Volatility Indexes seem to point to the Past

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Abstract:

In theory, by institutional trading options (wholesale), professional market participants asses and set future volatilities that can be identified for the retail using the Black-Scholes-formula in reverse. In reality, as regression analysis suggests, it is historical market data which instead are used to determine future values. Further analysis shows that historical volatilities are insufficient predictors.

Yet this questionable practice is considered by international accounting standards (IAS/IFRS) to allow "historical data and implied volatilities" for "reasonable estimations". In a kind of short-circuit, historical volatilities are introduced into option trading and returned as implied volatility-indexes.

In reality, both differ significantly from future values. Comparing the volatility of the past nine weeks with that of the following nine weeks, estimation error ranges from four to over ten percentage points.

Kurzfassung:

In der Theorie schätzen professionelle Teilnehmer im institutionellen Optionshandel die künftige Volatilitäten ein und bestimmen sie damit. Tatsächlich legen Regressionsanalysen jedoch nahe, dass historische Daten verwendet werden. Weiter zeigen Untersuchungen, dass historische Volatilitäten unbefriedigende Prediktoren sind.

Diese fragwürdige Praxis ist sogar durch internationale Bilanzsregeln (IAS/IFRS) festgeschrieben. Für Bewertungen können Schätzungen des Volatilitätsfaktors danach (wörtlich) "auf angemessene Weise" sowohl auf historischen Daten aufbauen als auch als implizite Volatilität erfolgen. In einer Art Kurzschluß werden so historische Volatilitäten in den Optionshandel induziert, aus dem sie dann als implizite Volatilitätsindizes abgegriffen werden.

In Wirklichkeit weichen beide Werte von späteren Werten signifikant ab. Schätzt man mit Volatilitäten der letzten neun Wochen die der kommenden neun Wochen, beträgt der Fehler vier bis über zehn Prozent.

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[*] Bitte keine publizistische Verwertung ,wie auch immer ,ohne die Angabe der Quelle und des Titels.
No quotes or copying by any means without referencing author and source please.

Introduction

Volatility is a measure of the "current market heat" and is assumed to be a "predictor" for future statistical standard deviation and is interpreted as a percentage risk of estimates. There are implied volatility indexes computed for the DJIA, NASDAQ, S&P500, FTSE and DAX. Volatility is also one of the most important factors for most financial-market models in use - a reason for reviewing this property on the basis of historical data.

Experimental Findings

The volatility of the DAX is calculated several times daily, - in a complicated approach but which can be described in simplified terms as: Probing the value which - used in the formula of Black and Scholes – results in a DAX option price being as close as possible to current future market quotations. This is for a mathematical reason: the Black-Scholes-formula (Black, Scholes 1972, 1973), which is a Differential Equation, cannot be solved like “volatility = function of (price, time,...)”. However, Monte-Carlo-techniques allow to approach an “implied” volatility as close as intended..

The argument is that professional future market assessments are measured by the implied volatility index. It is assumed that institutional wholesale trading takes place on a futures market while retail trading of option warrants is done "over- the-counter" (OTC).

This thesis is tested by comparing historical quotations of volatility indexes with the standard deviation determined ex-post. The VDAX, for example, is supposed to be a predictor. To measure the standard deviation, one needs a time range, here 13 weeks (representing 63 trading days - a quarter of a year).

The synchronous values correlate with the VDAX at a level of from 0.6 to 0.7 only, which is not a strong correlation and which does not substantiate the thesis.

However, if one compares values of the VDAX being about 45 trading days (or 9 weeks) older, the correlation improves, reaching levels over 0.9. It can therefore be considered strong. About 9 weeks later, The VDAX achieves the quality of "real" volatility measured ex-post. Every lengthening or shortening of the lag (i.e. testing the counter thesis) leads to increasingly lower correlation values.

Tab.: Correlation coefficients "r" of VDAX and Volatility ex-post.

Lag	Unit	r	Period
0	Trading Days	0.638	Jan 00 - March 09
45		**0.937**	
0	Weeks	0.703	Jan 00 - Oct 05
8		**0.803**	
0	Weeks	0.627	Nov 05 - March 09
9		**0.926**	

This additionally coincides with a look at the curve course. The VDAX values additionally "limp" after what one can observe along strong movements. Please refer to Fig.: VDAX in comparison to ex-post volatility course.

