

Viracocha Methodology

By Abdel Serna Vazquez

Viracocha (Vira) is a mathematical methodology that calculates historical variability of change in a stock's daily price and trading volume and then compares its most recent daily change with its expected variability. Vira then assigns a low, middle (expected) or high range of movement to the daily change and plots the resulting information for both share price and trading volume. The direction and magnitude of divergence of the two plotted lines can be used to identify potential buy and sell opportunities for the stock.

This discussion document states the mathematical notation that will explain in full the methodology. It also will discuss some avenues towards interpretation of the results.

The typical data set to analyse is a set of more than 100 days of share market information; for example in the Australian share market or any others. The methodology starts with getting the key financial data that is readily available in public form in daily data values of more than 100 but less than 370 days of operation both for the Price of the share and for the daily Volume of shares traded. But the method can be applied with hourly or even minute by minute data, the only requirement is that the sample size (n) is greater than 100.

The mathematical model behind Vira

This is the step-by-step description of the model:

1. Calculate the proportion of shares traded

$$P = \sum_{i=1}^n \frac{Volume_i}{Total_i}$$

2. Calculate the Moving Range of the Price from one day to the next day

$$\forall i > 1, i < n + 1 : MrC_i = |AvgPrice_i - AvgPrice_{i-1}|$$

3. Calculate the Moving Range of the proportion of shares traded from one day to the next day

$$\forall i > 1, i < n + 1 : MrP_i = |P_i - P_{i-1}|$$

4. Calculate the Total Moving ranges (summation) for both Price and Proportion (Volume)

$$MrCTotal = \sum_i MrC_i$$

$$MrPTotal = \sum_i MrP_i$$

5. Calculate the variability thresholds for Price (c) and Volume (p)

$$c = 1.4142 \left(\frac{MrCTotal}{n} \times \frac{1}{1.128} \right)$$

$$p = 1.4142 \left(\frac{MrPTotal}{n} \times \frac{1}{1.128} \right)$$

6. Assign the decision rules for Low, Middle and High for Price and Volume

$$\forall i > 1, i < n + 1 :$$

$$if |AvgPrice_{i-1} - AvgPrice_i| < c : C_i = 2$$

$$if (AvgPrice_i > AvgPrice_{i-1} : C_i = 3), else (C_i = 1)$$

$$if |P_{i-1} - P_i| < p : P_i = 2$$

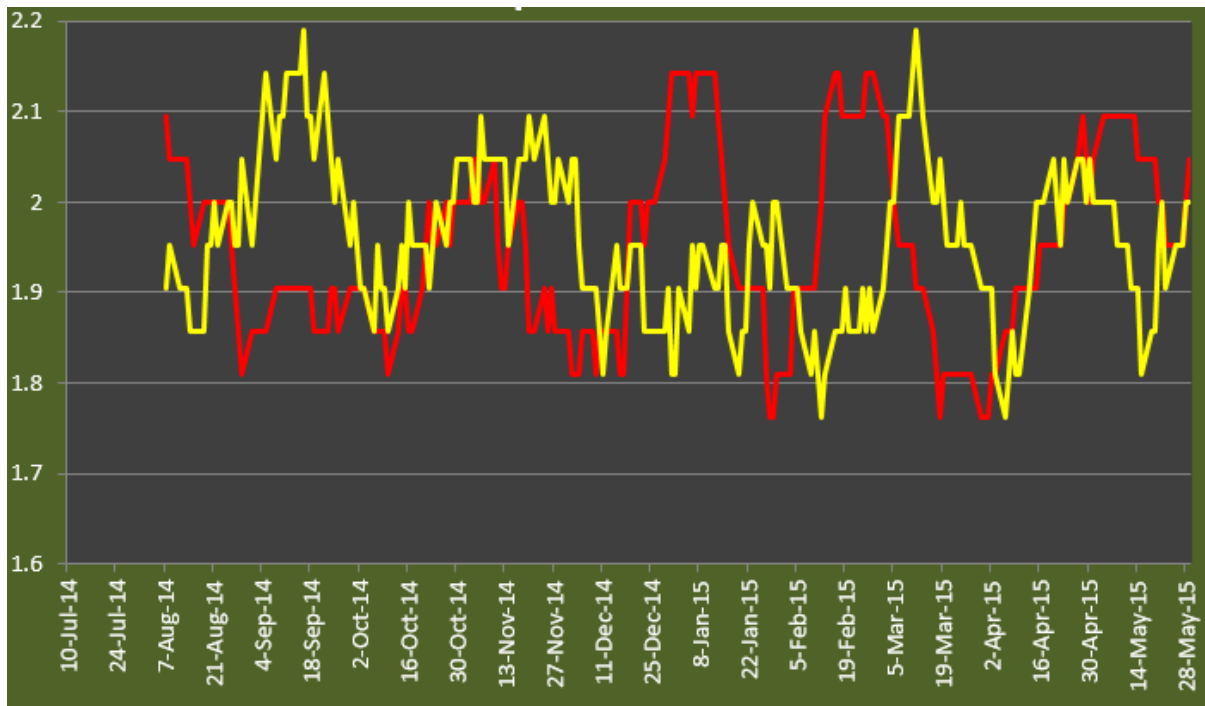
$$if (P_i > P_{i-1} : P_i = 3), else (P_i = 1)$$

