaw Stock Exchange Factbook, 2013

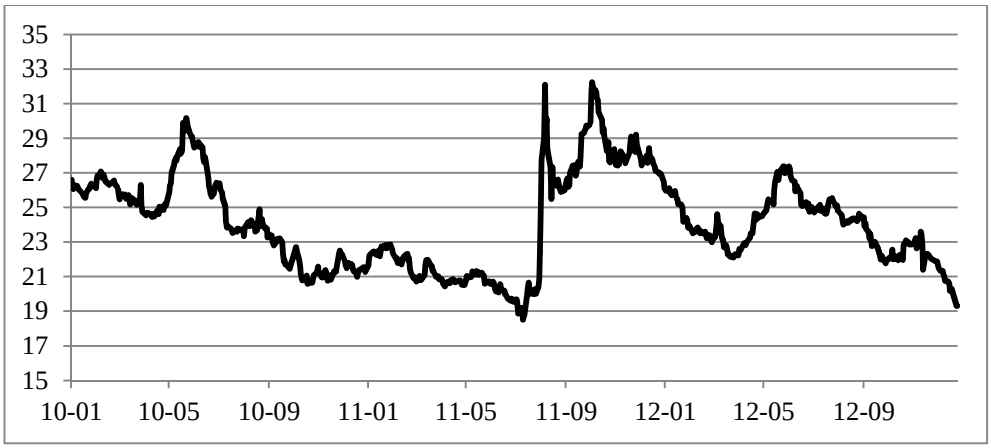
CONSTRUCTION AND ANALYSIS OF VOLATILITY INDEX FOR WARSAW STOCK EXCHANGE

The volatility index for Warsaw Stock Exchange was constructed with modification due to VIX methodology[3]. The changes concern:

- interest rate: Polish WIBOR,
- time scale: days,
- rolling days: 1 day,
- prices: last trading price, if not available, then reference price

Based on this assumption value of volatility index were calculated from Janury 2010 to December 2012. For purpose of this study index was named VWIG20. Figure 1 shows evolution of volatility index for Warsaw Stock Exchange. VWIG20 index earned its maximum value on July 2011 - below 19 percent. Minimum value we observed in August 2011 - more than 30 percent. Values of volatility index for Warsaw Stock Exchange ranged from 27 percent in January 2010 to 19 percent in December 2012. In Summer 2011 we observed the increase of index by more than 13 percent points.

Figure 1. Performance of VWIG from January 2010 to December 2012



Source: own calculation

According to the capital asset pricing model theories we predict that the expected return depends on the expected volatility[4]. Due to current results of volatility indices analysis, there are negative relationship between returns of volatility indices and underlying indices[5]. One of the explanation of this

[3] "The CBOE Volatility Index - VIX", CBOE White Paper, Revised, 2009
[4] Sharpe W.F. (1964)
[5] Simon D. P. (2003)

relationship says that the demand for puts increase when the market declines. Increased demand means high put prices, and hence higher implied volatility. Furthermore, the relationship is asymmetric: an equal size positive/negative shock on implied volatility does not have the same effect on the index return. Hence, analyst are calling the volatility index as "fear gauge"; the further volatility index increase in value, the more panic there is in the market. Further decline of the volatility index value, implies more complacency in the market.

To verify properties of volatility index more precisely the relation between the returns of the WIG20 index and changes in the VWIG20, we use regression analysis. We regress the daily return of the WIG20 on the daily changes of the VWIG20 and the change of VWIG20, when the change is positive:

$$R_t = a_1 \Delta VWIG20_t + a_2 \Delta VWIG20_t^+ + u_t$$

where:
R_t – daily returns of WIG20 index,
$\Delta WIG20_t$ – daily changes of VWIG20,
$\Delta WIG20^+_t$ – daily changes of VWIG20, if VWIG20>0 then ΔVWIG20, otherwise 0

The regression results are (t-values in brackets):

$$R_t = \underset{(-5.53)}{-0.248\Delta VWIG20_t} \underset{(-1.63)}{- 0.097\Delta VWIG20_t^+} \qquad R^2 = 0.128$$

All regression coefficients are significantly different from zero at a 1% significance level. The interpretation of the coefficients is the following: if VWIG20 falls by one percent, then the WIG20 return will increase 0.0028 index point. In other case, if VWIG rise by 1%, the WIG20 index return will decrease by 0.0034 index point. We can say, the cash market on Warsaw Stock Exchange is affected negatively more by an increase in VWIG20 than it is affected positively by an equal size decrease in VWIG20.

Additionally, we checked relationship in two different periods: bull market and bear market. Bull market we define as a period from February 8, 2010 to April 7, 2011, when the WIG20 index increase by 34%, but bear market is define from April 7, 2011 to May 23, 2012, when WIG20 index fall by 19%. The regression results for bull market are (t-values in brackets):

$$R_t = \underset{(-3.30)}{-0.253\Delta VWIG20_t} \underset{(0.79)}{+ 0.088\Delta VWIG20_t^+} \qquad R^2 = 0.05$$

In case of bear market we found that (t-values in brackets):

$$R_t = \underset{(-2.72)}{-20.071\Delta VWIG20_t} \underset{(-2.07)}{- 0.187\Delta VWIG20_t^+} \qquad R^2 = 0.185$$

We can see that the coefficient a_2 in bull market model is statistically insignificant. In bear market model both coefficients are statistically significant, and R^2 statistics is on higher level in compare to the first and the second models. This implies that bear market affect the risk – return relationship in the WIG20 options market.

CONCLUSIONS

We have constructed a volatility index - VWIG20 - for the Warsaw Stock Exchange using the WIG20 options. The construction methodology differs from the standard VIX methodology due to trading rules on Warsaw Stock Exchange and less liquidity than it is observed on developed market.

Next, the properties of VWIG20 have been studied. In line with other study, we found that the index can be used as a gauge of the investor's fear. This measure is stable over time, but the signaling results are better in bear market period, than during bull market.

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