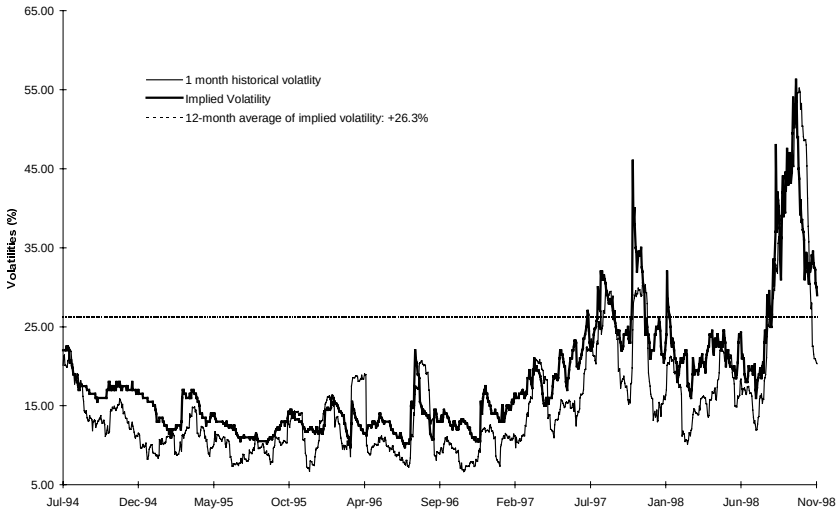
Derivatives

Predictability of implied volatilities

During the past 12 months, implied volatilities in the Swiss market have experienced very large swings. While volatilities have come off their peaks in recent weeks, the historical volatility has declined much further than implied volatilities, leading to a large gap between the two.

The graph shows (i) one-month historical volatility and (ii) mid-market implied volatility of at-the-money, front-month options (daily data).



Source: Warburg Dillon Read

The question arising is, whether implied volatility is a good indicator of future actual volatility or vice versa. Much academic literature has dealt with the subject of implied volatility as an indicator of future actual volatility, and reached contradictory conclusions.[1] Meanwhile, a recent in-house working paper has provided evidence that historical volatility calculated over a period of three to five months has some predictive power in forecasting future implied volatility.[2]

Despite these contradictory results, it can be shown that implied volatility and historical volatility have a strong positive correlation.[3] By choosing a third variable it may be possible to predict one of the two volatilities. Through the correlation of the two, the first predicts the behaviour of the second to a certain extent.

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[1] One of the most recent articles is: Christensen B.J., Prabhala N.R., 'The relation between implied and realised volatility', *Journal of Financial Economics*, Volume 50, No.2, November 1998, pp 125-150.

[2] Winzeler D.: *Vorhersage impliziter Volatilitäten mit Hilfe historischer Kursreihen*, 24th July 1998.

[3] In linear regression analysis, we calculate a correlation coefficient of 0.9 and a determination coefficient (R squared) of 0.81 over the period from 1st July 1994 to 20th November 1998.

For the next analysis, we therefore change our view from a micro to a macro forecast and arrive at an interesting relationship between implied volatility for stock markets and the risk premiums in the debt markets.

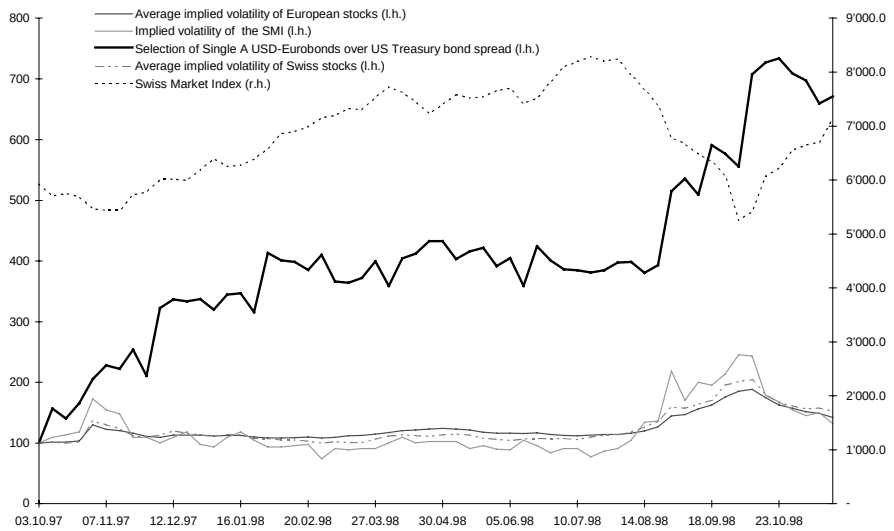
Volatility through macro-economic glasses