$$\forall j > 20, j < n + 1 : pV_j = \frac{\sum_{t=j}^{j-21} C_t}{21}, vV_j = \frac{\sum_{t=j}^{j-21} P_t}{21}$$

pV and vV is result.

The resulting pV and vV values represent 21-period moving averages of Price and Volume, respectively, after being put through the decision rules.

The pV and vV values are then plotted as a pair of lines (which we will call the Vira graph). The yellow line is Volume vV and the red line is Price pV . The graph below shows the interaction of Price and Volume variation for a typical stock.



Interpretation of the results

First, we need to establish that the future is not being predicted here. Rather, we are evaluating current conditions for good buy/sell opportunities based on whether or not recent changes in stock price and trading volume fall inside or outside of expected variation. The Vira graph, therefore, indicates relative buying and selling momentum in the underlying security. trying to do a data based inference of what could happen based on what we are observing at the present time. It is not crystal ball gazing!

The premise here is that one should only take action when special causes are evident, not when normal variation is present. Doing the latter would be equivalent to having a knee-jerk reaction to all movements in the market.

The output of the Vira graph can be categorized into the following nine scenarios:

Test 1,1 – Low price and Low volume

Test 1,2 – Low price and expected volume

Test 1,3 – Low price and high volume

Test 2,1 – Expected price and low volume

Test 2,2 – Expected price and expected volume

Test 2,3 – Expected price and high volume

Test 3,1 – High price and low volume

Test 3,2 – High price and expected volume

Test 3,3 – High price and high volume

The -low, expected and high- buckets are based on whether the last day's variation falls within the expected variation for that stock for that period of time. So, as said before, there is a threshold (or sensibility) for variation and then we place our last day in one of three buckets – low, middle (expected) or high – Well it is really one of three buckets for price; and one of three buckets for volume. If we were more sophisticated we could use the last hour of trading, or the last minute; but the method as explained now is focusing on the last day as it is a good and readily available measure.

The market of lamps

A good way to visualize what the Vira tool does is best explained in four main scenarios. I like to call this “The market of lamps”

Let's imagine we are a merchant that trades in lamps, those nice objects that one rubs and a genie comes out... that kind of lamp. There is a market of lamps and in there the lamp traders meet to buy and sell their lamps. To keep this story flowing nicely let us restrict the merchandise to just lamps... genie lamps to be precise. Let us also establish that you are in the trade of said genie lamps and that you have a stock of them of your own, and also that you have some cash to get into the market if a good opportunity arises. Of course, let us establish that you are willing to trade in lamps and bear some risks inherent to the trade.

Scenario 1: You go into the market one sunny morning, and you notice that there is an unusually low amount of lamps being traded, and when they do exchange hands you notice that the price for them is higher than the expected price. So as the price gets higher and higher, the volume is lower and lower. This is the first scenario and the question, as always, is: What do you do?

