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An investigation of the relative strength index

Abstract

Using daily data for the Swiss franc/US dollar exchange rate, this paper studies the trading profitability of the technical indicator Relative Strength Index (RSI). The authors find that for the past decade or so, using the standard configuration of RSI < = 30 and RSI > = 70 as buy or sell threshold, RSI offers no trading profit, but a small loss instead. However, when the buy/sell threshold parameters are altered, to deviate from the combination most commonly used, using RSI as the trading signal still yields profits. The authors also provide an explanation of this phenomenon. One implication of our findings is that consistent profit opportunities should no longer exist in what is already commonly and widely known, but taking a path less travelled could still lead to profit opportunities not yet discovered and utilized.

Introduction

Technical analysis has long been a part of the finance practice. It has been studied in the academic finance literature, too. For example, Park and Irwin (2007) surveyed both the early and the modern studies on technical analysis, and found that "early studies indicate that technical trading strategies are profitable in foreign exchange markets and futures markets, but not in stock markets. Modern studies indicate that technical trading strategies consistently generate economic profits in a variety of speculative markets at least until the early 1990s".

The opposite of technical analysis is the fundamental analysis. However, fundamental analysis and technical analysis are not necessarily incompatible with each other. It is documented by de Zwart, Markwat, Swinkels and van Dijk (2009) that combining technical analysis with fundamental analysis enhances the profitability of trading and investment strategies.

Literature review

Falbo and Pelizzari (2011) mention that there are many different methods of technical analysis, or different technical indicators. Not surprisingly, the profitability of technical indicators has long been subject to debate in the academic literature. It is likely also true that the profitability of technical indicators actually changes over time, as suggested by Lim and Brooks (2011).

Mitra (2011) suggests that moving average based technical trading rules are profitable in the stock market of India. Analyzing a survey of 692 fund managers in five countries, Menkhoff (2010) finds that the vast majority of them do use technical analysis, which is indirect evidence that technical analysis is useful in actual trading and investment. Szakmary, Shen and Sharma (2010) suggest that trend-following technical trading strategies are profitable in the commodity futures market. And, Menkhoff and Taylor (2007) try to explain why technical analysis could be profitable.

On the contrary, Pukthuanthong-Le and Thomas (2008) find that "the profitability of trend following eroded for major currencies and their associated cross exchange rates around the mid-1990s". Park and Irwin (2010) also suggest "that technical trading rules generally have not been profitable in the U.S. futures markets" Neely, Weller and Ulrich (2009) discover that market adapts over time and the profitability of technical trading rules changes over time.

1. Objectives of this study

This paper contributes to this important debate on the profitability of technical analysis by focusing on one particular technical indicator: the Relative Strength Index (RSI). The RSI was created by Wilder and first published by him in 1978. Despite that it is an important technical indicator that has been around for decades, we are aware of only one study that is dedicated to the RSI itself, a study by Rodriguez-Gonzalez, Garcia-Crespo, Colomo-Palacios, Iglesias and Gomez-Berbis (2011). Their study, however, is not a study about the profitability of the RSI itself, but instead is a study on modifying the RSI using neural networks to make it forward-looking.

This paper also contributes to the important topic of market efficiency, in the context of the currency market. If the market is completely efficient, we should find no profitability for the Relative Strength Index. On the other hand, if profitability exists, that is evidence that the market is not completely efficient. It is also possible, and perhaps quite likely, that market, being an aggregate of its participants, behaves just like an individual participant, or a human being, in that it takes time for the market to absorb and adapt to information, and therefore become more efficient than before, but this process of learning never ends. The outcome of this study should shed light on this interesting hypothesis, and contribute to the discussion on market efficiency.

2. Data and research method

Calculation of the Relative Strength Index (RSI) starts with examining the change of the closing price from one day to the next. For each day, an up change UC and a down change DC are calculated. For a day when the closing price is higher than that of the previous day, DC is zero, and UC is that day's close minus the previous day's close. That is, UC is how much the closing price has increased from the previous day to this day.

$$UC = close_{today} - close_{yesterday}, \qquad (1)$$
$$DC = 0.$$

On the other hand, for a day when the closing price is lower than that of the previous day, UC is zero, and DC is the previous day's close minus that day's close. That is, DC is how much the closing price has decreased from the previous day to this day, in its absolute value.

$$UC = 0,$$
$$DC = close_{yesterday} - close_{today}. \qquad (2)$$

Both UC and DC are always non-negative. For a day when that day's closing price is the same as that of the previous day, both UC and DC are zero.

