

The Magic MACD Ratios

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Astrology and Fibonacci

As a kid in primary school, as a class we were all asked to bring in a sheet of Astrology predictions for the following day. No problem – what is Astrology? So I went home and naturally asked mum for an Astrology sheet. (*Once I had one; then I could find out what it was and not have to ask anybody.*)

My mum came straight out and said that we don't have such rubbish in our house and to forget it, but when I explained to her that I needed it as most of my school homework she was annoyed, but we searched for one. When dad came home and I still didn't have the sheet I asked dad and he was annoyed too.

You see we were in a religious family and this to them bordered on the occult, and we lived without "those magazines" but we did have the Sydney Morning Herald, and it certainly was not there! So I came to school the following day without my homework and wow did that really upset my teacher!

Various kids started to 'read their stars', and I got to understand a bit about Astrology. Some story lines seemed to 'fit' certain situations, and I could see a belief in one story leading to a belief in many stories, leading to blind faith – that is; belief without thought of reason.

The simple kids seemed most gullible, followed by those that were in financial need and/or mental (home life) stress and/or sickness/death in their families. This to me was a mental game that I saw straight through – even at that age.

Having used the OmniTrader charting package for some time, I came across the Fibonacci retracements (predictions) at about 1999 and shortly after that the same topic was raised in a share group that I was attending. Co-incidental as that was, I decided to have a little look into Fibonacci and see what all the fuss was about!

Leonardo Pisano Fibonacci was born in Italy about 1170 and died in Italy about 1250, but lived most of his early life in North Africa (Algeria) where his father had a diplomatic post as an accountant and Leonardo learned the Arabic-Hindu place valued decimal number system, and later wrote books on this and introduced it to the western world.

With this he also introduced a series of solved problems for merchants to calculate profits on transactions, and how to convert various currencies.

He then developed the Fibonacci sequence, that famed number set by adding the last two to get the next: 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, etc, and this appears naturally everywhere and as that sequence gets into big numbers, the ratio of each forms a virtually constant natural ratio 1.618... and Euclid had also worked on this about 1000 years earlier! Fibonacci then introduced approximations to resolve problems that did not have exact solutions.

At this point I started to associate the Fibonacci ratios and Astrology! The first classic was the 'Fibonacci Retracement'. You got it – I am a real sceptic! In this

case two price lines are drawn, and percentage lines are then developed between these price lines, based on sub-ratios of the 1.618 natural number (ratio).

By careful adjustment it can be shown (usually by fiddling the distances), that historically, some support and resistance lines actually fell near and sometimes where these sub-percentage horizontal lines occur!

The second classic case is a fan of angles from a common (low or high) point as a ratio of the previous angles showing (you guessed it) other historical high and low points.

The problem is that the graph is price-wise linear and not semi-log, and that the time line is not necessarily linear because of non-trading days, holidays, weekends etc. So which do you want to believe?

The third classic case is a set of arcs (partial circles with a common historical high or low point), and the radius of each of these arcs is a Fibonacci ratio from each other – and hey presto – with suitable juggling – these sometimes align with prices.

Now which are you going to believe and why? As the associations between actual share prices, the time lines and the Fibonacci geometrical structures are so abstract, that I have no option but to put all this Fibonacci charting into the Astrology rubbish bin, and yes I understand why my parents were annoyed that I was to be ‘taught Astrology’ at primary school! In any case I put both Astrology and Fibonacci charting away and left that for the far less intelligent ‘suckers’ and ‘dipsticks’!

As the MACD is effectively the difference between two moving averages, then as the two moving averages cross up, so the MACD will cross up over zero. As the two moving averages cross down, so the MACD will cross under zero. That takes away the mystery of the MACD – and it is then seen for what it is – the difference between two moving averages!

Back to Reality

Folk Law (or Gerald Appel) came up with the 26:16 ratio, and in my books that is 1.625, in other words the slower moving average has a time constant of 1.625 times the faster moving average.

Compared to Fibonacci with his magical 1.618, this number is very close to 1.625, and if the Fibonacci ratio was used then the ratio becomes 26:16.069, which to all intents and purposes is the same!

This may work well in EOD data but in more real-time I personally prefer a time constant ratio of about 2.75 or about the square of 1.625, which is about 2.64. Now the pennies start to drop. This is a geometric series, so for EOD testing the time constants could be: 10, 16, 26, 42, 68, 112, 181, and there you have a family of time constants for observing a family of moving averages, or a family of MACD curves! My choice is to jump every second value.

