Examining Trend Characteristics

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Foreword

In the past, systematic managed futures strategies have often been described as mystical. As more studies and research have been applied, these strategies have become a lot more transparent and easier to understand. As part of the ongoing educational process, we commissioned our first paper: **'Examining Trend characteristics'.** I hope that through this short, easy reading paper, we have provided you with some food for thought.

On behalf of Amplitude, we welcome your critique, suggestions and comments. We have a solid research base and we will be proud to use some of that resource to produce some more innovative papers in the future.

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Please send your feedback to

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Executive Summary

Many funds in the managed futures and the macro space try to generate profits by identifying trends and taking the appropriate short or long positions. Strong market moves usually lead to profitable trades while a narrow-range 'trading' market environment creates harder conditions to generate profitable transactions.

In order to describe this behaviour quantitatively, an appropriate index of trend indication needs to be identified. Existing trend indicator concepts have their limitations. These are discussed in the first section of this paper.

We then develop a **Trend indicator** (TI) which overcomes some of the weaknesses of other trend concepts. We use this trend indicator to explore the close but crucially different relationship between trends and volatility.

The underlying data used is the USD/EUR minute exchange rates between 1990–2004. We find that in periods of low volatility there are few trends, but in highly volatile markets, trends are no stronger than in medium volatile periods. At volatilities of above 0.5% per day, the relationship between the trend indicator and the volatility is independent and the knowledge of the exact volatility at the level has no information other than the fact that it is higher than 0.5%.

We then use the TI concept to examine simple trend following systems (in this case a simple MACD system). We find that the TI concept can be used to determine the underlying trading timeframe that is used in a trend following system.

We test this concept with a live FX fund and try to establish the timeframes that it operates on. From the results, we can conclude that the fund is trading in line with its described strategy: over several time periods.

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Existing Trend Indication Concepts

There are different ways to describe the trend characteristics of price movements. A common indicator is the Average Directional Indicator (ADX), which describes a trading or trending market environment.

If the high and low of a day t are high(t) and low(t), the ADX at time t over n days is defined via the following formulae:

$$HD(t) := high(t) - high(t-1), \qquad\qquad LD(t) := low(t-1) - low(t)$$

$$DMP(t) := \sum_{s=t-n+1}^{t} \left\{ \begin{array}{ll} HD(s) & if \quad HD(s) > 0 \wedge HD(s) > LD(s) \\ 0 & else \end{array} \right\}$$

$$DMM(t) := \sum_{s=t-n+1}^{t} \left\{ \begin{array}{ll} LD(s) & if \quad LD(s) > 0 \wedge LD(s) > HD(s) \\ 0 & else \end{array} \right\}$$

$$ADX(t) := MA_n \left(\frac{ABS(DMP - DMM)}{DMP + DMM} * 100 \right)$$

Where MA_n is the moving average over n days.

ADX is intuitively a measure of the difference between the increase of daily highs and the decrease of daily lows over a certain timeframe.

One downside of the ADX is, that it may indicate a trending market, where the market just shows higher volatility, but there is no real trend. This is illustrated in the chart on the next page.

