Electronic Virtual Intelligent Life

Applying Emergent Behaviour in the Financial Markets

In this Article we feature the application of Emergent Behaviour in the Adaptive Modeler product from a Company called Altreva(TM) and illustrate its ability to outperform the S&P500 index during the last 8 years. Our thanks go to Altreva for providing the System Graphics shown below and for their permission to include them in our Article Case.

The application of the Concepts of Virtual Intelligent Life to Complex Dynamical systems such as Stock Markets provides exciting new Business opportunities. In the past people have approached the task of modelling Financial Markets by trying to avoid rather than harness the Complexity. The resulting over simplified models typically predict rationalised outcomes that do not correspond to the real world behaviour of the Markets.

However by creating an Agent based model of the Market, i.e. A Virtual Market we can harness that Complexity and use the features that it generates such as Emergrent Behaviour to forecast real world Financial Time Series and of course the opportunity to generate Wealth.

Old models based on classical top down analytical methods and concepts such as the Efficient Market Hypothesis do not replicate the Stylised Facts that characterize the real world finacial markets. For example the typical distribution of returns (i.e. percentage of prices variation) will over time horizons of the order of a month be Leptokurtic (i.e. Fat Tailed, over peaked probabilities) non-Gaussian. Another such feature of this emergent behaviour is Volatility Clustering, i.e. localised bursts in the amplitude of price fluctuations.

The Adaptive Modeler we feature here, however exploits the concepts of Virtual Intelligent Life and does as we shall show replicate these Stylized Facts of the real world Financial markets. We explain the concept of Virtual Intelligent Life in detail in our **Evil-Futures** page (this can be found on our Pan European Web Site www.Evil.eu) in terms of Simple Agents interacting in a complex (non linear) way and evolving through many generations rapdily in real time under a genetic operator that introduces mutations and selection at each iteration.

The Adaptive model we are discussing here is comprised of a large number of autonomous 'heterogeneous' interacting Agents. They interact with each other via a simple set of trading rules and a price discovery mechanism. The model enables these agents to Evolve through an

evolutionary operator that selects the new generation of agents based on performance. The Trading Rules and Strategies can be thought of as the genes and DNA of the Agents in this Virtual Market. So strictly speaking it is the Trading Strategies and the associated Trading Signals that are evolving in a Darwinian (survival of the fitest) kind of a way. A simplistic example of two different Trading Strategies is provided by contrasting the Rational Trader with the Trend Follower (noise trader).

The Chart below shows the outputs from the Adaptive Modeler(TM) product. All charts are taken from models of the S&P500 index, using daily quotes, starting in 1950. The first Chart shows the forecast together with the real price from the start of the model. This demonstrates that after some initial chaotic behaviour the forecast (which is the price formed on the Virtual Market) tends to stay close to the real world price. This is a first step towards forecasting as the next day's price is normally close to the previous day's price.