As I mentioned before my preference for moving averages is 20, 55, 150, 410, 1125, and these might sound huge, but with when you have in the order of 12 or 36 or 72 timeslots per day the 1125 time constant on an EOD basis works out as 93, 31, or 15 ‘days’ which ain’t that long and if based on 150 time constants, on an EOD basis this works out as 12.5, 4.1 and 2.1 ‘days’, and because live data prices and volumes can turn in less than an hour, these time constants may even appear ‘too long’!

Understanding the 'Trigger'

Behind the MACD is the Trigger line. Now this is important, and it needs to be understood how it works and why. The trigger line is a moving average of the MACD. That tells us a lot, because with a bit of knowledge in maths, you can visualise how it works.

Take the infinity case where the time constant for the trigger line (moving average) is infinity. In this case, as the MACD oscillates around the zero line, then the trigger never moves from zero because the time constant is infinity, so the trigger condition is when the MACD crosses zero! That was easy – in hindsight! In other words, this is the same as a 'two moving average' indicator.

Now take the zero case where the trigger line exactly follows the MACD. Immediately the MACD turns down it is a sell signal and the moment it turns up it is buy signal, as the MACD wriggles, then so does the trigger, and that is like trying to run down a frightened hare! The hare wins and you lose! The 9EMA on a 26:16 MACD comes close to this!

Obviously there is middle ground, where the trigger does not violently follow the MACD, but the trigger is not the zero line, and this means that to me the trigger line should have a time constant greater than the shortest time constant in the MACD, and I am sure that many will argue, but count the false triggers, and you will see why.

Now that the activity of the trigger can be better understood in that the longer the time constant of the trigger the less 'trigger happy' it is; this gives a much better understanding of exactly how the trigger time constant causes the MACD to be more responsive than the 'two moving averages' indicator, and give very few false triggers. Remember, with a long-term moving average as a qualifier (to consider a trade or not), this pulls the number of false trades down substantially. What more could you want!

The MACD still false triggers because the passage of share prices is random, and the trigger (or trailing moving average) asymptotically merges onto the constant value MACD as the price is still steadily rising, because the MACD is in effect a 1st order differential of the price gradient, and when the price stabilises the jump out signal grows a hair trigger!

Rating the MACD

This may come as a shock, but the MACD is not normal. That is; the MACD is in reality the difference of two moving averages and these moving averages are direct functions of the trading prices. So this MACD is in reality a direct function of the price and because of this, the units for the MACD are therefore in terms of the trading price – even though the MACD is the difference of these two moving averages.

What this really means is that a rule set on the value of a MACD cannot be translated to another price, as the value of the MACD is in itself dependent on the price!

For live data, shares priced in the less than 5 c range the MACD typically can be typically about -0.003 to +0.003, but for shares priced at about the \$40 mark the MACD will give typically -0.2 to +0.2, and the MACD really cannot be compared between these prices as it is not normalised.

To 'normalise' the MACD, we need to refer the MACD value to a reference price, and this reference price changes. This would appear to make the normalisation process seemingly difficult – but it is not, because the reference prices are those used to develop the MACD at that instance anyway!

To get a better understanding of the moving average, in Control Theory terms, the moving average is the output of (in most cases) a 1st order filter, and that output can be written as:

$$\text{Output} = \text{Input}(\text{Input}) - \text{Error}(\text{Gradient}) - \text{Error}(\text{Step}) - \text{Error}(\text{Impulse}) \text{ etc.}$$

Converting this to moving average terms as in technical market indicators, this could be written as:

$$\text{Moving Average} = \text{Current Price} - \text{Error}(\text{Gradient}) - \text{Error}(\text{Time Constant})$$

A bit tidier this can be written as:

$$\text{MA}(1) = \text{Price} - \text{Er}(\text{G1}) - \text{Er}(\text{TC1}) \quad \text{first moving average}$$

$$\text{MA}(2) = \text{Price} - \text{Er}(\text{G2}) - \text{Er}(\text{TC2}) \quad \text{second moving average}$$

