INTERMARKET ANALYSIS: AN ECONOMETRIC APPROACH

Traders are instinctively aware of relationships between markets. Bond futures, for example, often take their cue from the behavior of the dollar, of grain prices, of energy prices, or of whatever else suits their fancy during a given period. The question arises: what are the precise effects of behavior in other markets, and how can these effects be quantified within a trading system?

First, a premise must be offered: no matter how powerful the effects of related markets are on any given market, they will never approach the importance of that market's own (univariate) technical structure. Therefore, the efforts below will focus on finding significant partial contributions toward explaining a market's behavior after univariate effects have been taken into account.

Second, the target variable to be modeled will not be the price level itself, but the volatility-adjusted return. The usage of this variable will allow for more stable comparisons across markets since it compares percentage changes from market to market, adjusted for the relative volatilities of markets.

Third, intermarket analysis must mask out obvious correlations. What value can be gained by noting the correlation between the Deutsche Mark and the Swiss Franc or between Treasury Bonds and Treasury Notes?

Fourth, the model structure must be flexible enough to accommodate changes in market conditions and in intermarket relationships quickly. In practice, this means changing the structure of both the univariate technical indicators and the intermarket indicators as often as necessary.

Fifth and finally, the resulting model needs to account as consistently and rigorously as possible for all relationships, no matter how weak, in its coefficients.

Methodology: The Variables Used

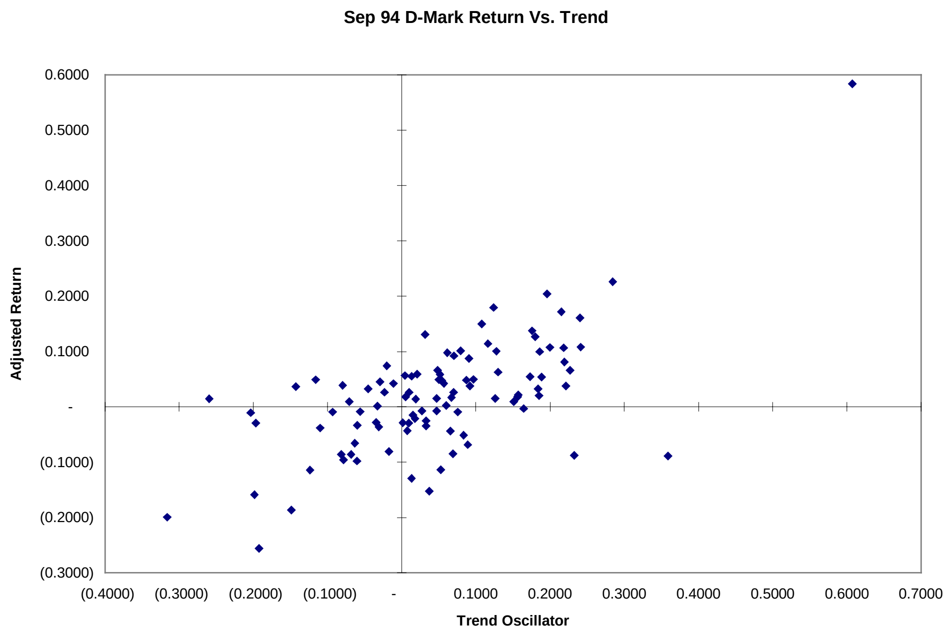
The first step in the procedure is the creation of an optimal N-day moving average and the corresponding N-day high-low-close volatility for each commodity in the model (see "Adapting Moving Averages For Changing Markets," by H.L. Simons, Futures, May 1994). These are used to create the dependent variable to be modeled, the volatility-adjusted return:

1. **Ret = log(Close/Close$_{t-1}$)/Volatility**

Next, two independent variables will be created for each market, a volatility-adjusted trend oscillator and a quadratically-detrended representation of the closing price series:

2. **Tr = [(Close - Moving Average)/Volatility]/Close**

The strongly positive correlation between the Return and Trend variables for the September 1994 Deutsche Mark future is shown in the scatter diagram below:

