

## ON THE USE OF LAG CURVES TO DETERMINE BUY AND SELL POINTS

It is well known that prices of stocks, bonds, commodities, real estate, paintings and other sources of wealth vary with time. There are periods when their values are on the increase (bull market) while at other times they are decreasing (bear market). Although most long term investors base their investment decisions on fundamentals and are of the belief that hourly, weekly, and even monthly variations in stock prices are random and hence have no predictive value (see “Random Walk Down Wall Street” by Burton G. Malkiel), there are others, especially some hedge fund managers, who believe there are definite trends in markets which can be taken advantage of (see “Trend Following” by Michael W. Covel). This latter group goes by the name of technical analysts. I count myself among this group and have been fairly successful at it over the past sixty plus years. The most skilled technicians have been those who discover and recognize trends, either up or down, in historical chart patterns and act on them. They do not make long term predictions about prices but rather ride perceived trends until there is a reversal. It is the purpose of this article to describe my approach to technical investing by first defining lag curves as either time shifted price curves or curves sketched in by hand and then acting on the signals produced by them to make investments in both bull and bear markets.

Our basic approach to technical analysis ignores much of the jargon of the field such as head and shoulders patterns and double bottoms, but rather relies only on the price history of a particular stock or other commodity and any trends it exhibits. To tell when to buy(B) or sell(S) one needs to generate a second curve known as a lag curve which follows the primary price trend  $P(t)$  by a fixed amount of time  $dt$ . Although running averages are often used for this purpose, we find it much more convenient and responsive to simply define a lag curve as  $P(t-dt)$  or as a hand drawn curve omn differing from  $P(t)$  by an amount  $dt$ .

What I have just described can expressed, for the case of a lag curve constructed by  $P(t-dt)$ , in a mathematical basis as follows. Start with the hypothetical price curve-

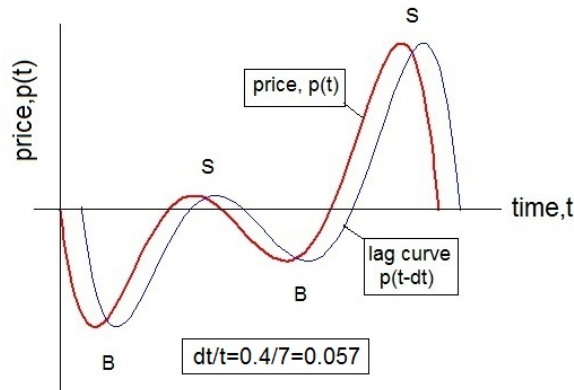
$$P(t) = -t^5 + 2t^4 + 13t^3 - 14t^2 - 24t \quad \text{for} \quad -3 < t < 4$$

Next introduce a time shifted lag curve  $P(t-dt)$ . It has the form-

$$P(t - dt) = -(t - dt)^5 + 2(t - dt)^4 + 13(t - dt)^3 - 14(t - dt)^2 - 24(t - dt)$$

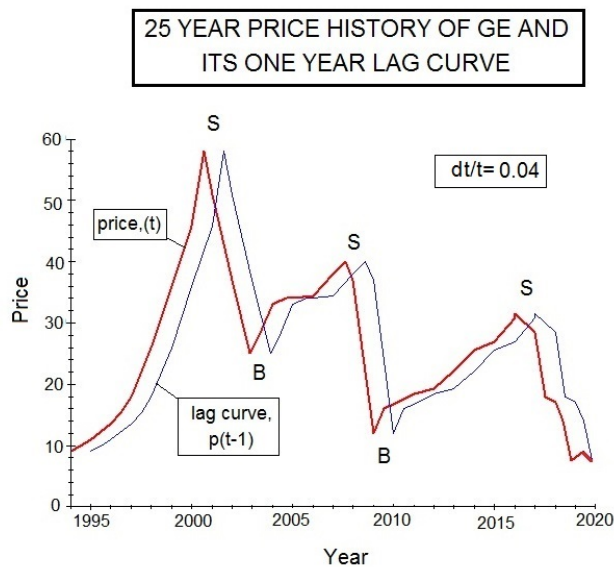
, where  $-2.6 < t < 4.4$ . This means here we take  $dt/t=0.057$ . Plotting both  $P(t)$  and  $P(t-dt)$  on the same graph produces-

IDEALIZED PRICE AND LAG CURVE PATTERN SHOWING  
BUY AND SELL SIGNALS AT CROSS-OVER POINTS



The time lapse between the price and lag curve should typically be set somewhere in the range  $0.03 < dt/t < 0.06$ . Here  $t$  represents the time range of the entire graph. Also, in real markets the red price curve will not be as smooth as it is for the above polynomial. So one must typically first smooth out the  $P(t)$  curve by a short term averaging typically using  $dt/2$  as the time measure. Note that the time in this graph is scalable suggesting such patterns exist for any chosen time range (window). That is, the price-lag curve should apply equally well for day traders as for longer term investors. Note that buy points B and sell points S occur when the price (red) and lag curve (blue) first cross each other. We term these points the cross-over points. One is in an uptrend where  $P(t) > P(t-dt)$  and in a downtrend when  $P(t) < P(t-dt)$ .