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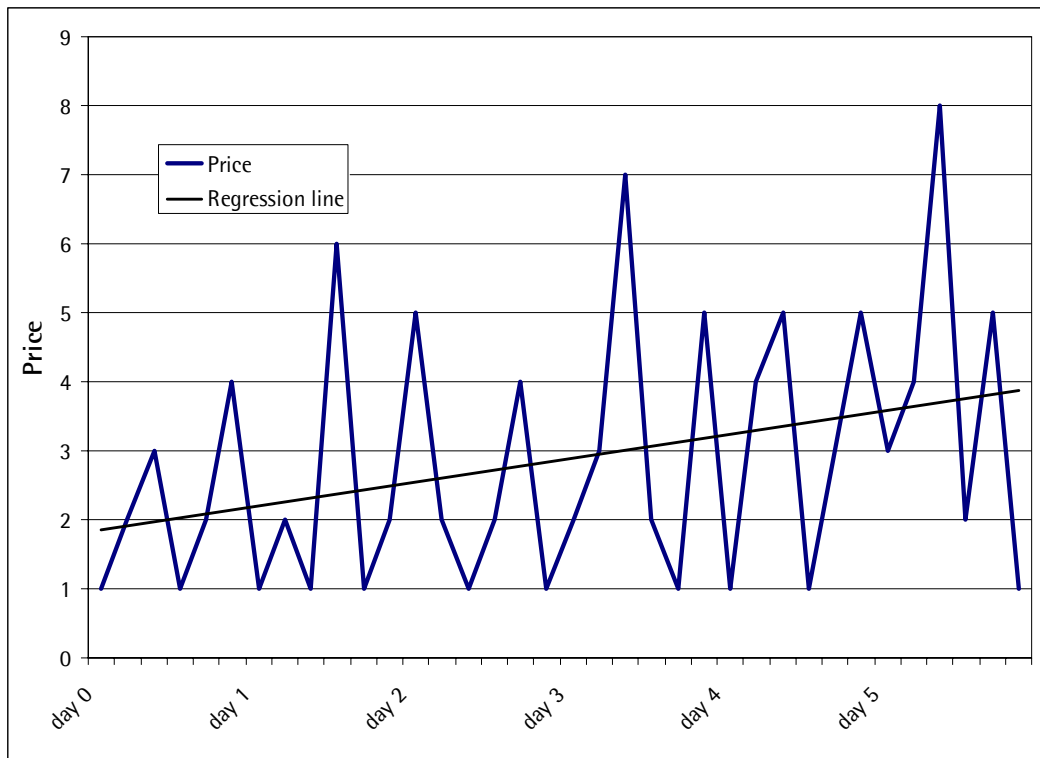
The relevant inputs for the calculation of the ADX are HD(t) and LD(t), given below:

t	HD(t)	LD(t)
1	2	0
2	0	0
3	2	0
4	0	0
5	3	0

The ADX will indicate a strong upward trend, although it is actually more of a range trading market. In order to avoid this drawback, one could use the absolute value of the slope of the linear regression as a measure of the trend. This alone would be misleading. Although the chart above shows an upward trend in the regression line, in reality there is no trend. We therefore propose to take account of the volatility around the trend, measured, for example, by the standard error of the slope.

These two aspects are incorporated into our proposed trend indicator (TI) on the next page. This indicator will be defined in such a way, that it can be calculated easily over any timescale.

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Proposed Trend Indicator: TI

We propose a Trend indicator for trends of n minutes, TI(n), defined as follows. The TI(n) for a specific time t is calculated by doing a linear regression on the n minutes around t (n/2 before t and n/2 after). With following variables

n: time scale in minutes (e.g. 30 for 30 minutes, 1440 for 1 day,…)

t: point in time where to calculate the indicator (e.g. 14/2/2002 16:45)

a: the slope of the linear regression from t–n/2 to t+n/2

σ_a: the error of this regression

R: a small summand that is added to avoid that single outliers (with nearly no error of the slope) would disturb the result. In this paper R=10^{-11}

The TI over n minutes at t is defined as:

$$TI_t(n) = \frac{|a|}{\sigma_a + R}$$

Clarification of Definition

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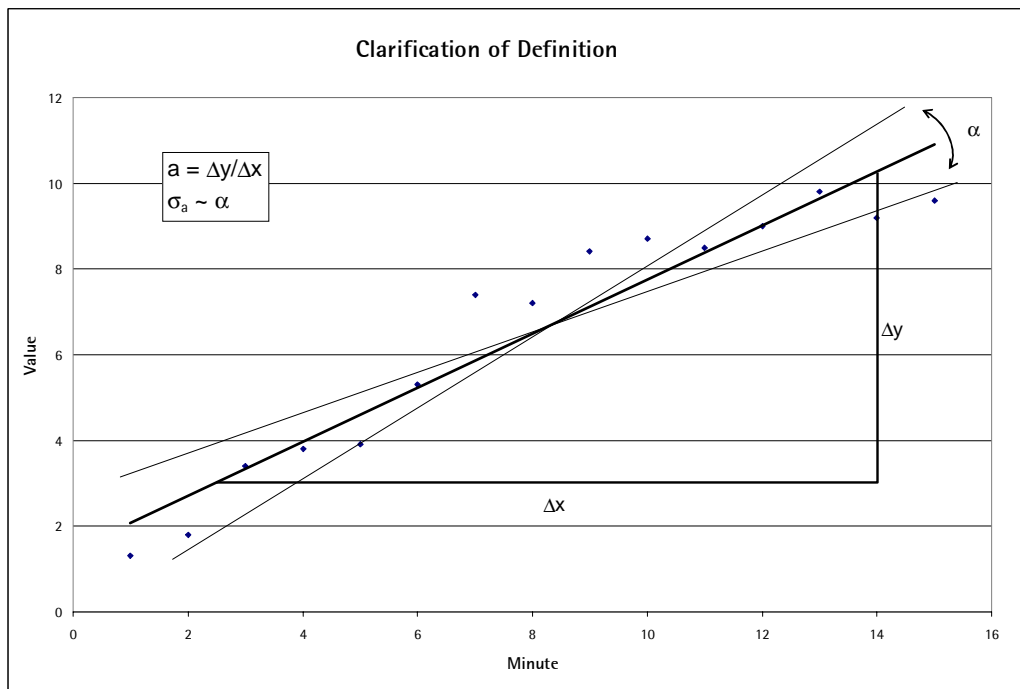
Volatility and Trends

Often trend and volatility are referred to in the same context and even used as synonyms for each other. It is normally assumed that one is strongly correlated to the other. Nonetheless it can be observed that despite high volatility strong trends cannot always be found. This calls into doubt the belief in a high correlation between trend and volatility.

In this section, we will explore the relationship between trends and volatility – using our trend indicator as a proxy for trends. **We have used USD/EUR minute price data between 1990 and 2004.** The 1 day (1440 minute) volatility and 1 day TI's were calculated and plotted in the frequency graph below. Different colours represent the density or frequency of occurrence. Due to the extreme range of data, the natural logarithm of density is used.

Plot of logarithmic Density

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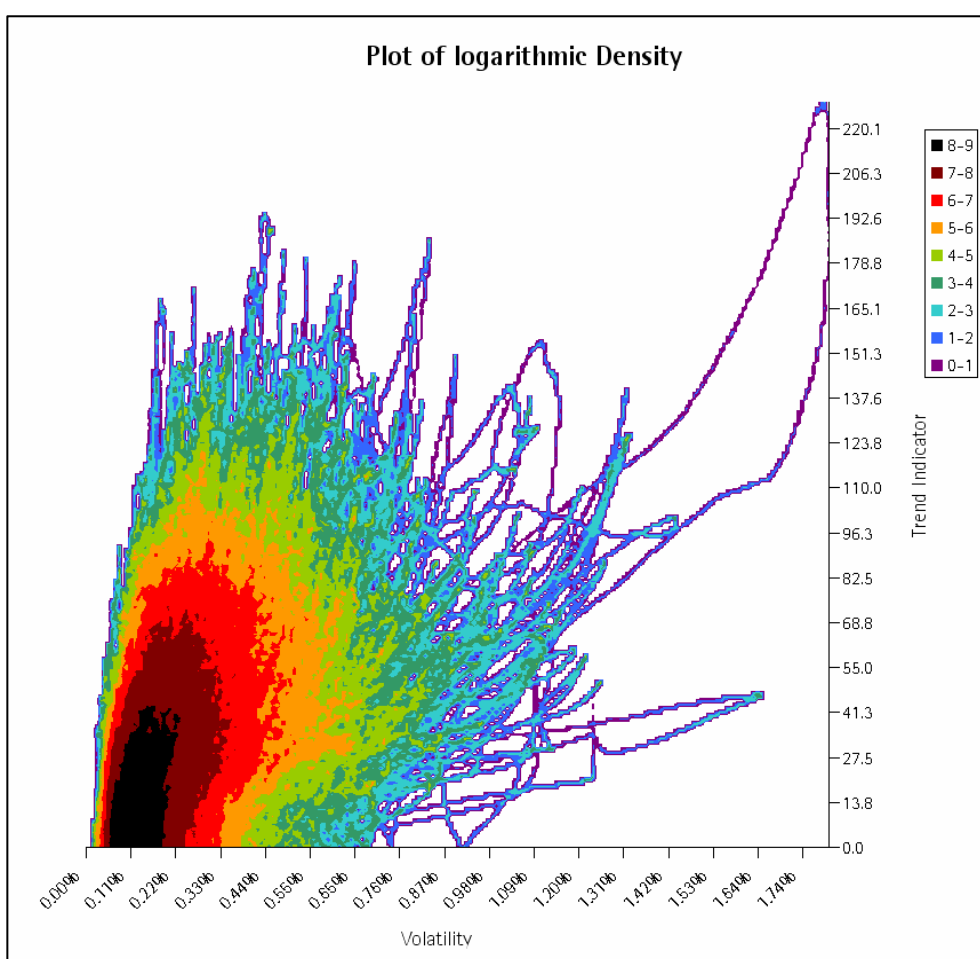
The graph as shown on the previous page is challenging to interpret. In order to unravel its meaning, the graph will be modified. For a particular level of volatility all the data is normalised and the relative frequencies are calculated.

