

# Using Two Sets of Multiple Moving Averages of Price to Time Positions in a Portfolio of Exchange Traded Funds

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## Abstract

This paper attempts to determine if the use of two sets of multiple moving averages of price can be employed to generate above market portfolio rates of return in a portfolio of exchange traded funds. A set of short term moving averages of price and a set of long term moving averages of price and the relationship within each set are used to determine the timing of entry and exit points for establishing positions in the exchange traded funds (ETFs). Returns using the moving average convergence divergence (MACD) indicator and a combination of the short term MACD and long term MACD to determine entry and exit points are compared to a buy and hold strategy of the S&P 500 Index. The portfolio returns over a five year time period (1/1/2006 – 12/31/2010) are calculated and compared to their S&P 500 benchmark. A comparison is then performed between a portfolio of seven exchange traded funds using the combined S-T MACD indicator and the L-T MACD indicator for entry and exit points to a buy and hold equally weighted and rebalanced portfolio comprised of the same exchange traded funds. The asset classes represented in the portfolio include domestic equities, developed foreign equities, emerging market foreign equities, domestic bonds, precious metals, and real estate. The use of two MACD indicators used in sequence with different parameters to represent expanding and contracting bands of multiple moving averages to determine entry and exit points was found to increase the return of a portfolio of exchange traded funds for the selected holding period over a buy and hold strategy.

## I. Introduction

Technical analysis attempts to forecast future prices by observing patterns on price charts. Many traders and investors use technical analysis to time their entry and exit points both in time and in price points based upon their interpretation of repeating patterns. Technical analysis may work because of the self-fulfilling nature of its prophecy. Many traders and investors see the same patterns and act upon those patterns in similar ways and hence the observed patterns become self-fulfilling.

Many indicators have been developed over the years and used in technical analysis to predict future price movements. An indicator is an algorithm resulting in values graphed on a price chart. The moving average indicator and the moving average convergence divergence (MACD) indicator are common indicators used in technical analysis.

The moving average of price is the average price calculated over a certain number of time periods. In this study the time periods are days. Each new day's price results in the calculation of a new moving average. The successive moving averages over time can be graphed on a price chart as the moving average indicator. Selecting various time periods over which to calculate the moving average can result in multiple moving average indicators which can be shown on a price chart.

There are two conventional approaches using multiple moving averages to indicate entry and exit price points when opening or closing positions. The first approach employs the use of two moving average indicators of differing time periods. This is referred as the moving average crossover strategy. The entry price point is indicated when the moving average computed using fewer time periods crosses from below the moving average computed using more time periods. The exit price point is indicated when the moving average computed using fewer time periods crosses from above the moving average computed using more time periods. The second approach is a modification of the first approach and uses the moving average convergence divergence (MACD) indicator. The MACD indicator is the difference between two moving averages of price. The MACD indicator acts as an oscillator line fluctuating within limits above and below a zero value line. The entry point is determined where the MACD indicator crosses from below a moving average of the MACD indicator itself. The exit point is determined where the MACD indicator crosses from above a moving average of the MACD indicator itself. A variation of the MACD indicator is the MACD histogram that plots the difference between the MACD indicator and a moving average of the MACD indicator. The entry point is determined when the histogram crosses the zero line from below. The exit point is determined when the histogram crosses from above the zero line. Both of these approaches are essentially the same in that they both look at the coming together (convergence) or spreading apart (divergence) of two moving average indicators of price.

This paper is unique in that it examines the results of using the convergence and divergence of two moving average indicators in sequence rather than in isolation. The sequence of that convergence and divergence or vice versa is founded upon the classification of two sets of moving averages representing the actions and sentiment of two distinct participants in the equities market. This paper essentially tests the results of two moving average crossover strategies in sequence, a 3 and 15 day moving average crossover strategy followed in sequence by a 30 and 60 day moving average crossover strategy. The results from testing the combined sequence of the S-T MACD (Short Term Moving Average Convergence Divergence) indicator followed by the L-T MACD (Long Term Moving Average Convergence Divergence) indicator are the same as testing the sequence of 3 and 15 day moving average crossovers followed by the 30 and 60 moving average crossovers.