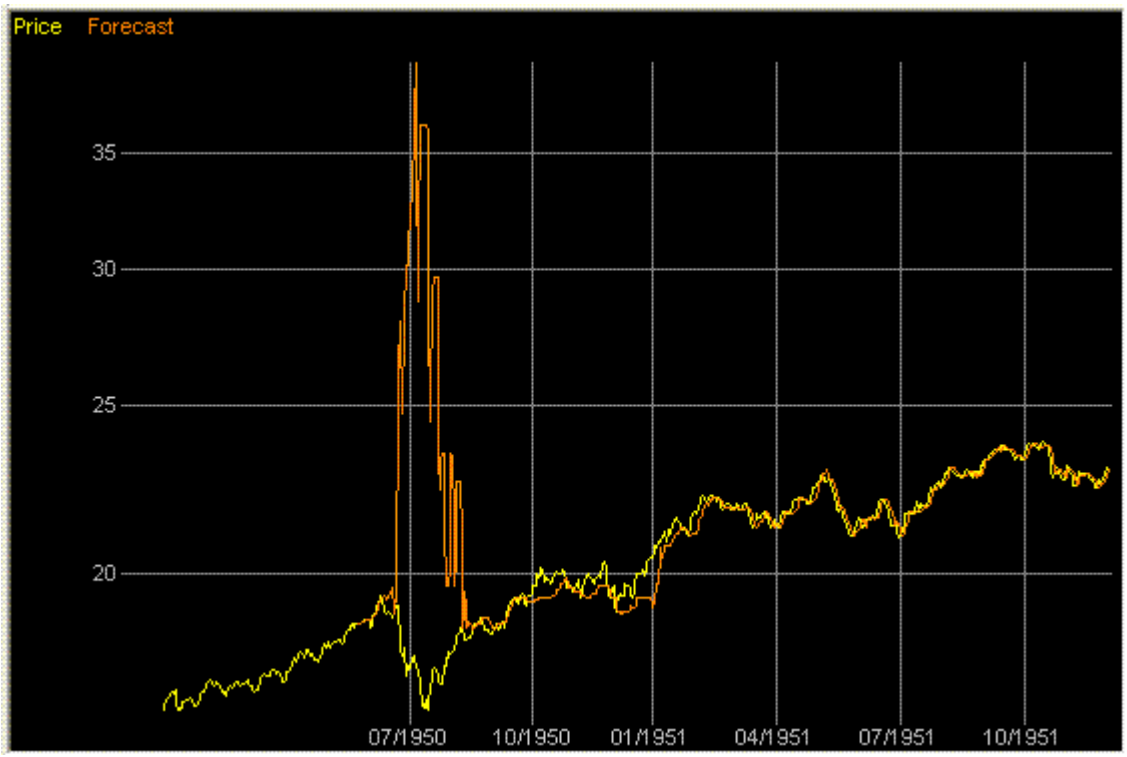

Figure 1: Initial Chaotic Behaviour of Model soon converges on real world price.

The following table summarises the result of using the model with an inital trading balance of $100,000. As can be seen the returns are impressive. In particular the model won during 40 periods and lost on only 6 periods.

STATUS		SETTINGS	
Trading Simulator start date:	5/3/1960 16:00:00	Compounding period:	Year
Calculation period start date:	6/12/1961 16:00:00	Requested periods:	46
Current model date:	6/11/2007 16:00:00	Risk free rate:	5%
Current wealth:	628,314,300	VaR Confidence level:	95%
RETURN		**RELATIVE RETURN**	
Total Return:	492120.10%	Total Excess Return:	489938.70%
Compounded Avg Return:	20.30%	Compounded Avg Excess Return:	13.27%
		Beta:	0.31
RISK		**REWARD/RISK RATIOS**	
Historical Volatility:	13.09%	Sharpe Ratio:	1.17
Value at Risk:	7,405,654	Alpha:	14.7%
Relative Value at Risk:	7,550,054	Risk-adjusted Return:	19.38%
Maximum DrawDown:	29.7%	MAR Ratio:	0.68

PERIOD RETURNS	2001	2002	2003	2004	2005	2006	2007*
Trading Simulator:	21.26%	1.54%	13.23%	3.35%	-6.43%	31.38%	3.40%
Security:	-13.04%	-23.37%	26.38%	8.99%	3.00%	13.62%	6.40%

Average period return:	22.88%	Winning periods:	40	Average gain:	27.29%
Stdev of period returns:	28.48%	Losing periods:	6	Average loss:	-6.55%

Figure 2: Performance Summary

The Graphs below demonstrate the model outperforming the S&P500 index during the last 46 years. Of particular interest here is the outperformance during the last 8 years, including the 2000-2002 market correction of 47% and the subsequent bull market back to its previous highs.

The 'Trailing FDA' chart shows the moving average of the percentage of forecasts that were in the right direction during the last 250 days. 'TS Wealth' shows the wealth of the Trading Simulator which is simulating actual trades based on the forecasts.