As an example, the distribution of trends is shown below for volatilities in the range 0.20% – 0.21%,
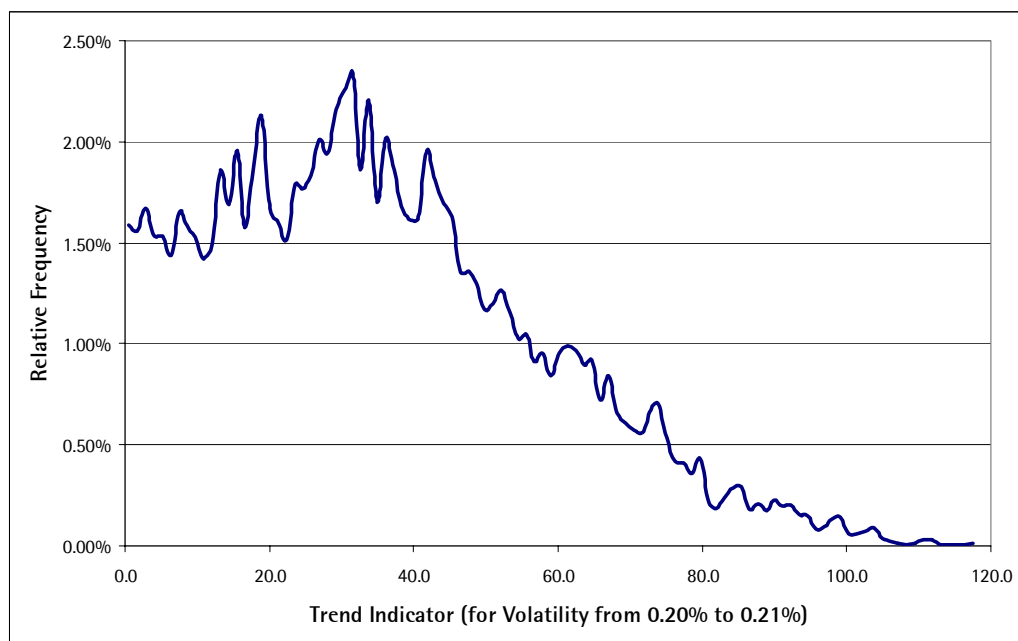
This procedure is carried out for all volatilities and the results are displayed in the chart on the next page.