The VDAX seems unsuitable for forecasts, particularly considering that volatility is an important factor of most evaluation models, with a disproportionately high effect on results. Average volatility levels at 23 percent, with an average absolute error of 6.5 percentage points.

The result was also checked for the VIX, the volatility of the Standard & Poor's index 500 with quotations of each trading day over more than ten years. The best correlation with r=0.935 is achieved when trying a time lag of about 47 trading days or again approximately 9 weeks.

NASDAQ Volatility, VXN, achieves even stronger correlation intensities. Average volatility levels at 30 percent, with an average absolute error of 10 percentage points.

Lag	Unit	R	Period
0	Trading Days	0.75	Jan 01 – Jul 09
61		0.85	
0	Trading Days	0.88	Jan 01 – Apr 05
32		**0.94**	
0	Trading Days	0.75	Apr 05 – Jul 09
61		**0,90**	

For similar findings regarding the S&P-Volatility, please refer to Fig.: Volatility Index VIX to the S&P 500.

Impact of International Accounting Standards

These findings are not caused by model or calculation errors. It seems - unexpectedly - to happen in such a way that professional traders in the option markets fundamentally orientate themselves more on the basis of data from the previous nine weeks than by assessing future developments.

These practices are supported by accounting standard IAS 39, AG 82 (f): "... *Measures of the volatility of actively traded items can normally be reasonably estimated on the basis of historical market data or by using volatilities implied in current market prices.* "

The short circuit: Market participants use historical volatility when trading options and - unsurprisingly- an approximation of volatility by using the Black Scholes formula in reverse - [aside from formula-caused distortion (smile effect)] - once again produces historical values.

Independently, the prediction power can be tested in a different way: VIX volatility over the last 45 trading days differs from that over the 45 following days on average by about 4.9 percentage points (absolute values). This is too high for a predictor, particularly since volatility disproportionately affects model prices. Please refer to Fig. Prediction Error.

Accounting standards that allow historical volatilities as an adequate predictor for future ones, do not comply with the empiric observations of VDAX, VXN, VIX and VFTSE.

Excursion: Impact on GARCH-Techniques

Robert F. Engle (1993) and Tim Bollerslev are considered the founders of forecasting techniques based on autoregression phenomena. These techniques are often used to forecast volatilities. Two hypotheses:

- They haven't prevented important indexes of implied volatility from apparent dependence on nine-week-old historical data. The GARCH approach could be the reason that implied volatilities correlate to two-month-old data. They use historical data also!
- They may have prevented implied volatility predictions from being less future-oriented.

The variable lag correlation approach should be used to examine GARCH-based predictions - room for further research.

Autoregression suggests that a variable, often volatility, depends on historic data of the same variable.

The phenomenon of autocorrelation in general means that series of quotations of one or more months correlate with historical quotations. It can’t be argued that a variable is physically or economically dependent on previous periods. The explanation is rather that an underlying reacts on similar situations in a similar way.

Methodology - Lag Correlation

Correlation states first about similar behaviour of two timely synchronized can reach from −1 to +1. One would speak of strong ("stramme") correlation only with a coefficient greater than 0,8 or better 0.9[1]. Correlation as such suggests the hypothesis of a functional, linear dependency. More research is required to achieve an explanation of dependency and which variable might be the independent and which the dependent one.

Lag correlation does not compare chronologically synchronous values, but a presumably independent variable to - later at a time lag- values of said presumably dependent variable. Varying the time span, the margin with the (only[2]) maximal correlation and r > 0.9 can be determined. This implies a hypothesis that original information requires some time to make an impact on dependent, derivative variables - in this case the volatility indexes.

A classical population statistics example is the correlation of births and marriages. One could consider marriage as the independent events and birth as the dependant event, with a time lag of nine months. This is not always unequivocal in contrast to scientific "processes" in sociology: It could also be that only knowledge of pregnancy stimulates the decision to marriage.

Summary

The recourse to the latest historical volatility would be allowed only with constant volatility in the case of the model theory, as is presumed in the Black-Scholes formula. This assumption is however not the case. The volatility itself is "volatile".

