COMPLEX HAMILTONIAN SYSTEMS

VOLATILITY RESPONSE MODEL

CONTENTS

1 INTRODUCTION

Traditionally markets are described as 'stochastic'. Conventional thinking dictates that predictions for the future should be unaffected by the price one day ago or one week ago. The only relevant data point for predicting the future is the price right now. These stochastic views form the basis of pricing of options (Black-Scholes equation) and other more complicated derivatives.

About 1900 Louis Bachelier suggested that a random process known as Brownian motion could model fluctuations of the stock market. The Black-Scholes equation is an implementation of this idea. It has its roots in mathematical physics, where quantities are infinitely divisible, time flows continuously and variables change smoothly. It is based on arbitrage pricing theory, in which both drift and volatility are constant. Such models may not be appropriate for the world of finance. Large fluctuations in the stock market are far more common than Brownian motion predicts.

Different approaches to modelling financial markets are employing the new science of complex systems. A complex system is any system featuring a large number of interacting components (agents, processes, etc.) whose aggregate activity is non-linear and typically exhibits hierarchical self-organisation. The murmurations of starlings in flight are examples of a complex system in which individual birds appear to fly in zigzag paths but the flock as a whole has a continuous undulating boundary. Financial markets can be considered as complex systems where many buyers and sellers act as a collection of parties interacting according to specified rules. However the rules of interaction have to be determined in order to find a mathematical description and these are both physical and emotional in nature.

In this paper we present the results of an approach to describe the evolution of complex systems applied to financial markets using the Hamiltonian concept of physics. This allows us to bypass the need to determine the rules of interaction of all the many parties involved in a financial market. We call this the Volatility Response Model (VRM).

2 VOLATILITY RESPONSE MODEL (VRM)

Foreign exchange traders use charting systems to look for historic support and resistance levels in the past and extrapolate these into the future. These levels will have been highs and lows during a certain time period in the past.

The Volatility Response Model (VRM) uses all available historic daily and weekly high, low and close data available for a financial instrument to calculate a unique function called the Hamiltonian. The Hamiltonian (we use the symbol H in the figure below) is determined from all this historic data and then used to predict all possible support and resistance levels one time interval into the future

HISTORIC DATA   HAMILTONIAN   FUTURE VOLATILITY LEVELS
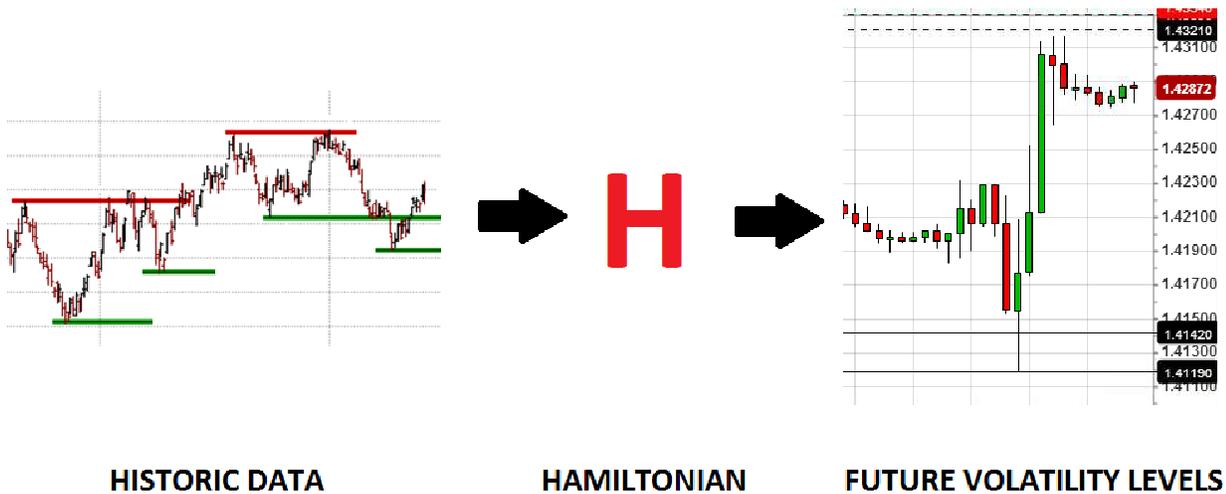
With current historic data, the VRM generates 24 support and resistance levels. The VRM shows that the price action in the next time interval is not random, but occurs about these 24 levels, some of which are closely spaced, and some of which have large gaps. With current historic data, the VRM calculates 24 levels for the next day and 24 levels for the next week. In summary, financial markets do not move randomly, but move about the levels determined by the VRM.