## **II.Literature Review**

Whether technical analysis trading rules can generate above market returns has been a controversial issue. Malkiel (2011) states that technical analysis cannot be relied upon to generate above market returns and is essentially a useless and fruitless endeavor. Various studies have suggested that technical indicators alone cannot be used to predict future prices. Neftci (1991), Hudson (1996) and Mills (1997) suggested that technical trading rules cannot be profitably employed. Hudson and Mills found that a modification of the moving average, the variable length moving average, was profitable in the FT 30 Index. Some studies have supported technical analysis trading rules. Treynor and Ferguson (1985) and Brock (1992) suggested that trading rules can be used profitably. Brock found that a moving average crossover strategy from 1910 to 2000 performed better than a buy and hold strategy except for the period from 1980 to 2000 where the market followed a major uptrend. Most of these earlier studies examined simple trading rules such as the moving average and MACD Indicators. Parisi and Vasquez (2000)

found buy signals were more profitable than sell signals in the Chilean stock market. Hameed and Ting (2000) found evidence of predictability in the Malaysian stock market. Gunasekarage and Power (2001) found that technical trading rules are useful to predict equity prices in the stock markets of Bombay, Colombo, Dhaka, and Karachi. Ito (2009) found profitable trading rules for equities in the Mexican, Indonesian and Taiwan stock markets. Sehgal (2007) found that technical trading rules do not outperform a buy and hold strategy on a net return basis for individual stocks in India although technical indicators performed better during market upturns compared to market downturns. There appears to be greater probability of success using technical analysis trading rules in less developed financial markets than in more developed markets. This pattern would be in harmony with the efficient markets hypothesis.

Some have tested the MACD Indicator with mixed results. Brock, Lakonishok and LeBaron (1992) tested several moving averages and their crossing and found them beneficial in forecasting stock prices. Their benchmark was holding cash. Seykota (1991) tested the MACD Indicator from 1989 to 1991 on the S&P 500 Index and found no above average returns. Chong, Li, and Yu (2008) tested the MACD Indicator against some of the major stock indexes in the United States, the United Kingdom, Germany, Japan, and Hong Kong and found that the MACD Indicator generated above market returns in the German and Hong Kong stock markets. The MACD indicator crossing the 0 line which this paper tests produced higher returns than the MACD indicator crossing its signal line. The results after 2000 were inferior to the results before 2000. Sullivan, Timmermann and White (1999) found above market performance of moving average crossovers for the Dow Jones Industrial Average. Chong and Ng (2008) tested the MACD Indicator on the London Stock Exchange FT 30 Index and determined that they generated above market returns. Chong, Cheng, and Wong (2010) found that the MACD Indicator trading rules beat a buy and hold strategy in the BRIC countries (Brazil, Russia, India, China). Again the trading rules were more successful in stock markets with a short history (Russia) but work less successfully in markets with a long history (Brazil).

### **III. Construction and Use of Indicators**

The GMMA indicator is comprised of two sets of six moving averages of price each. The short term set is comprised of moving averages of 3, 5, 8, 10, 12, and 15 days and a long term set comprised of moving averages of 30, 35, 40, 45, 50, and 60 days. These are the time periods recommended by Guppy ([www.guppytraders.com](http://www.guppytraders.com)) and the ones used in this paper. The GMMA indicator is the visual representation on price charts of these two sets of moving averages of price. According to Guppy the short term set of moving averages represents traders and the long term set of moving averages represents investors. According to Guppy the GMMA indicator is a clue to the behavior of traders and investors as two distinct groups that can be used to understand the character and strength of the price trend.

According to Guppy the GMMA indicator shows changes in trend by visualizing the sentiment of investors (long term set of moving averages) and traders (short term set of moving averages). It is the composite picture of these averages that provides the view of the trend. The GMMA indicator is interpreted by observing the relationship between these two sets of moving averages and the relationship within each set of moving averages. The relationships within and

between the sets of moving averages reveal agreement and disagreement between traders and investors.