The statement, "volatility" being the " *magnitude of future changes in price of the financial instrument or other item*" is from a statistical perspective of low explanatory power: The standard deviation (sigma) says that - normal distribution assumed - only about 68 percent of the cases fall in the predicted range of the last quotation plus / minus sigma: a level of DAX at 4800 would lie typically in one year in 68 for every 100 cases between 3696 and 5904. For 95 percent of cases the range plus / minus 2 x sigma applies: from 2592 until 7008 etc. This type of forecast is not of much use.

In any case, it is economically implausible that a future value should depend on current ones or on a suggested volatility for the future. Application Guideline 82 is misleading.

[1] Fahrmeier, p.135, correlation. coifficients differ according to: poor (|r| < 0,5 / moderate 0,5 ≤ |r| < 0,8 / strong 0,8 ≤ |r|.

[2] More than one correlation maximum – possible in theory - could not be observed.

References

I haven’t found a paper in the net that reviews the hypothesis of IAS 39/AG82(f).

Black, Fisher / Scholes, Myron: "The Valuation of Option Contracts and a Test of Market Efficiency“, (1972) Journal of Finance, 27, S. 399-417

Black, Fisher / Scholes, Myron: „The Pricing of Options and Corporate Liabilities“, (1973) Journal of Political Economy 81 (3), S. 637-654

Engle, R. F., V.K. Ng: „Measuring and Testing the Impact of News on Volatility“ (1993) Journal of Finance 48, S. 1749-1778

Fahrmeir, Ludwig et al.: "Statistik", 3. Ed., Berlin, Heidelberg, (1997-2001) (lag correlation = „verschiebliche Korrelation“, assuming Y = a + b * (x + t) with t = time lag)

Hull, J. C.: „Options, Futures and Other Derivates“, 3rd edition, Prentice Hall, (1997)

Pape, Ulrich / Merk, Andreas: "Zur Angemessenheit von Optionspreisen – Ergebnisse einer empirischen Überprüfung des Black/Scholes-Modells" ESCP-EAP-Workingpaper, (2003), p.8. and 14

The IASC Foundation in Delaware and London maintains © of all IAS and IFRS publications including the ones confirmed as mandatory EU-Accounting Standards. Please refer to the IASB in London.

There are well documented Nobel Prize pages covering B&S (1997) and GARCH (2003)

Historical Critics regarding the "B&S"-Formula (by years - a selection):

Galai, D.: „A Survey of Empirical Tests of Option-Pricing-Models“ in Brenner, S. Menachem (Hrsg.): "Option Pricing“ (1983)

Geyer Geske, R, W. Touros (1991): „Skewness, Kurtosis and Black-Scholes Mispricing“ In: Statistical Papers, Vol. 32, S. 299-309 Anderson,

, Alois L. J.: ZfB 91/1 (43.Jg.) S. 65-74: „Is the random walk dead“

Kapitel 2 „Failure of the Gaussian Hypothesis"

Attachments: Empirical Results, Data References and ToC

Fig.: VDAX in comparison to ex-post volatility course.