3 PROPERTIES OF THE VRM LEVELS

Experience with the VRM levels in foreign exchange markets has revealed some interesting properties:

a. The VRM uses all available historic data to calculate 24 daily levels and 24 weekly levels.

b. The 24 weekly levels should be viewed in parallel with the corresponding 24 daily levels.

c. For daily and weekly levels, the levels are major profit-taking levels of the market.

d. For each time period eight of these levels are sentiment levels for the markets.

e. Two of the levels will usually be the high and low for the time period (one day or one week).

f. After some profit taking the market will pass through a VRM level 80% of the time.

g. After passing through a VRM level price action will often retrace back to that level.

h. Markets can sometimes remain many hours at a VRM level.

i. Once a price action has passed through a VRM level, then stop losses can be placed on the other side of a VRM level.

j. Market price action about a VRM can be best seen using an Exponential Moving Average (EMA) channel.

k. Market price action should be observed for market triplets such as GBP-USD, EUR-GBP and EUR-USD about their respective VRM levels.

l. In the case of foreign exchange triplets such as GBP-USD, EUR-GBP and EUR-USD the three price actions about their corresponding VRM levels show how the three markets interact and which foreign exchange pair is leading the three markets.

4 SHORT AND LONG TERM TREND CHANNELS

The VRM levels calculated for the next future time period can be used to create a future short-term trend channel and a future long-term trend channel using all historic daily and weekly data respectively. These channels interact with each other as they pass through or bounce off each other.

HISTORIC DATA   **HAMILTONIAN**   **FUTURE TREND CHANNEL**
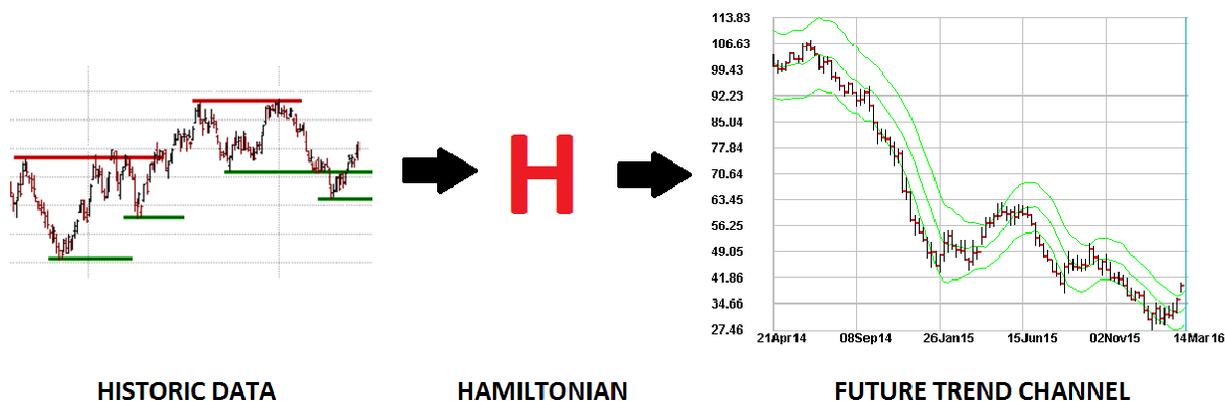
Some properties of the Trend Channels include:

a. The short term trend channel top, middle or bottom can bounce off the long term trend channel top, middle or bottom.

b. Market price action can bounce off the short and long term trend channel top, middle and bottom.

c. Market volatility increases as the financial instrument price action tries to break through a trend channel top, middle or bottom.

d. In rising markets the price action is usually above the trend channel middle and below the trend channel middle when markets are falling and bearish.

e. When the price action closes on the other side of the trend channel top, middle or bottom this is a signal for a change from bullishness to bearishness or vice versa.

5 EXAMPLES

In this section we present examples of market price action about the VRM levels and the associated short and long term trend channels

5.1 USD-CAD Starting 17th September 2017

The top chart below shows the VRM weekly levels predicted for the USD-CAD exchange rate lasting the full week starting 17th September 2017. For Wednesday 20 September the VRM did very well predicting the extent of the volatility of the USD-CAD caused by the Fed Interest Rate decision and the FOMC Press conference. The VRM predicted the high of 1.2391.