A relative strength RS is defined as the ratio of the *n*-day exponential moving average of the UC time series and the *n*-day exponential moving average of the DC time series. Very often, a 14-day exponential moving average is used.

$$RS = EMA\ (UC, n)\ /\ EMA\ (DC, n). \qquad (3)$$

Finally, *RS* is converted to the *RSI* by:

$$RSI = 100 - 100/\ (1 + RS). \qquad (4)$$

We obtain the daily data on US Dollar/Swiss Franc exchange rate, from January 5, 1998 to May 22, 2009, courtesy of the TradeStation Group. We will be using mostly observation numbers rather than date to refer to data points, with Observation 1 being that for January 5, 1998, and Observation 2955 being that for May 22, 2009.

Figure 1 plots the exchange rate itself over time in units of pips. For example, a reading of 15000 on the vertical axis means the actual exchange rate is 1.5000. That is, it takes 1.5 Swiss Francs (CHF) to buy one US Dollar (USD). As can be seen from the figure, for the first 800 to 900 observations, the general trend is that CHF is depreciating against the USD. For the rest of the time, CHF is in general appreciating against the USD.
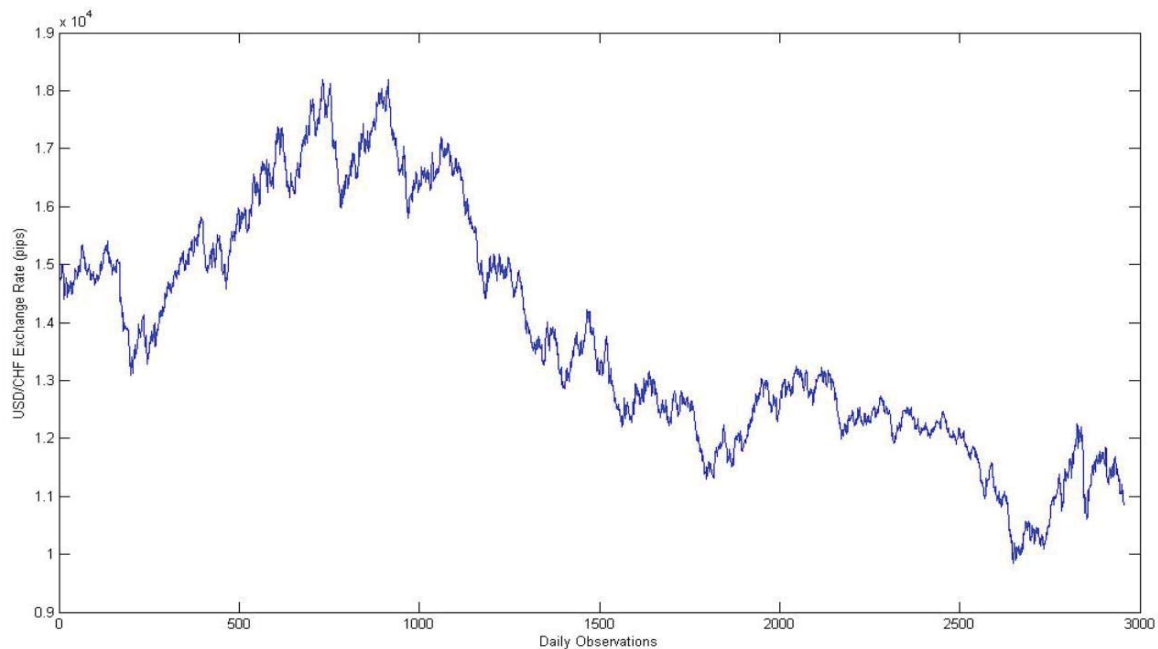
Fig. 1. The daily US Dollar/Swiss Franc exchange rate in units of pips