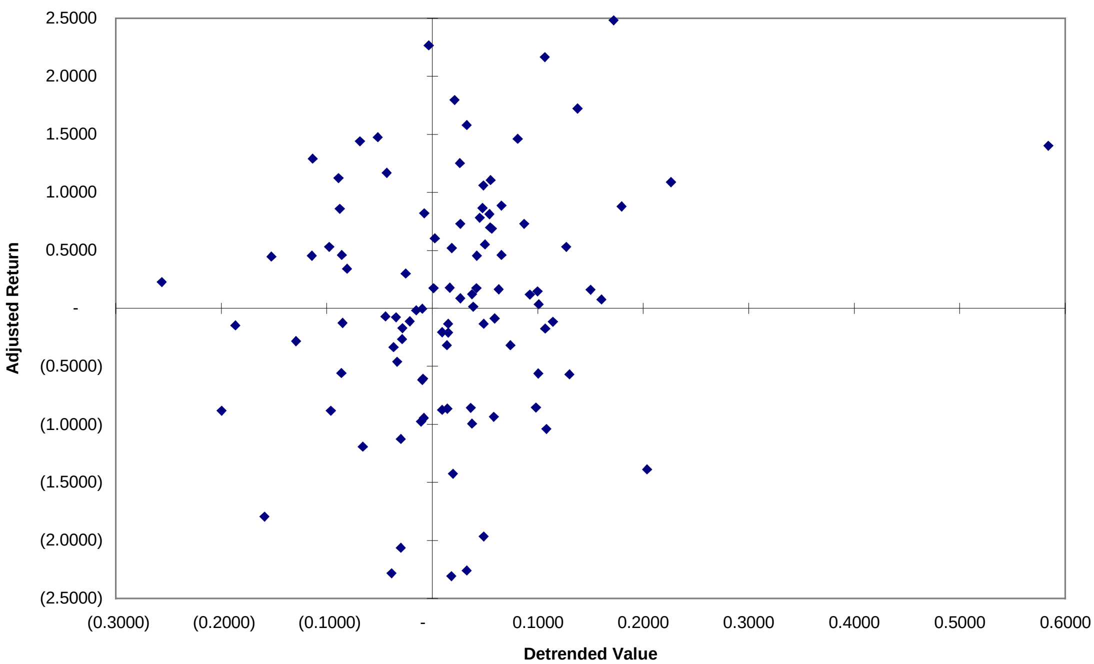


The detrended variable is created by regressing the closing price series against a 'time' variable, a sequence of numbers from 1 to the size of the interval, and against the square of this variable. This residual is then divided by the standard deviation of the closing price series.

3. Det = {Residual of Close against time and time-squared}/Std(Close)

The weakly negative relationship between the Return and Detrended variables for the September 1994 Deutsche Mark contracts is shown in the scatter diagram below:

Sep 94 D-Mark Return Vs. Detrended Value



Methodology: Equation Construction

It is now time to construct a simultaneous equation system to capture intermarket relationships. The process described has been programmed to run automatically in a statistical/econometric programming language called SORITEC.

A regression equation for each commodity in the model is constructed with the Return variable expressed as a function of the Trend and Detrended variables. The residuals for each equation are captured. Next, a correlation matrix for each market's Return against the residuals saved above is created, with obvious correlations masked out and set to zero. The most positively and negatively correlated relationships are noted and captured. The resulting equation for each model has the general form for market 'i', where markets 'p' and 'n' are the most positively and negatively correlated market returns:

4. $Ret_i = f(Tr_i, Det_i, Ret_p, Ret_n)$

The entire family of equations is estimated using a technique called two-stage least squares. If a Ret_p or Ret_n does not have a statistically significant contribution to explaining the behavior of Ret_i, it is dropped from the equation.. This entire system is then reestimated using two-stage least squares, and the search for significance is repeated.

At the conclusion of this search process, four outcomes are possible for each equation:

- **$Ret_i = f(Tr_i, Det_i)$**
- **$Ret_i = f(Tr_i, Det_i, Ret_p, Ret_n)$**
- **$Ret_i = f(Tr_i, Det_i, Ret_p)$**
- **$Ret_i = f(Tr_i, Det_i, Ret_n)$**

A sample model for July 19, 1994 is shown below for the following group of commodities:

CDU - Sep Canadian Dollars	BPU - Sep British Pounds	DMU - Sep Deutsche Marks
SFU - Sep Swiss Francs	JYU - Sep Japanese Yen	EDZ - Dec Eurodollars
TYU - Sep Ten Year Notes	USU - Sep Treasury Bonds	SPU - Sep S & P 500
CRU - Sep KR-CRB Index	HGU - Sep Copper	LCV - Oct Live Cattle
CLU - Sep Crude Oil	HOU - Sep Heating Oil	HUU - Sep Gasoline
GCZ - Dec Gold	SIU - Sep Silver	SBV - Oct Sugar
MBU - Sep Municipal Bonds	CTZ - Dec Cotton	NGU - Sep Natural Gas
BRU - Sep Brent Crude Oil		