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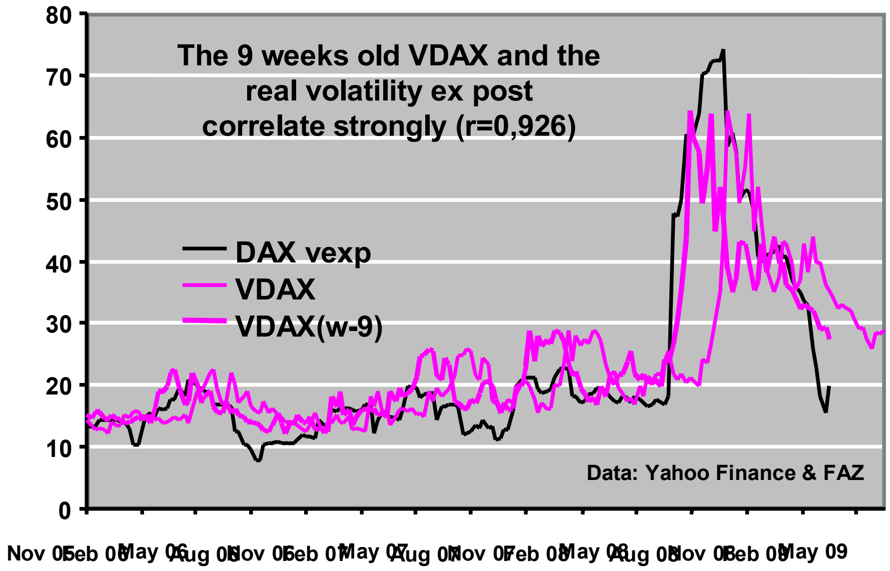
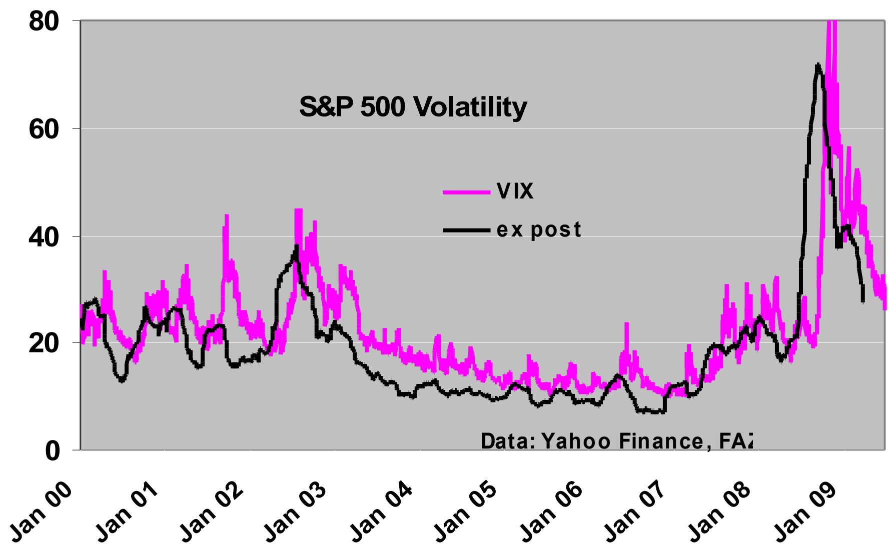


Fig.: Volatility Index VIX to the S&P 500

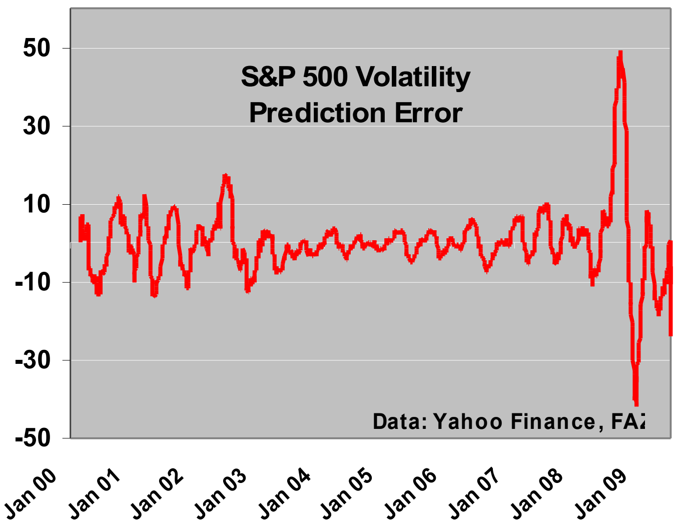
Index VIX in comparison with the real volatility determined ex-post.

To secure the result with the VDAX, the VIX index with all trading day dates was analyzed similarly over more than 10 years. Here, the highest correlation happens to be r=0.935 when compared to 47 trading days old VIX data.



It is also observable that the volatility index lags behind the ex-post determined real values. Besides, VIX levels about 2.5 percent points higher.

Fig. Prediction Error



The prediction error shown in terms of percentaged deviations of the VIX.

Data

Daily/weekly exchange data of major indexes are used to compute standard deviations and to compare them with the quoted implied volatilities of DAX, FTSE, NASDAQ and Standard & Poor's 500.

A few quotations had to be eliminated for precise daily matching. This is due to different bank holidays in Chicago. New York, London and Frankfurt.

Source: courtesy Yahoo Finance and FAZ.

There are no quoted implied volatility data for the NIKKEI 225 available. The DJIA volatilities seem to require a fee (also room for further research).

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