Scenario 2: You go into the market, and you can hear the traders as you go in, today is a loud one. You notice that there is an unusually high volume of lamps being traded, and that when they do exchange hands the price of the transaction is lower than the expected price. So as the price keeps going down the lamps keep being traded. This is the second scenario and the question is “What do you

do?” Now the inference here is that there is a point in which, due to the demand, the price will eventually bounce. VIRA will place you in that scenario but will not give you exactly where that point is.

Scenario 3: You go into the market, and the air smells like orange blossom. You notice that there is an unusually low amount of lamps traded at an unusually low price. Traders are starting to walk away from the market and the price keeps dropping. This is the third scenario: What do you do?

Scenario 4: You go into the market this morning, it is raining and there are big tents set everywhere to keep traders from the rain. You notice that there is an unusually high amount of lamps traded at a very high price. Traders are happy to keep going into the market, and this is keeping that price up there. As always the question is: What do you do?

So, the story of lamps may seem a bit inconclusive. But the fact is that Vira won't work by itself, it needs other useful information such as the actual price and trends. So we are not proposing this is the only thing that matters.

An even simpler way towards interpretations is to look for the extremes, so from all the tests that have been shown we would use a couple:

- The price variability is high, and the volume variability is low -(Test 3,1) and in some instances overlapping with (3,2) and (3,3)-: This indicates that the price of the stock traded has been rising above the expected price variation and the volume has remained the same. This indicates a momentum in the market in which the price has been high for an unexpected amount of time. This is the sell zone.

- The volume variability is high and the price variability is low -(Test 1,1) and (1,3): This indicates that the volume of stock traded has remained high at a low price of stock. This indicates a momentum in the market in which there has been an unusual amount of shares traded at a low price. This is the buy zone.

We will now analyse a few historical charts to demonstrate the application of Vira to market movements.

Example: Sept 11

Here is an example of those Tests depicted against the DJIA indicator, the data spans one year on daily data values; and that second dip there in DJIA is the Sept 11 attack. I did a special study on this because that was a really unexpected event and I wanted to see how it looked through Viracocha so I used it to depict what those Tests I have been talking about mean for the Viracocha lines and how they relate to the actual movement of the indicator (Average Price). It goes without saying that, since the events were totally unexpected (and unprecedented) then it is hard to ask any analysis tool to give some previous insight. But for the purpose of depicting the *-what-* of the method I thought it was a good example. This particular time series doesn't include absolutely all the types of tests; but there is a good amount of them, and one could get the idea of how this works for the ones that are not depicted I hope. The white vertical dashed lines are the start and end