We next apply the price-lag approach to some real stocks. Take first the case of General Electric (GE) looked at through a 25 year time window from 1994 through 2019. We get-

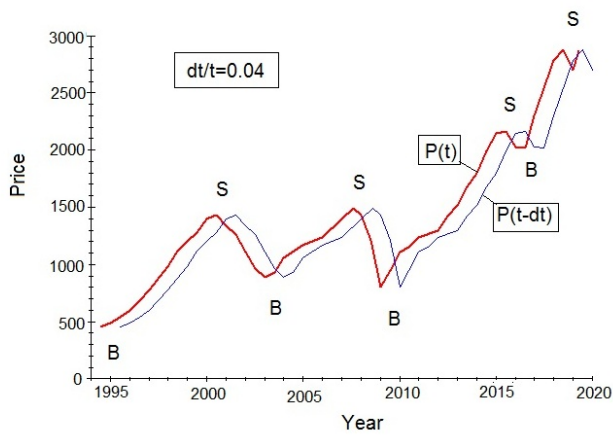


The red price curve represents an averaged value of the real price using  $dt/2$  as the time averaging increments. Also we have taken  $dt/t=1/25=0.04$ . The cross-over points are clearly indicated. A  $dt/t=0.03$  increment would have gotten one out a bit closer to the top in 2001. The chart shows that we are near but not quite yet at a cross-over point buy B for GE in April of 2019.

I inherited quite a few shares of GE stock from my parents back in 2000 and sold all of them by 2001 as suggested by the above graph. I have never been back in this stock again although there were later multi-year uptrends starting in 2003 and 2010. Also profitable downtrends were indicated in 2001, 2007, and 2017. My reason for not participating in these later up and downtrend periods was that I have been very unhappy with GE products in my home here in Gainesville. We moved into a brand new house in 2003 which had all new stainless steel GE kitchen appliances. These appliances have proven to be unreliable, first the stove-top went, next the refrigerator needed several replacement visits because of a freezing water line, followed by a broken dishwasher motor. From this it became clear to me that GE was no longer producing high quality consumer products and I wanted to no longer have any connections with them. This fact when multiplied nationally probably accounts for the dismal stock behavior from a 2000 high of \$60/sh to a present low of \$9/sh.

Consider next the price-lag curve behavior of the S&P500 stock index. This is perhaps the most broadly based measure of the direction the US stock market finds itself in. When its trend is up one is in a bull market while when in a downtrend one is in a bear market. The S&P500 index allows for direct participation by individual investors through the exchange traded funds SPY for long positions and SDS for short positions. Also there is the related leveraged fund SSO which mimics the S&P500 by a factor of two on the positive side. Here is the constructed price-lag curve picture for this index when looked at over a twenty-five year time period using a  $dt$  of one year and a  $P(t)$  averaging based on a six month( $dt/2=0.5$  year) time interval-

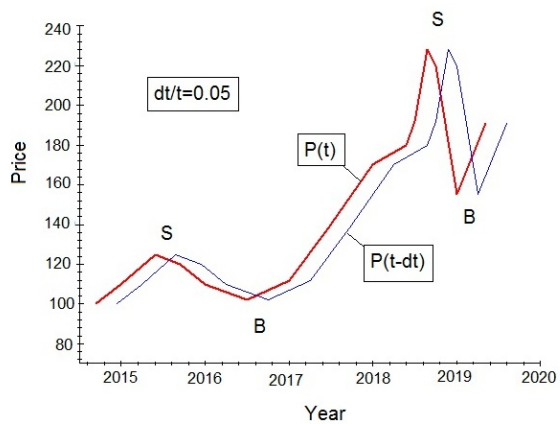
25 YEAR HISTORICAL GRAPH OF THE S&P500 AND ITS LAG CURVE. BUY AND SELL SIGNALS ARE INDICATED AT THE CROSS-OVER POINTS



The graph clearly indicated multiple year uptrends when one should have been long and downtrends during which one should have been short or out of the market. It is not quite clear yet whether we have a new cross-over point in April of 2019 but the indications are that one is near a sell point S on the index.