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Volatility and Relative Frequency of Trend Indicator
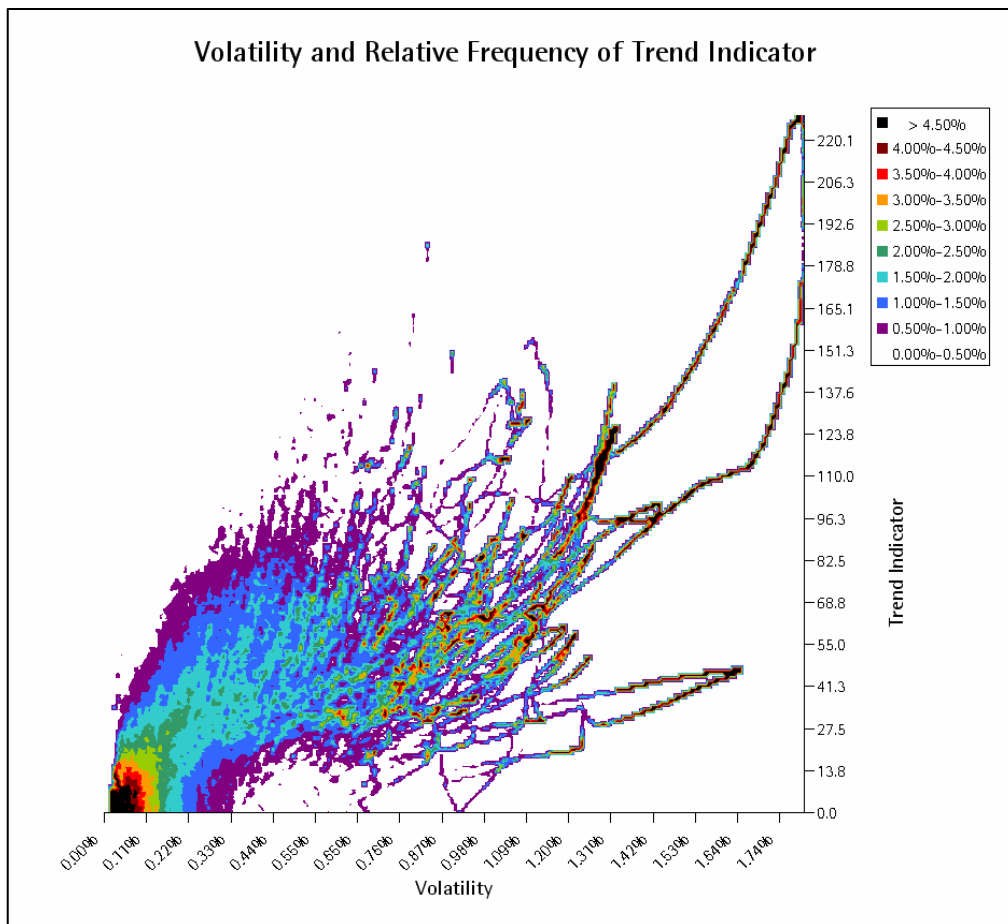
This graph shows that for low volatility, there is a correlation between volatility and the TI. About above 0.4% the average TI seems to stay constant.

If one plots the average TI versus volatility, this is even more obvious and this is shown in the figure below.

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Average Trend Indicator versus Volatility
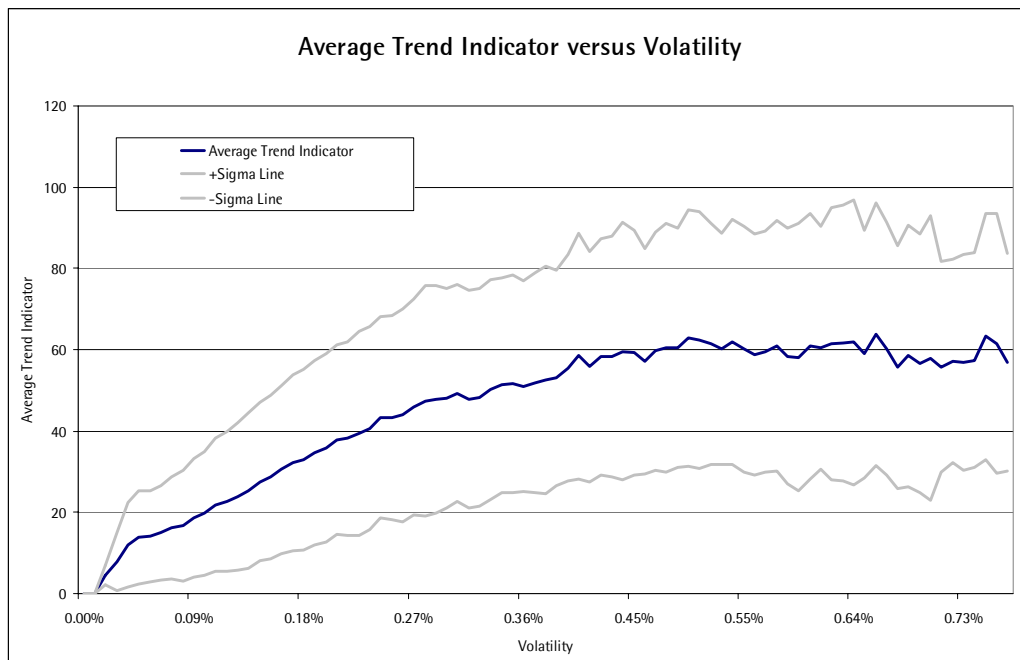
For low volatility the expected value of the Trend Indicator increases as volatility increases. But for high values of the volatility this relation doesn't hold anymore. At about the 0.5% volatility level, the expected value of the Trend Indicator is basically independent of volatility.