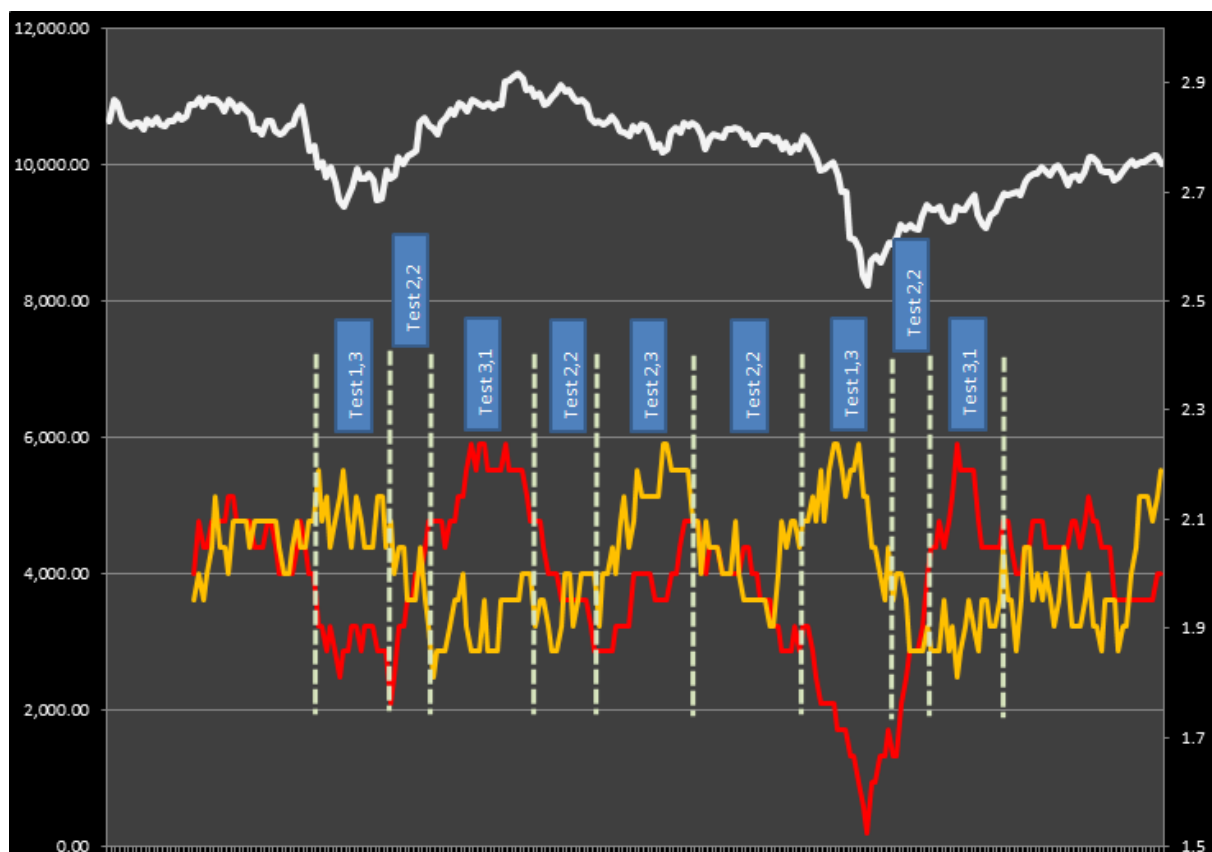
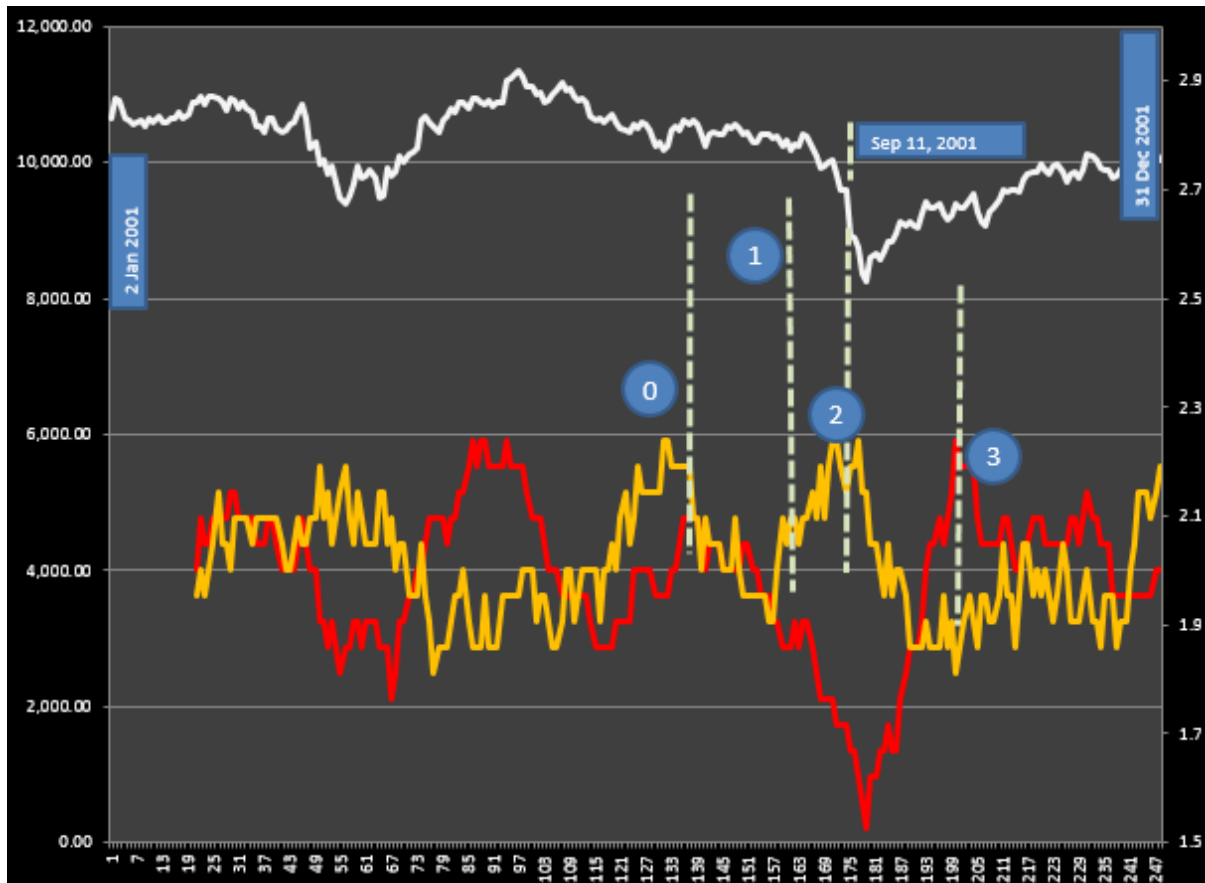