Figure 2 plots the Relative Strength Index (RSI) computed from the daily exchange rate. RSI was computed based on the past 14 time periods, which is a time period length commonly used in practice. The figure shows that RSI, during this decade for USD/CHF exchange rate, can go occasionally as high as 90 or above, or 10 or below, which is considered rather extreme. If we consider the times when RSI goes above 80 or below 20, there are more of these cases, but still not very common. Just from a visual inspection of the figure, in the majority of the observations, RSI is indeed between 30 and 70, which is consistent with the conventional wisdom that an RSI below 30 or above 70 represents oversold or overbought conditions and therefore are buying or selling opportunities.
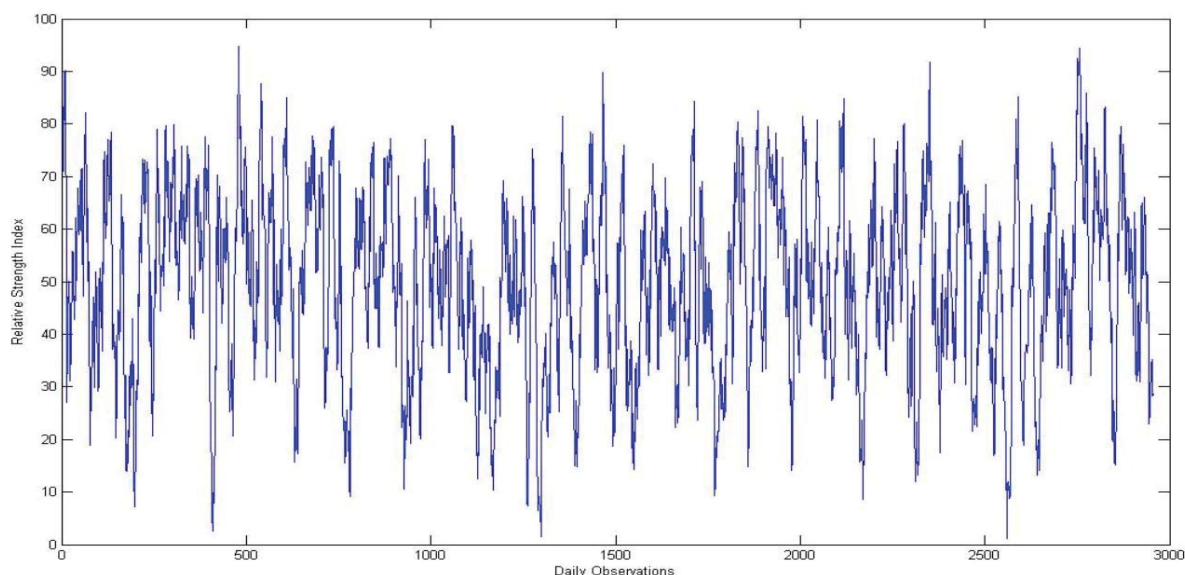
Fig. 2. The Relative Strength Index (RSI) technical indicator for the daily US Dollar/Swiss Franc exchange rate.

However, if one buys when RSI reaches 30 and sells when RSI reaches 70, as conventional wisdom dictates, will that be a profitable trading strategy? We investigate.

We start with Observation 15, the first observation where RSI is available and computed, and progress over time observation by observation. The first time we encounter an RSI value that is 30 or below, or 70 or above, a buy or sell transaction is carried out. For example, without loss of generality, the first such RSI we encounter is 70 or above, and we sell at the price corresponding to that RSI, creating a short position. Once such an open position is created, it can only be closed when an opposite trading signal is encountered. Continuing with our example, once we have a short position, the position will remain open until we encounter an RSI that is 30 or below, when we close the short position at the corresponding exchange rate, book the profit or loss, then also open a long position at that same exchange rate. The long position won't be closed until an RSI that is 70 or above is encountered, when we close the long position at the exchange rate at that time, book the profit or loss, then also open a short position at that same exchange rate. And the process goes on and on. The last open position, because it cannot be closed based on the data we have, will not count either as a profit or a loss. The way profit or loss is booked is simply take the difference in pips of the entry and exit points. For example, if we long at 1.5000 and close the position at 1.5145, that is a profit of 145 pips. If we long at 1.5000 and close the position at 1.4000, that is a loss of 1000 pips.

Results

The trading simulation with RSI at 30 and 70 being the buy/sell threshold comes back disappointing. The total profit is -3009 pips, or in other words a loss of

3009 pips. If we count opening a position and then later closing that same position as a trade, there are 53 trades in total. The trade with the biggest loss has a loss of 1702 pips.

The RSI as a technical indicator was first published by Wilder in 1978. For more than three decades, the investment community has been using it, most commonly with 30 and 70 being the buy/sell threshold. It is not surprising that an indicator that has been known for so long and has been used so widely can no longer give one any edge in trading.