Therefore at volatilities above 0.5% the knowledge of the exact volatility holds no more information than the fact that it is higher than 0.5%.

It should be noted that days are rare where the daily volatility is above 0.5%.

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A Simple Trend Following System

Having explored the relationship between trends and volatility, we can start to use the trend indicator to investigate simple trend following systems. Specifically, we will use a relatively standard smoothed moving average convergence divergence indicator (MACD) as an example of a simple trend following system. Clearly we would expect the MACD indicator to be correlated with the TI if both are on a similar time scale. The MACD indicator is the difference between two moving averages (with periods t_1 and t_2) and this result is smoothed (over a third time period t_3),

Let us consider two MACD systems over USD/EUR exchange rate data.

MACD1: Moving averages over 16 and 32 hours and a smoothing time of 10 hours.

MACD2: Moving averages over 5 and 10 days and a smoothing time of 3 days.
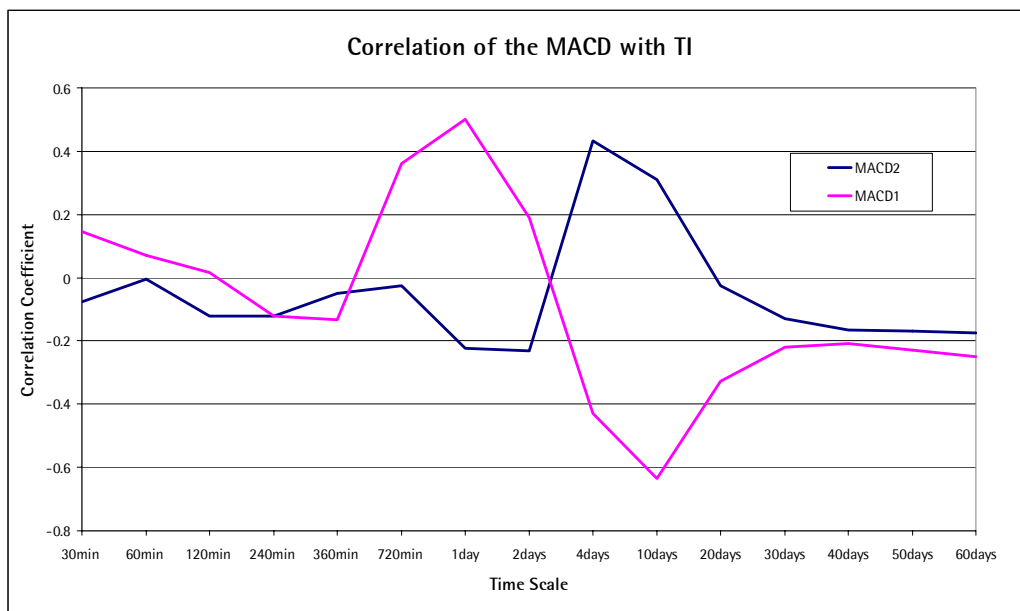
The chart above shows the correlation of the MACD1 and MACD2 indicators with TI(n) (the trend indicator with a time frame of n) at the y-axis, and n on the x-axis.