Figure 1. DJIA around Sept 11 attack. The left axis is the DJIA daily average, and the right axis is the VIRA value. Vira can fluctuate between 1 and 3, with the value of 2 being a neutral - normal- variability.

of the period of time when a particular test is returning a 'positive' presence. Of course there may be times when we go for very short periods from one test to the other, and the software is calculating that, but I didn't show here on the graph for ease of representation.

The second graph shows the same information but with an interpretation of the day-to-day flow on the days around Sept 11.



Event 0 – The market was steady. Both Volume and Price indicators in Vira were around the value of 2 which is the normal variability area.

Event 1 – The Price and Volume lines diverge suddenly, with Price falling. This indicates a potential buying opportunity.

Event 2 – Sept 11. This obviously throws things out of whack. And the expected recovery in the market that probably was going to happen after Event 1 is now obliterated with DJIA dropping almost 2,000 points. The ‘get in’ signal is marked by that low spot in the red ‘price’ line a bit after Sept 11. The extreme divergence between the yellow and red lines are a clear signal to ‘get in’ the market.

Event 3 – This event indicates a return to normal for volume and a potential sell opportunity based on higher-than-average Price variability from the buy signal marked at Event 2.

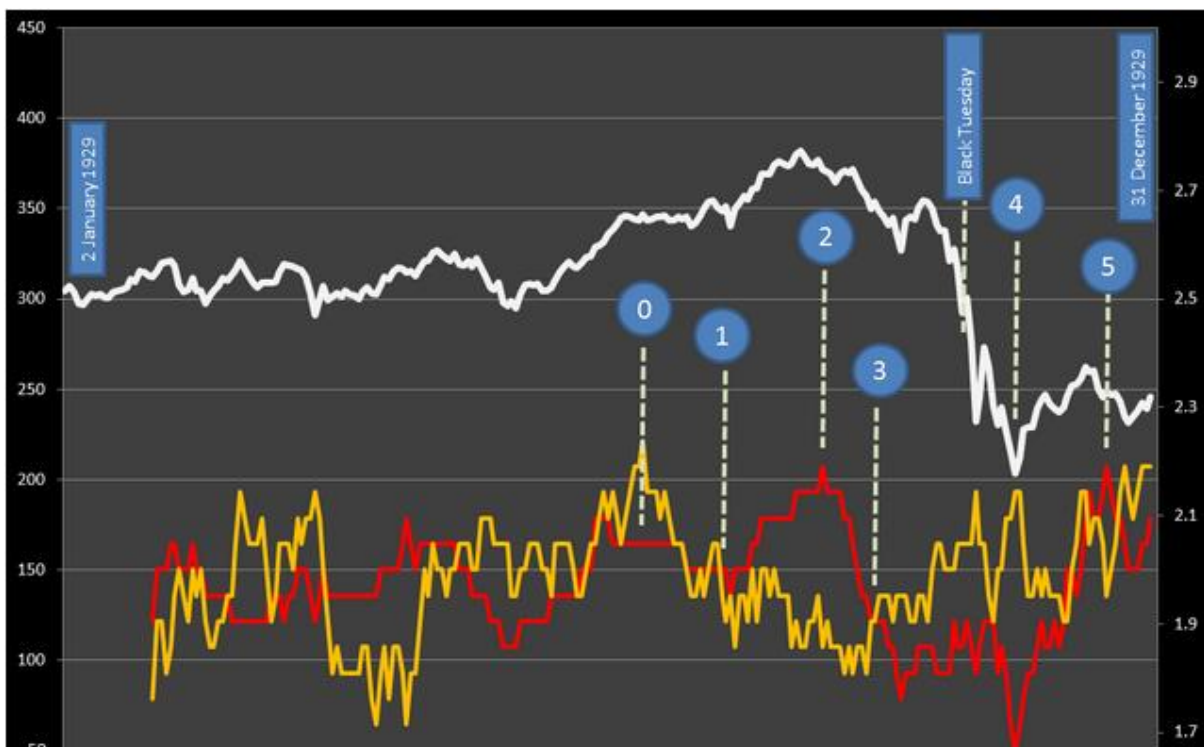
The conclusion of this Sept 11 analysis is that, although an unexpected set of circumstances affected the market, Vira successfully tracked the volume and price variability of the market and indicated when the market started returning back to normal.