This paper uses multiple moving averages to determine entry and exit points but in a different way. In this paper I have constructed two indicators that represent the relationships within each set of moving averages and the relationship between the two sets of moving averages. The first indicator (S-T MACD) calculates the sum of the differences between all of the individual moving averages in the short term set and graphs them. It is analogous to the moving average convergence divergence (MACD) indicator. The S-T MACD reveals the degree of separation between the individual moving averages (3, 5, 8, 10, 12, and 15) in the short term set of moving averages. The MACD indicator plots the difference between two moving averages of price. I used the MACD indicator with the moving average settings of 3 and 15 days to represent the sum of the differences between the moving averages in the short term set of moving averages and graphs them. The second indicator (L-T MACD) calculates the sum of the differences between all of the individual moving averages in the long term set of moving averages and graphs them. It also is analogous to the moving average convergence divergence (MACD) indicator. The L-T MACD reveals the degree of separation between the individual moving averages (30, 35, 40, 45, 50, and 60) in the long term set of moving averages. I used the MACD indicator settings of 30 and 60 days to represent the sum of the differences between the moving averages in the set. Each of the indicators is an oscillator – a graph of the results of a computation where the results behave in a wavelike pattern where the wave fluctuates between an upper and lower value around the zero value line.

A higher relative value of the S-T MACD and the L-T MACD reveals more separation of the moving averages and a lower value represents less separation of the moving averages. Contraction of the band of moving averages indicates convergence and agreement on the price. Expansion of the band of moving averages indicates divergence and disagreement on the price. A value of zero of the S-T MACD and the L-T MACD indicates no separation of the moving averages within the band and agreement on price. Movement of the S-T MACD and the L-T MACD towards a value of zero represents convergence of the moving averages. Movement of the S-T MACD and the L-T MACD away from zero represents divergence of the moving averages. Agreement on price indicates an actionable point – an entry or exit point.

The GMMA concept is based on the composite picture of these two sets of multiple moving averages that provide a view of the trend. The expansion and contraction of the band of moving averages gives clues to the current stage of the trend of price. When the two sets of moving averages are consistently separated it shows trend consistency. The GMMA indicator and its related indicators (L-T MACD and S-T MACD) were used to determine if a systematic and mechanical method could be developed to trade the trend.

This paper tests the use of a sequence of MACD indicators to arrive at entry and exit points on a price chart. The S-T MACD indicator crosses the 0 line prior to the L-T MACD crossing the 0 line because it uses shorter term moving average periods in the calculation of the MACD indicator. Traders are more concerned with shorter term price movements and the S-T MACD indicator reacts more quickly than the L-T MACD indicator to changes in trend as revealed by the moving average. Traders come to agreement on price quicker than investors who

use longer term moving averages to reveal changes in trend. Traders lead investors in their buy and sell decisions. This paper then differs from other studies using the MACD indicator in that this paper uses a sequence of MACD indicators crossing the 0 line instead of a singular MACD indicator line crossing the 0 line or its signal line. The signal line is a moving average of the MACD indicator values.

Others have tested the MACD indicator with mixed results. Seykota (1994) tested the MACD indicator from 1989 to 1991 on the S&P 500 Index. His results found no above average returns. Chong, Li, and Yu (2008) tested the MACD indicator against some of the major stock indexes in the United States, the United Kingdom, Germany, Japan, and Hong Kong. In the German and United Kingdom stock markets the MACD indicator did provide above market returns. The MACD indicator crossing the 0 line which this paper tests produced higher returns than the MACD indicator crossing its signal line. The results post 2000 were inferior to the results pre 2000.

#### **IV. Backtesting of Indicator Conditions**

Backtests were performed for a set of exchange traded funds representing various asset classes. Backtesting involves using backtesting software to generate entry and exit rules against historical prices to determine the success of a trading strategy. The back test period was from 01/01/2006 thru 12/31/2010. Exchange traded funds included in the backtest set were screened using the ETF screener at Fidelity.com and met all of the following criteria. A total of 161 exchange traded funds met all of the following criteria.

- Inception date prior to 01/01/2006
- Sponsor was from one of the following families: PowerShares, iShares, Proshares, Rydex, or Vanguard. These fund families sponsor the most numerous exchange traded funds.
- Financial asset classes: domestic small cap equities, domestic large cap equities, foreign developed equities, foreign emerging markets, fixed income, real estate, precious metals
- Leveraged and inverse funds were excluded

Source: [www.fidelity.com](http://www.fidelity.com)

##### **1) Backtest of S-T MACD Indicator on 161 Exchange Traded Funds.**

The first backtest was run on the S-T MACD indicator. The sequence of an entry point and an exit point constituted a trade.