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The chart shows a peak of correlation between MACD1 and TI(n) at about 24 hours, and a peak for MACD2 at between 4 and 10 days. Thus in principle, this sort of analysis can show us the underlying timeframe of trends that a particular systematic system is designed to pick up. MACD1, by virtue of its parameterisation is designed to pick up 1 day trends, and MACD2 is similarly designed to pick up 1-2 week trends. In the next section, we will use this technique to reverse engineer the broad trend following parameters of a particular fund.

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Reverse Engineering the Time Frames of a Trading System

We have recently seen new strategies that claim to operate on short time frames. It would be interesting for an investor to reconfirm independently the time frame that a fund operates on. Using the analysis of the previous section, we can try to uncover the underlying trading timescale of a fund.

First of all, we need to identify a fund that claims to operate on particular time frames. Often this information is hard to obtain. A prerequisite for an investor to run this analysis is to have return information on a strategy/instrument level. Most CTA's invest in a number of markets and the underlying instrument level information is usually proprietary and rarely disclosed.

In this case study, a specific fund has been selected that claims to trade on multiple timeframes in the FX markets. The correlation of the fund's monthly returns with the TI of the USD/EUR exchange rate over different time scales is plotted in the graph below, using the data from 1/2002 till 12/2004.
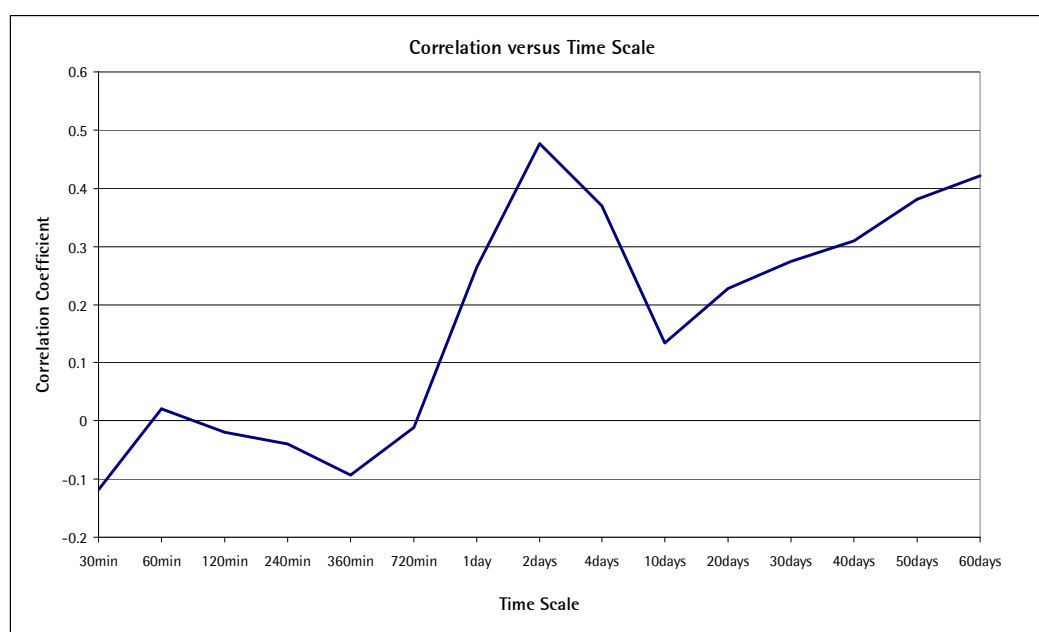
The graph shows strong correlation in the two day time frame and at the longer end, which is in line with the fund's communicated strategy.

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Conclusion

Through this research paper, we have considered the nature of trends and how to develop an efficient indicator of them. Our proposed indicator was used to probe the relationship between trends and volatility – two concepts that are usually held to be interchangeable and we found that one does not imply the other.

We then considered a simple trend following system and used the trend indicator to determine the underlying timeframes of these trend following systems. Finally, this was repeated for a real fund, and we found that the fund operated with two primary trading time frames.

We hope we have helped you gain a further insight into trend following approaches. We believe that the trend indicator concept can be a powerful tool to analyse systematic traders.