5.2 EUR-GBP

EUR-GBP Euro-UK Pound Sterling : EUR=GBP DAILY
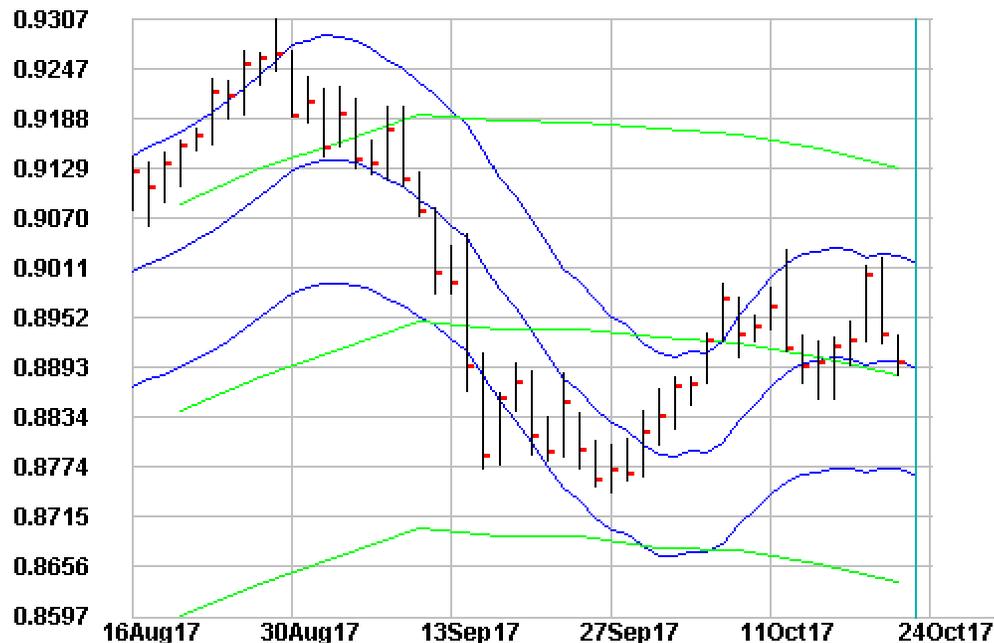
The figure above shows the EUR-GBP Spot foreign exchange rate daily high, low and close values for the period 16 August 2017 through 24 October 2017. A black vertical line shows daily high and low with red closing tab. Also shown in green are the weekly long term trend channel top, middle and bottom calculated before the start of each future week. The daily short term trend channel top, middle and bottom are shown in blue and calculated before the start of each day. This chart shows the following VRM properties:

a) About 1st September the daily short term trend channel middle bouncing off the long term trend channel top and the corresponding increase in volatility

b) About 2nd October the daily short term trend channel bottom bouncing off the long term trend channel bottom.

5.3 March 10 2016 European Central Bank Rate Change

On March 10, 2016 the European Central Bank announced their interest rate structure. The figure above shows from left to right the one-hour candlestick response of the FX triplet GBP-USD, EUR-GBP and EUR-USD spot foreign exchange rates. All these levels were calculated before the day of the ECB announcement.

As can be seen on the ECB announcement all three markets plunged to a VRM level and then rose to a VRM level. The EUR-GBP and EUR-USD both closed the day at a high VRM level. The response to the ECB news was volatile. But the response moved between VRM levels.

5.4 GBP-USD Foreign Exchange Rate Price Action on 26 October 2017

The figure above shows the 30-minute candlestick chart for the GBP-USD spot exchange rate for 26th October 2017. The dash line levels show the daily VRM sentiment levels and the solid lines show some of the remaining levels. The blue line is the middle of the short term trend channel. By about 23:00 hrs the high of the day at the VRM level 1.3280 is made and the exchange rate falls to the VRM level 1.3155. As the market passes through the blue trend channel middle, volatility increases. An optimum EMA channel is used to show the price action as the market moves through the VRM levels.

6 CONTACT INFORMATION

Predictions updated daily after the New York Close can be found at

https://www.complexhamiltoniansystems.com/fxcharts/

More results and this document can be found at

https://www.complexhamiltoniansystems.com/vrmdocs/

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