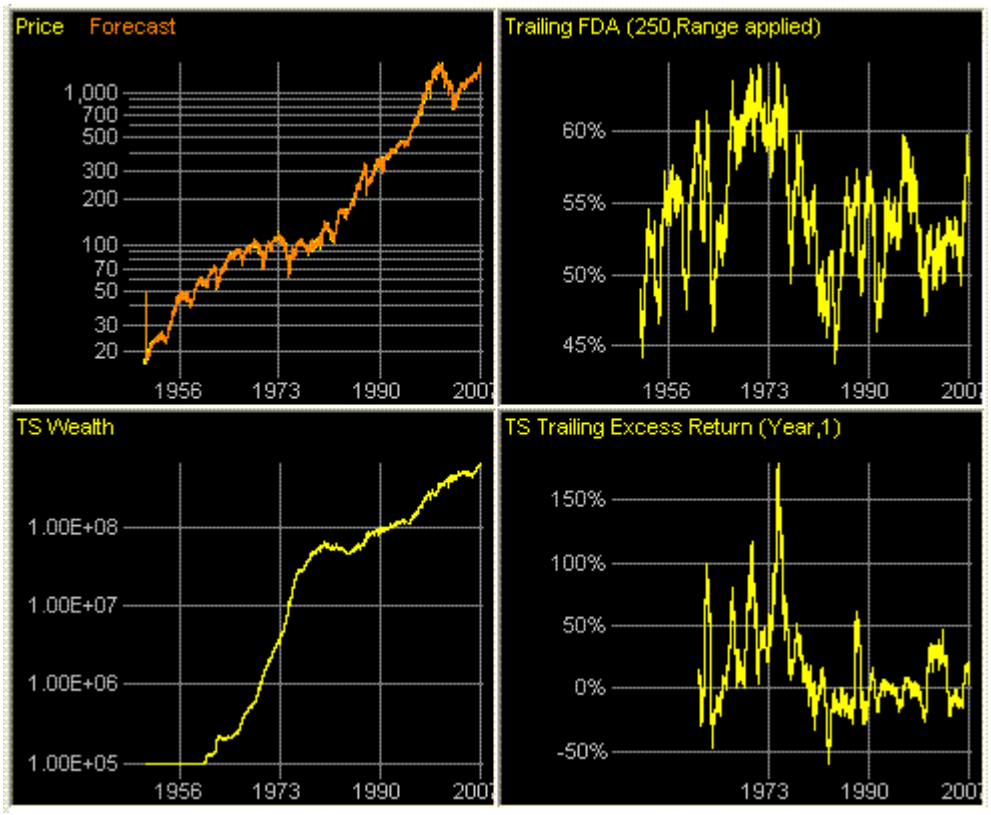

Figure 3: Outperformance Chart

In the final Chart shown below, we illustrate the ability of the Adaptive Modeler product to replicate some of the Stylized Facts of the real world Financial time series, that we introduced earlier. The Chart shows the price return distribution together with the forecast return distribution for the period 1960-2007 (11861 days).

This shows the positive kurtosis of both distributions and some other basic statistics. Note that the first 10 years of the model have been left out of this sample because this is considered a training period which includes the initial chaotic behaviour during which the Trading Simulator was disabled.

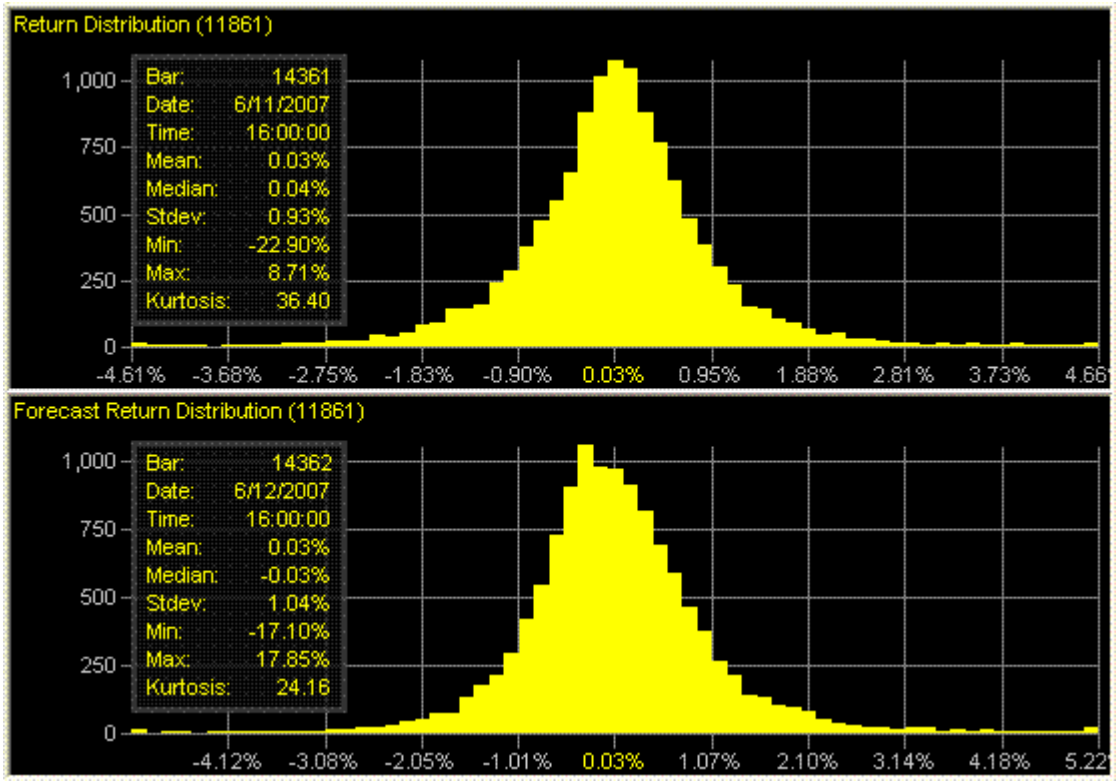

Figure 4: Fat Tail return Distributions

Other models of Artificial Stock Markets include the well known Santa Fe Artificial Stock Market which used a SWARM simulation software, and GASM named after its origin in Genoa, this used Agents with finite financial resources and a realistic clearing mechanism i.e. Clearing House or Limit order book.

Evil Limited takes takes no responsibility for any investment actions or trades that you may take as a result of reading the information in this article.

Evil Limited is Registered in England N° 5663548. Registered Office: 20-22 Bedford Row, London, WC1R 4JS, United Kingdom. **EVIL**® is a Registered Trade Mark across all countries in the European Union. Contact us via email – Sales@Evil-Limited.com