$BRURET = 0.644 * BRUTR - 0.096 * BRUDET_{t-1} + 0.149 * CRURET - 0.022 * CTZRET$

$NGURET = 0.825 * NGUTR - 0.174 * NGUDET_{t-1} + 0.345 * SPURET$

$CTZRET = 0.631 * CTZTR - 0.065 * CTZDET_{t-1} + 0.366 * EDZRET - 0.052 * BRURET$

$MBURET = 0.786 * MBUTR - 0.147 * MBUDET_{t-1} - 0.308 * SPURET + 0.020 * CRURET$

$SBVRET = 0.962 * SBVTR - 0.160 * SBVDET_{t-1} - 0.171 * GCZRET$

$SIURET = 0.640 * SIUTR - 0.053 * SIUDET_{t-1} + 0.121 * CRURET - 0.169 * SPURET$

$GCZRET = 0.670 * GCZTR - 0.104 * GCZDET_{t-1} + 0.046 * BPURET - 0.026 * SPURET$

$HUURET = 0.742 * HUUTR - 0.093 * HUUDET_{t-1} + 0.116 * CRURET$

$HOURET = 0.737 * HOUTR - 0.108 * HOUDET_{t-1} + 0.151 * CRURET - 0.005 * SPURET$

$CLURET = 0.714 * CLUTR - 0.076 * CLUDET_{t-1} + 0.072 * CRURET + 0.056 * USURET$

$LCVRET = 0.500 * LCVTR - 0.120 * LCVDET_{t-1} - 0.251 * MBURET$

$HGURET = 0.717 * HGUTR - 0.176 * HGUDET_{t-1}$

$CRURET = 0.554 * CRUTR - 0.154 * CRUDET_{t-1} + 0.370 * GCZRET$

$SPURET = 0.404 * SPUTR - 0.066 * SPUDET_{t-1} + 0.273 * USURET$

$USURET = 0.681 * USUTR - 0.077 * USUDET_{t-1} - 0.041 * SPURET - 0.009 * CRURET$

$TYURET = 0.579 * TYUTR - 0.095 * TYUDET_{t-1} + 0.014 * SPURET - 0.039 * CRURET$

$EDZRET = 0.568 * EDZTR - 0.060 * EDZDET_{t-1} - 0.042 * SPURET - 0.052 * HGURET$

$JYURET = 0.528 * JYUTR - 0.089 * JYUDET_{t-1} - 0.117 * LCVRET$

$SFURET = 0.561 * SFUTR - 0.055 * SFUDET_{t-1} + 0.045 * SIURET - 0.030 * USURET$

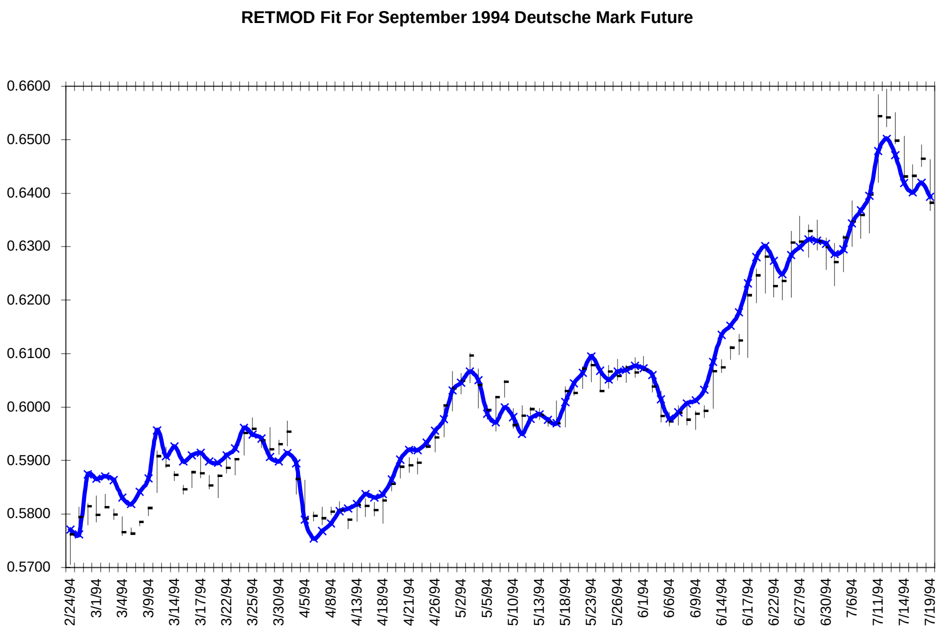
$\mathbf{DMURET = 0.591 * DMUTR - 0.058 * DMUDET_{t-1} + 0.027 * SIURET}$

$BPURET = 0.701 * BPUTR - 0.045 * BPUDET_{t-1} + 0.206 * SIURET - 0.083 * BRURET$

$CDURET = 0.754 * CDUTR - 0.123 * CDUDET_{t-1} - 0.535 * TYURET - 0.149 * CLURET$

The equation for the September Deutsche Mark would read “The volatility-adjusted return on September Marks is a function of a function of the trend oscillator on September Marks, the lagged detrended value on September Marks, and the volatility adjusted return on September silver.” A scatter diagram between the returns on the D-Mark and silver is shown below:

This simultaneous equation model is then solved using a technique called three-stage least squares. The resulting fit for the September Deutsche Mark is shown below:



The fitted values from this model are then entered into a trading rule matrix to generate actual buy and sell signals.