Example: The crash of 1929

Well it is back in 1929 and you have the power of Vira... Well you don't really because of obvious reasons: (1) we can't -yet- to go back in time and (2) if you did, your smart phone wouldn't work would it?

But we will analyse the market crash of '29 all the same. I know it has been done to death, but not through Vira, which will give it a new perspective I think.

Imagine you are back then and that you do somehow have the power of Vira (well in essence you could've done it since the math used for Vira has remained the same throughout the years). We will do a re-enactment of the most important signals that you would have seen through the glass of this methodology. We are showing the fully year of 1929 through the Dow Jones Industrial indicator. You



could argue that we could've zoomed in to the weeks or days prior to the crash... but in reality nobody saw it coming, and they were all taking decisions based on the yearly info available to all.

Event 0 – Thursday July 11, 1929. I was going to start this series in event No.1, but after considering it for a bit I thought it was best to start in a signal to get in to the market. This is shown in event 0, that Thursday was a good day to get in.

Event 1 – Tuesday August 6, 1929. This is the first indication in Vira to watch it, the streams have crossed (yes, just like in Ghostbusters) and there is an indication that people are leaving the market and that the price is climbing.

Event 2 – Monday September 9, 1929. This is the peak of the sell zone. The divergence between Price and Volume is at its greatest and it can be seen in the Dow that after this peak it all starts going pear shaped.

Event 3 – Wednesday September 25, 1929. This is the last cry to get out, by now it is a “Please for the love of all things get out now!” kind of signal. The shares traded start to climb significantly, and in hindsight we know that it is panic building up.

Black Tuesday – October 29, 1929.

Events 4 and 5 are a long shot... nobody in their right minds would've gone back in, but there were some opportunities still to make some of that loss before Christmas.

Event 4 – Monday November 11, 1929. Big delta of price and volume. Signal to buy, but as I said it was not for the faint of heart.

Event 5 – Friday December 13, 1929. And this is the exit from the last buy signal, albeit it is a very, very washed up one as you can see from the difference between price and volume. Yes, there was money to be made between November and December 1929 according to the information out there.

So here we have it, the market crash of 1929. The crash analyses have the aim to learn from the extreme circumstances about the application of Vira and how to read it. I hope it is helps.

Conclusion

Vira offers a novel approach to an age-old concept of interpreting changes in equity trading volume and price in order to make buy/sell trading decisions. The Vira mathematical model does this by determining whether or not recent changes in trading volume and price are outside of their expected variation and then normalizes their movement. The resulting data is then presented on a two-line graph (the Vira graph) that visually indicates momentum of movement for each indicator. The relative divergence and changes in momentum between the Volume and Price lines can then be used to identify potential buy/sell trading opportunities. A cursory review of several infamous historical market movements shows that the Vira model is a promising new trading analysis tool. More work is needed, however, to test Vira with large amounts of historical trading data to provide statistical analysis of Vira's accuracy.