Enter position: the following condition must be met

S-T MACD moving up crossing 0 (short term moving averages diverging)

Exit position: the following condition must be met

S-T MACD moving down crossing 0 (short term moving averages converging)

TABLE I BACKTEST RESULTS OF S-T MACD INDICATOR – 161 ETF

	Winning Trades	Losing Trades	Total Trades
Number of Trades	3,137	6,042	9,221
Average Return per Trade	4.8	(2.3)	.1
Average Days in Trade	26	6	13
Winning Percentage			34
Average Gain/Loss Ratio			2.1

The wealth index after the five year test period was 76.23 meaning the portfolio value at the end of the five year period was 76.23 percent of the beginning of period portfolio value. The wealth index indicates the compounded value of the portfolio thru time. The wealth index for the same period for a buy and hold strategy was 112.61. The buy and hold strategy assumed purchasing equal dollar amounts of the exchange traded funds and holding them for the five year duration.

## 2) Backtest of L-T MACD indicator on 161 Exchange Traded Funds.

The second backtest was run on the L-T MACD indicator. The sequence of an entry point and an exit point constituted a trade.

Enter position: the following condition must be met

L-T MACD moving up crossing 0 (long term moving averages diverging)

Exit position: the following condition must be met

L-T MACD moving down crossing 0 (long term moving averages converging)

TABLE II BACKTEST RESULTS OF L-T MACD INDICATOR – 161 ETFs

	Winning Trades	Losing Trades	Total Trades
Number of Trades	548	605	1,154
Average Return per Trade	17.4	(5.0)	5.7
Average Days in Trade	161	34	94
Winning Percentage			47
Average Gain/Loss Ratio			3.5

The wealth index after the five year test period was 103.09 meaning the portfolio value at the end of the five year period was 103.09 percent of the beginning of period portfolio value. The wealth index for the same period for a buy and hold strategy was 112.61.

## 3) Backtest of MACD HISTOGRAM Indicator on 161 Exchange Traded Funds.

The third backtest was run using the conventional MACD HISTOGRAM indicator using the standard parameters of 12, 26, and 9 day moving averages. The MACD HISTOGRAM indicator calculates the difference between the 12 - 26 day moving averages and a 9 day moving average of that difference and plots the difference as a histogram.

Enter position: the following condition must be met

MACD HISTOGRAM indicator moving up crossing 0

Exit position: the following condition must be met  
MACD HISTOGRAM indicator moving down crossing 0

TABLE III BACKTEST OF RESULTS OF MACD HISTOGRAM INDICATOR – 161 ETFs

	Winning Trades	Losing Trades	Total Trades
Number of Trades	3,319	5,047	8,407
Average Return per Trade	4.34	(2.70)	.09
Average Days in Trade	20	8	12
Winning Percentage			39
Average Gain/Loss Ratio			1.6

The wealth index after the five year test period was 97.22 meaning the portfolio value at the end of the five year period was 97.22 percent of the beginning of period portfolio value. The wealth index for the same period for a buy and hold strategy was 112.61.

#### 4) Backtest of combined S-T MACD Indicator and L-T MACD Indicator on 161 Exchange Traded Funds.

Enter position: the following combined condition must be met  
S-T MACD indicator moving up crossing 0 and then L-T MACD moving up crossing 0 (short term and long term moving averages diverging)

Exit position: the following combined condition must be met  
S-T MACD indicator moving down crossing 0 and then L-T MACD moving down crossing 0 (short term and long term moving averages converging)

The crossing of the L-T MACD indicator and 0 occurred the next trading day after the crossing of the S-T MACD indicator and the 0 line

TABLE IV BACKTEST RESULTS OF COMBINED S-T AND L-T MACD INDICATOR – 161 ETFs

	Winning Trades	Losing Trades	Total Trades
Number of Trades	420	528	949
Average Return per Trade	15.10	(5.17)	3.81
Average Days in Trade	153	38	89
Winning Percentage			44
Average Gain/Loss Ratio			2.9

The wealth index after the five year test period was 121.86 meaning the portfolio value at the end of the five year period was 121.86 percent of the beginning of period portfolio value. The wealth index for the same period for a buy and hold strategy was 112.61.