Now the MACD can be written as:

$$\begin{aligned} \text{MACD} &= \text{MA}(1) - \text{MA}(2) \\ &= \text{Price} - \text{Er}(\text{G1}) - \text{Er}(\text{TC1}) - (\text{Price} - \text{Er}(\text{G2}) - \text{Er}(\text{TC2})) \\ &= \text{Price} - \text{Er}(\text{G1}) - \text{Er}(\text{TC1}) - \text{Price} + \text{Er}(\text{G2}) + \text{Er}(\text{TC2}) \\ &= (\text{Er}(\text{G2}) - \text{Er}(\text{G1})) + (\text{Er}(\text{TC2}) - \text{Er}(\text{TC1})) \\ &= \text{Er}(\text{G2} - \text{G1}) + \text{Er}(\text{TC2} - \text{TC1}) \end{aligned}$$

Or as a differential equation this becomes:

$$\text{MACD} = d\text{G2}/d\text{P} - d\text{G1}/d\text{P} + d\text{TC2}/d\text{P} - d\text{TC1}/d\text{P}$$

The problem here is that the MACD is essentially a direct function of the Price, as the Errors are in fact referred to the Price, and that is what makes the MACD an 'abnormal' indicator.

To fix this problem it is necessary to divide the MACD by the average of the two moving averages, and that in-effect 'normalises' the MACD, by cancelling out the 'Price' relationship. So the normalised MACD becomes:

The average of the moving averages is:

$$\text{Average} = (\text{MA}(1) + \text{MA}(2))/2$$

So the NMACD becomes:

$$\text{NMACD} = 2 * (\text{MA}(1) - \text{MA}(2)) / (\text{MA}(1) + \text{MA}(2))$$

In computer maths this is a no-brainer, as the two moving average values are already there and it is a very simple inclusion. What is really happening is that the new denominator (originally 1) is the sum of the two moving averages, which is:

$$\begin{aligned}
 \text{Sum} &= \text{MA}(1) + \text{MA}(2) \\
 &= \text{Price} - \text{Er}(G1) - \text{Er}(\text{TC1}) + (\text{Price} - \text{Er}(G2) - \text{Er}(\text{TC2})) \\
 &= \text{Price} - \text{Er}(G1) - \text{Er}(\text{TC1}) + \text{Price} - \text{Er}(G2) - \text{Er}(\text{TC2}) \\
 &= 2 * \text{Price} - (\text{Er}(G2) + \text{Er}(G1)) - (\text{Er}(\text{TC2}) + \text{Er}(\text{TC1})) \\
 &= 2 * \text{Price} - \text{Er}(G2 + G1) - \text{Er}(\text{TC2} + \text{TC1})
 \end{aligned}$$

As a differential equation this becomes:

$$\text{Sum} = 2 * \text{Price} - dG2/dP - dG1/dP - dTC2/dP - dTC1/dP$$

So the normalised MACD now becomes:

$$\text{NMACD} = 2 * (\text{Er}(G2 - G1) + \text{Er}(\text{TC2} - \text{TC1})) / (2 * \text{Price} - \text{Er}(G2 + G1) - \text{Er}(\text{TC2} + \text{TC1}))$$

This now becomes a partial differential equation:

$$\text{NMACD} = 2 * (dG2/dP - dG1/dP + dTC2/dP - dTC1/dP) / (2 * \text{Price} - dG2/dP - dG1/dP - dTC2/dP - dTC1/dP)$$

It is not necessary to go deeper suffice to say that dividing the MACD by the average of the two moving averages to a very large degree removes the price dependency of the MACD, and leaves the new normalised MACD price independent.

With the normalised NACD (NMACD) the typical range is -0.05 to + 0.05 and this brings in the need to use some practical license to multiply the figure by 1000 and give it a useful range of about +50 to -50 or so. If the normalised MACD (NMACD) was called the “moore”, then the milli-moore would be written as “mM”!

It does seem strange that after some years of developing indicators to realise that the normalised MACD is nothing more than the **rate of change** of price of a security with the time constants as the differential and not the time itself as the differential – using the same “Z transform” technique!

Because the price has been normalised out, what is left is the relative ROC (Rate Of Change) and this has a very different characteristic to that of an MACD. If a stock rises (or falls) at a relatively constant rate over time, then the NMACD will move to a relatively constant positive (or negative) value, and using a trailing trigger moving average will lead to false sell situations. This type of indicator really needs a threshold level to be considered against - and that is another world!

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