But would it be possible for a different threshold combination to still be generating trading profits? We experiment with 20/80 first.

The trading simulation with RSI at 20 and 80 being the buy/sell threshold comes back with a small profit. The total profit is 2387 pips. If we count opening a position and then later closing that same position as a trade, there are 23 trades in total. The trade with the biggest loss has a loss of a staggering 2442 pips, which is even bigger than the total profit. This parameter combination is eventually a bit profitable, however. One has to be able to stomach quite a bit of loss in order to reach that eventual profit. The reduced number of trades is because the threshold for trading is now higher than the previous case of 30/70, and therefore less trades meet the standard and are carried out.

We move one step further in the same direction, and try the 10/90 combination next. The trading simulation with RSI at 10 and 90 being the buy/sell threshold comes back with an even smaller profit. The total profit is 1094 pips. There are only 6 trades in total. The trade with the biggest loss has a loss of 3622 pips, which is even bigger than that of the 20/80 parameter combination.

Given the degeneration of performance when we move from the 20/80 parameter combination to the 10/90 parameter combination, we naturally decide to go the other way and try 40/60 instead.

Surprisingly, the trading simulation with RSI at 40 and 60 being the buy/sell threshold performs the best among all the parameter combinations we have tested so far. The total profit is 5206 pips. There are 125 trades in total. The trade with the biggest loss has a loss of 1876 pips.

To be complete, and to give us an idea about the parameter stability in terms of profitability, we investigate the cases in between, too. The first of these cases is the 35/65 parameter combination. The total profit is 6621 pips. There are 93 trades in total. The trade with the biggest loss has a loss of 1461 pips. The second of these intermediate cases is the 25/75 parameter combination. For this case, the total profit is 863 pips. There are 41 trades in total. The trade with the biggest loss has a loss of 1380 pips. It is interesting that the famous and widely used 30/70 parameter combination generates a loss, but a little bit above and a little below that, they are both profitable cases. We suspect this is exactly because that the 30/70 parameter combination is so famous and so widely used. When a market inefficiency is known and exploited by many for a long period of time, the very activities of making profit off this market inefficiency tend to reduce the market inefficiency itself, and eventually remove the profit opportunity. It has to be this way. Otherwise, if a market inefficiency can be used by many people to make as much money as they please, and the market inefficiency and the profit opportunity never reduces or disappears, it would have become an infinite fountain of free wealth, which exists only in myth, not in reality.

To complete our investigation, we carry out trading simulation with RSI at 15 and 85 being the buy/sell threshold. It is also a profitable case. The total profit is 4616 pips. There are 10 trades in total. The trade with the biggest loss has a loss of 1946 pips.

Conclusion and recommendation

The significance of the findings in this paper is two-folded. On one hand, we find that for the past decade or so, using the standard configuration of RSI $< = 30$ and RSI $> = 70$ as buy or sell threshold, RSI offers no trading profit, but a small loss instead. Once a technical indicator is well known and a standard parameter configuration for the technical indicator is well used in practice, its profitability diminishes.

However, there is hope left. As the rest of our findings indicate, when the buy/sell threshold parameters are altered, to deviate from the combination most commonly used, using RSI as the trading signal still yields profits.

This is merely an initial investigation of the Relative Strength Index. Much more can be possibly done in subsequent studies. For example, the same trading simulation can be carried out on price data in the stock or the futures markets. It is also possible for more complicated trading rules to be derived based on RSI, but not completely dependent on the RSI. For example, we could use RSI as a threshold to open a position, but once a position is opened, a trailing stop loss order, rather than another RSI threshold, will be used for determining when to close the position.

For practitioners, the recommendation coming out of this study is to take the path less travelled. What is already commonly known and commonly used hardly offers any opportunity for profit any more. However, even for an indicator as widely known as the RSI, altering parameter configuration to an uncommon combination still finds profits that have yet to be discovered and picked up.

For academics, this study has implications on the theory of market efficiency. What can be seen from this study is that the market is neither completely efficient, nor persistently inefficient, but rather an entity that learns and adapts, and gradually becomes more efficient but never absolutely and perfectly efficient. Each and every participant in the market learns and adapts in this way. The market is just an aggregate of its participants. Why should not the market behave in this way too?

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