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About Amplitude

Amplitude Capital is a London based manager specialising in trading pure electronic exchange-traded securities globally. The Amplitude team has diversified backgrounds ranging from investment banking, hedge funds, consultancy, software development and quantitative research. The team is currently ten with the bulk of the team focused on trading, research and development. The team has been successfully trading proprietary capital and has established all the necessary operational requirements for a full fledged asset management capability.

The first fund will be launched following authorisation from the FSA and this is anticipated shortly. The focus will be a short-term traded strategy in the FX and managed futures space with an average holding period of 1-2 days.

More information on the team is available on our website www.ampcap.com. The summaries of those involved in this paper are enclosed on the next page.

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The People behind this Paper

Dr Shamil Chandaria: Dr. Shamil Chandaria is the Chairman of the Amplitude group. As Chairman, he plays a wide ranging role at Amplitude ranging from Group Strategy to Research & Development. Prior to Amplitude, he was a Managing Director at Deutsche bank for eight years where he was the Global Head of Structured Capital Markets and a board member of DB Investor where he managed a Eur 25 bn portfolio of proprietary holdings. Dr Chandaria reported directly to the CEO of Deutsche Bank and was involved with its core financial strategy. Previously he was a director at BZW (now Barclays Capital) in Structured Capital Markets. He has also taught Finance at the Masters level program at the London School of Economics. In 1989, Dr Chandaria completed his Ph.D in Finance from the London School of Economics. He has a M.A. with distinction in Philosophy from University College London and a First Class degree in Economics from Cambridge University. Dr Chandaria has 15 years experience in the capital markets and is a highly regarded structured financier with an impressive track record of innovative transactions. He has a keen interest in philosophy and runs the Ad Astra Trust, a charitable foundation.

Karsten Schroeder: Karsten Schroeder is the CEO of Amplitude Capital and the portfolio manager for the Amplitude fund. He oversees all the key decisions related to product development, trading ideas and strategy for the Amplitude's range of funds. He had been working on the development of the system for five years until the founding of Amplitude Capital in September 2004. Karsten was with McKinsey where he was involved in a number of key Corporate Finance projects involving blue chip European clients. Karsten finished his pre diploma in Computer Science and Business at the European Business School from 1997-99. He finished his diploma in Business administration at the HHL and this included an international year out at the Australian Graduate School of Management. Karsten has a private pilot license and loves flying.

Florian Leder: Florian is a mathematician with an out-standing academic background. His degree is in Physics from the University of Karlsruhe, Germany . He won a bronze medal at the 29th International Physics Olympics in Reykjavik, Iceland in July 1998. He also studied astronomy at the University of Toronto in Canada. Florian reports to Steffen Bendel who is the head of research, IT and technology at Amplitude. He will work with the team on generation of new ideas and also work on improving, where possible the existing Amplitude systems. His exposure to quantitative projects during his study of Physics and Mathematics have provided him with the programming skills required to deal with the various projects that Amplitude team work on. Florian has a keen interest in quantitative methods and producing papers that can make the analysis of systematic strategies more transparent to the alternative community. Florian enjoys dancing, especially Tango Argentino and loves his motorcycle.

Stanley Marchon: Stanley Marchon is the Head of Investor relations, sales and marketing at Amplitude Capital. He provides insight on business development and structuring as well as providing strategic direction and operational diligence on the day to day functions of the Amplitude group. Stanley's baptism in the hedge fund industry was at IKOS in March 2001 where he joined as Marketing Associate. For over three years he made a valued contribution to the asset base at IKOS which grew from US$170m to US$2.5bn. He is a member of the Institute of Management and served on the 'AIMA' marketing and PR committee for 2004. He completed his MBA in Marketing with a distinction at the University of Sheffield in January 2001 and won the Sheffield Insulation 'Marketing Management' Prize for being the best overall in the Marketing module. Prior to his MBA, Stanley worked for ten years in the area of advertising, sales and marketing, retail management, consultancy, exports and military service (Indian Air Force). His first Degree is BA in Economics from the National Defence Academy, Khadakwasla and he was conferred with a Certificate of Graduation while at Coca-Cola India at Mumbai in January 1997.

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