Implied volatility is the market's expectation of the future variability of the returns of the underlying asset. Thus, it captures the underlying's risk. Another risk measure for companies is the spread of corporate debt over risk-free rate, ie, government bonds. With the help of macro economic tools, economists try to forecast this spread. In this analysis, we investigate correlations of implied volatilities and the yield spread of a selection of single-A rated US$-eurobonds with a maturity of one to five years over a weighted yield of US Treasury bonds with a maturity of one to five years.

The implied volatilities used are:

- the implied volatility of at-the-money options on the Swiss Market Index (SMI) with a maturity of approximately one month (SMI implied volatility);
- the equally weighted average of the one-month implied volatilities of at-the-money options on the individual stocks which are included in the SMI (Swiss average implied volatility); and
- the equally-weighted average of the one-month implied volatilities of at-the-money options on the individual stocks which are included in our European universe (European average implied volatility).[4]

Yield spreads versus implied volatilities and SMI



Source: Warburg Dillon Read

[4] Warburg Dillon Read's European equity derivatives universe consists of 271 stocks in CH, D, UK, NL, F, S, ES, and I.

For all three implied volatility definitions, we run a linear regression analysis with the implied volatilities as the dependent variables and the interest rate spread as the independent variable. For the simplicity of data collection we chose US$-eurobond yields instead of European currencies' eurobond yields.[5] Data is taken from 3rd October 1997 to 20th November 1998 on a weekly basis.

Implied volatilities and risk premiums strongly linked

We find that the yield spread is significantly correlated with all of the above implied volatility series. The correlation coefficient between the spread and the SMI implied volatility is 0.5. That between the spread and the Swiss average implied volatility is a high 0.93, and that between the spread and the European average implied volatility is also a high 0.81. Given the high correlation coefficients for both average implied volatilities, we can assume that the latest downturn and rebound in equities markets are largely due to adjustments in the risk premium that investors require for equities, ie, that the risk premium has been increased heavily during the downturn and is now decreasing while the markets are heading north. [6]

Are the times of high volatilities over now? No, not necessarily. Our strategist sees three major problems for the near future: (1) liquidity contraction which means higher equity risk-premium and higher capital costs; (2) solvency crises which means excess capacity and lower prices; and (3) earnings deflation which means consensus upgrades are illogical.[7] If we link the findings of the above regression analysis with the fear of a liquidity contraction, we have to expect higher volatilities as soon as the market plummets after leaving the first up-leg of the 'W'-shaped index performance we expect.

Derivative strategies and implied volatility

If investors use options in their investment strategy, the value of their portfolio is greatly affected by the risk of changes in implied volatility (tau-risk[8]). With changing implied volatilities, an option strategy might therefore not behave as we would expect with constant volatility.

[5] We imply a strong correlation between US, European and Swiss interest rates.

[6] We imply a strong correlation between the risk premium required for bonds and that required for equities.

[7] See: WDR's *European Strategy* of 30th October, 1998 by Julian Edwards and Stephen Grant and the *Global Economic Perspectives* of 19th November 1998 by George Magnus and his Global Economics team.

[8] Warburg Dillon Read uses tau (τ) to indicate the risk of changing option-prices due to a change in implied volatility. Some authors refer to this risk as 'Vega-Risk'.

This risk, however, can be limited in three different ways:

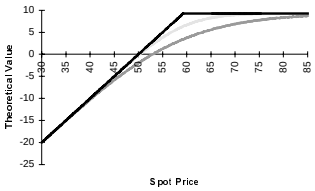
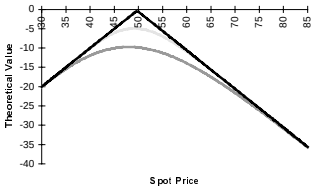
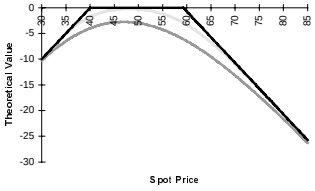
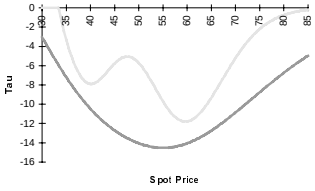
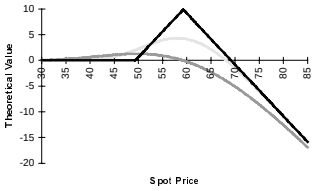
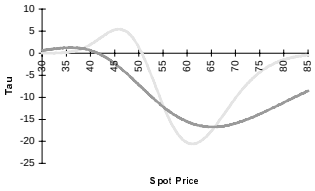
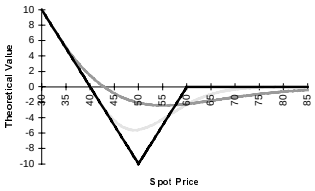
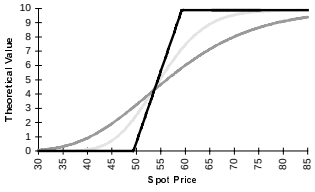
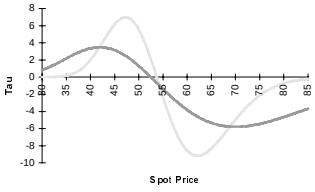
1. The investor holds the options until expiry. At that point, the payout of the option is determined solely by the strike price and the stock price at the time.

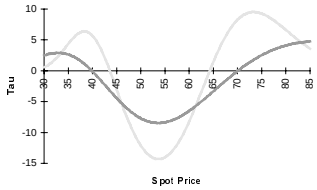
2. The investor sets up a position in options that have a partially offsetting tau-risk.

3. The investor hedges away the tau-risk by buying or selling the appropriate number of volatility-futures.

With the 'Buy and Hold'-strategy mentioned in the first point, the investor is not exposed to any tau-risk at expiry. This makes a discussion obsolete. Hedging the tau-risk by buying or selling volatility-futures as mentioned in the third point is seldom possible as contracts are only available for very few underlyings.

By buying and selling options which to some extent have offsetting tau-risk (see point two), the investor is able to partially neutralise his portfolio against possible changes in implied volatility. Hereafter we show the most common option strategies and the 'tau-risk' associated with them. The light grey line shows the theoretical value of the strategy in the left-hand charts and the tau-risk for an implied volatility of 25% in the right-hand charts. The dark grey line shows the same for an implied volatility of 50%. We have chosen such a large difference in order to accentuate possible effects.

	Theoretical Value	tau
Covered Short Call **similar: Short Put**		
	As implied volatility increases, the distribution of tau widens while the amplitude remains at a low level.	
Short Straddle		
	As implied volatility increases, the distribution of tau widens while the amplitude remains high.	
Short Strangle		
	As implied volatility increases, the distribution of tau widens while the amplitude remains at average levels.	
Ratio Spread with Calls		
	As implied volatility increases, the distribution of tau widens while the amplitude decreases from a high to an average level.	
Ratio Spread with Puts		
	As implied volatility increases, the distribution of tau widens while the amplitude decreases from a high to an average level.	
Bull Call Spread **Bull Put Spread** **Risk Reversal**		
	As implied volatility increases, the distribution of tau widens while the amplitude decreases to a low level.	

	Theoretical Value	tau
Long Butterfly		
	As implied volatility increases, the distribution of tau widens while the amplitude decreases sharply from a relatively high to a low level.	
Long Condor		
	As implied volatility increases, the distribution of tau widens while the amplitude decreases sharply from a relatively high to a low level.	

Conclusions

The findings of our regression analysis combined with the fear of a liquidity contraction and subsequent higher bond-yield spreads, suggests that implied volatilities will rise again, as soon as markets plummet after leaving the first up-leg of the 'W'-shaped index performance we expect.

Investors using options in their investment strategy should therefore be aware of the danger of a sharp rise in implied volatility and adjust their portfolio accordingly. An investor can either follow a strategy which exposes him to low tau-risk such as the ratio spread with puts, the bull spreads with calls or puts, the risk reversal, the butterfly or the condor. A more aggressive investor might wish to follow a tau-positive strategy thus profiting from an expected rise in implied volatility. Possible strategies consist of buying options. The strategies suggested include long puts, long straddles, the ratio spread with puts and the ratio back-spread with calls (which is being short the ratio spread with calls).

In any case, since implied volatilities have experienced large swings in the past 12 months, investors using options have to be aware of the risk of changing implied volatilities. It can greatly affect the outcome of their investment strategy.