#### 5) Backtest of combined S-T MACD Indicator and L-T MACD Indicator on Portfolio of Exchange Traded Funds (7 ETFs).

The following table lists the exchange traded funds in the simulated portfolio

## DESCRIPTION OF EXCHANGE TRADED FUNDS IN SIMULATED PORTFOLIO

ETF Symbol	Description	Asset Class	Inception Date
IWM	iShares Russell 2000 Index Fund ETF	Domestic Equities Small Cap	May 2000
LQD	iShares Trust Government \$Investment Top Corporate Bond	Domestic Fixed Income	July 2002
EEM	iShares MSCI Emerging Markets Index	Foreign Emerging Markets	April 2003
IVV	iShares S&P 500 Index	Domestic Equities Large Cap	May 2000
GLD	SPDR Gold Trust	Precious Metals	November 2004
EFA	iShares MSCI EAFE Index Fund	Foreign Developed Markets	August 2001
VNQ	Vanguard REIT ETF	US Real Estate	September 2004

Enter position: the following combined condition must be met  
S-T MACD indicator moving up crossing 0 and then L-T MACD moving up crossing 0 (short term and long term moving averages converging)

Exit position: the following combined condition must be met  
S-T MACD indicator moving down crossing 0 and then L-T MACD moving down crossing 0 (short term and long term moving averages converging)

The crossing of the L-T MACD indicator and 0 occurred the next trading day after the crossing of the S-T MACD indicator and the 0 line.

TABLE V BACKTEST RESULTS OF COMBINED S-T MACD INDICATOR AND L-T MACD INDICATOR – 7 ETFs

	Winning Trades	Losing Trades	Total Trades
Number of Trades	20	25	45
Average Return per Trade	17.36	(4.52)	5.20
Average Days in Trade	171	31	93
Winning Percentage			44
Average Gain/Loss Ratio			3.8

The wealth index after the five year test period was 134.24 meaning the portfolio value at the end of the five year period was 134.24 percent of the beginning of period portfolio value. The wealth index for the same period for a buy and hold strategy was 112.61.

The benchmark buy and hold portfolio for the S-T MACD (161 ETFs), L-T MACD (161 ETFs), MACD HISTOGRAM (161 ETFs), S-T L-T combination (161 ETFs), and S-T L-T combination (7 ETFs) was a \$100,000 investment in the S&P 500 Index at 01/03/2006. The benchmark portfolio of the S&P 500 Index had a value of \$112,610 at 12/31/2010. The wealth index was calculated by dividing \$112,610 by \$100,000 resulting in a wealth index of 112.61.

Fidelity, Schwab, and Ameritrade now allow commission free trading in selected exchange traded funds. There are no exchange traded funds for certain asset classes like commodities or precious metals that can be traded without commissions thru these online brokerages. Some online brokerages like Trade Station and Interactive Brokers do charge commissions of two dollars per transaction on stocks. Fidelity, Schwab, and Ameritrade charge eight dollars for each equity transaction.

The wealth index for Table IV and Table V was calculated using a commission cost of eight dollars per transaction. Tables IV and V were revised because only the trading results in these tables were profitable before commissions were considered.

TABLE VI SUMMARY OF SIMULATED PORTFOLIOS

		Portfolio Value at 12/31/2010	Use of MACD Indicator – Wealth Index	Buy and Hold S&P 500 Index Wealth Index
TABLE I	S-T MACD (161 ETFs)	\$76,230	76.23	112.61
TABLE II	L-T MACD (161 ETFs)	\$103,090	103.09	112.61
TABLE III	MACD HISTOGRAM (161 ETFs)	\$97,220	97.22	112.61
TABLE IV	S-T L-T MACD combination (161 ETFs)	\$121,860	121.86	112.61
	After commissions (1,898 commissions)	\$106,676	106.67	
TABLE V	S-T L-T MACD combination (7 ETFs)	\$134,240	134.24	112.61
	After commissions (90 commissions)	\$133,520	133.52	

#### IV. Conclusion

The S-T MACD indicator, L-T MACD indicator, and the MACD HISTOGRAM indicator resulted in a lower wealth indexes than a respective buy and hold strategy. The combined S-T MACD L-T MACD indicators resulted in a higher wealth index than a buy and hold strategy in a portfolio of exchange traded funds.

This study did not indicate that the MACD indicator by itself can be used to generate above market returns. The use of a combination of two MACD indicators with different parameters used in sequence to generate entry and exit signals can be used to produce returns greater than a buy and hold strategy in a small portfolio of diverse asset classes over a buy and hold portfolio of those same asset classes.

The superior performance of the portfolio of 7 exchange traded funds over the portfolio of 161 funds was probably due to the more diversified nature of the portfolio. Most of the funds in the portfolio of 161 funds were equity funds. The 7 fund portfolio was composed of funds from diverse asset classes.

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