Next we apply our procedure to the individual stock Apple, Inc.(symbol APPL) using the shorter time window of  $t=5$  years and  $dt/t=0.05$  meaning a  $dt$  of 3 month and a  $P(t)$  averaging of  $dt/2$ =six weeks. Here we arrive at the following graph-

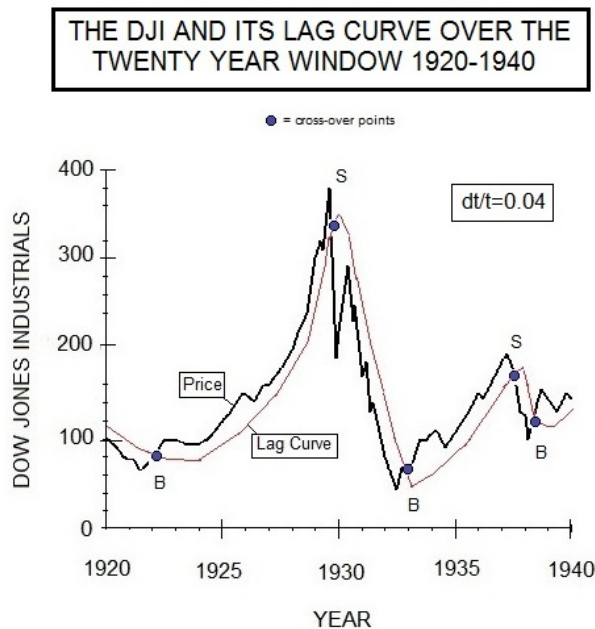
P(t) AND P(t-dt) PLOTS FOR AAPL OVER A 5 YEAR WINDOW INDICATING BUY AND SELL POINTS



The graph indicates that we are presently in an uptrend. However the price fluctuations have become rather erratic suggesting the trend may soon reverse. The best historical

return on Apple in this window was during the uptrend lasting from 2016 through late 2018. During that time interval the price essentially doubled.

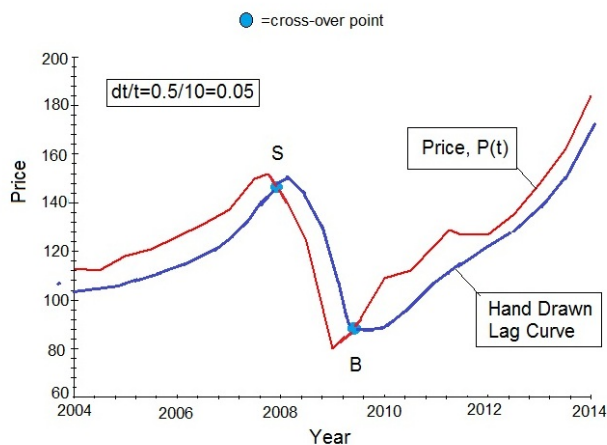
We point out that trends in market behavior can also be detected by our second approach of again using the price function  $P(t)$  over a given time window but this time employing a drawn in lag curve sketched by hand which uses  $dt$  as the average time separation. Often this approach reduces the potential losses when trends reverse. Here is an example of such a drawn in lag curve using a  $dt=0.8$  year. The graph represents the twenty year window from 1920 through 1940 of the Dow Jones Industrial Average(DJI) and its drawn in lag curve-



Although I myself did not live through most of this period, it is clear that any good investor investing at that time would have done very well during this period on both the long and short side of the stock market. The cross-over point in September of 1929 would have taken him out of the long side of the market. He would not have gone in again on the long side until 1933 during the depth of the depression. J.P.Getty, the oil billionaire, did something like this when he bought up a good part of the oil industry stock at bargain basement prices during the 1930s.

To further make clear how well a price-lag curve strategy works we look at another example. This time we consider the ten year window from 2004 through 2014 of the ETF SPY. This period takes one right over the "Great Recession". The SPY fund is the most active of the ETFs. It is tied directly to the S&P500 Index by the equality that one  $SPY=(1/10)S\&P500$ . Thus, at today's close (April 11, 2019) we have the  $S\&P500=2888.32$  and  $SPY= 288.21$ . Using a  $dt$  of 0.8 year so that  $dt/t=0.04$  with a  $dt/2=0.4$  year smoothing parameter for  $P(t)$ , we get the following graph when the lag curve is drawn in by hand –

PRICE AND LAG CURVE FOR SPY OVER A TEN YEAR PERIOD



Using a chart like this last one I was able to avoid the losses most investors and IRA holders experienced during the Great Recession of 2008-2010. According to my financial diary I sold all my long holdings on Nov.7, 2007 indicated by S in the above graph. The remarks I recorded at that time were “Sold all stocks as the market is not acting right and the charts indicate a sell”. The use of such price-lag curves also allowed me to side-step the dot com bust of 2000. I point out, however, that I did not reenter the long side of the stock market at the cross over point in late 2009. This I attribute mainly to the vast negative financial press one was being subjected to in early 2010 though 2012. Clearly these financial experts turned out to be wrong yet I reacted emotionally to their stories. This is another lesson I have learned when investing using trend following, It is to not listen what others are saying but rather react un-emotionally only to the signals given by the cross-over points between price and lag curve.

We have shown above through various examples that successful investing requires only a knowledge of the historical price and constructed lag curve. In stock market investments I have confined my transactions in the last fifteen years to just the two ETF of SPY and QQQ. These are highly liquid broad based funds reflecting the S&P500 and Nasdaq100 Index, respectively. Unlike individual stocks, these funds are quite a bit less volatile yet still are able to return about 1% per day on one’s investment portfolio under the right market conditions. I can highly recommend these two exchange traded funds to you.

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 Gainesville, Florida