

time zones. The other one can be finding statistical tests, if there exist, those adjust sample sizes.

2. Instruments of technical analysis like candlestick patterns and all other tools are not profitable all the times (even in the case using combined states). Based on mathematical expectation if the amount of probability was more than 50%, total result can be a profit, instead of a loss. More probability eventuate to a higher profit level. It is impossible to reach to a 100% solution, so technical analysts try to find entering points with an acceptable and logical probability. Thus considering a 95% or even a 90% confidence level cannot be a very good criterion to test profitability of results. It is strongly recommended to consider lower levels of confidence like 80% or even 70% to have more reliable results.
3. All the patterns mentioned in this dissertation are reversal patterns. It is recommended to analyze other reversal and continues patterns realizing whether or not they are profitable.
4. Three different scenarios are analyzed based on three next candles after the each pattern. It is recommended to consider more candles after the pattern and analyze profit or loss to them.

References

- Bigalow Stephan W., "Profitable Candlestick Trading", Wiley Publishing, Inc., 2002
- Goo Yeong-Jia, Chen Dar-Hsin, C Yi-Wei, "The Application of Japanese Candlesticks, Trading Strategies in Taiwan", Investment Management and Financial Innovations, Volume 4, 2007
- Nison Steve, "Japanese Candlestick Charting Techniques", New York Institute of Finance, 1991
- Purdy David Matthew, "A Framework to Evaluate and Trade the FOREX Market", MS dissertation, University of New York Institution of Technology, Utica/Rome, 2009
- Rhoads Rossel, "Candlestick Charting for Dummies", Wiley Publishing, Inc., 2008
- Schwager Jack D., "Getting Started in Technical Analysis", Wiley, 1999

patterns, except this point that pattern 7 has a better result in daily data and a worse result in hourly data in all the scenarios.

8. Conclusions

Major Hypothesis, A:

On the basis of minor hypotheses, there is not any evidence that we can say “various candlestick patterns predict candles and trends in Foreign Exchange Market effectively”, so we can reject this main hypothesis.

As it is shown in exhibits 19 (the 2nd scenario), and 22 (the 3rd scenario) the success rates of correct prediction of the next candle after a confirmed pattern is almost insignificant in all cases. We can conclude that “a reversal pattern does not proceed by a confirmed candle” in all mentioned patterns, so all these hypotheses are rejected.

According exhibits 20 and 23, the profit is significant in many cases, especially about 4-hourly and hourly data. This meaningful profit include all patterns. It can be said that “the profit of trading after all mentioned confirmed patterns is significantly profitable”.

Major Hypothesis, B:

Although the success rates of correct prediction of the next candle after a confirmed pattern is almost insignificant in all cases, but the profit of trading after this confirmation can be significant. We can conclude that a confirmed pattern could be profitable in all mentioned patterns.

Marshal (2005) in his paper “Candlesticks Technical Trading Strategies: Can They Create Value for Investors?” finds that technical trading strategies are not profitable once transaction costs and risk are taken into account, and that which finds that profitability of these strategies is robust to those adjustments. By using an innovative extension of the bootstrap methodology, which allows the generation of random open, high, low and close prices, to test the profitability of candlestick technical trading strategies, he showed that candlestick technical analysis does not have value. Although this conclusion is consistent with the first hypothesis of our research, but the findings of this research are based on statistical tests of historical data. Moreover the second hypothesis shows that in the case of first candle confirmation after a specific trend, the profit of trading can be significant.

Suggestions and Areas for Further Research

1. Some patterns were found very rarely in longer-term time zones. This eventuate to very low sample sizes, so the value of statistics were infected to lower extents. As a result many of the hypotheses were rejected in longer-term time spans in almost all confidence levels. While in shorter-term time zones (4-hourly and hourly data) the number of found patterns were much further, so the statistics were larger figures and many of the tests were significant in different confidence levels. This problem can have some solutions. One of them can be using lower confidence levels in longer time zones such as 80% or less, or vice versa, larger confidence levels in shorter

Pattern			1	2	3	4	5	6	7	8	9
Daily	EURUSD	1%	0	0	0	-	-	0	0	0	0
		5%	0	0	0	-	-	0	0	0	0
		10%	0	0	0	-	-	0	0	0	0
	GBPUSD	1%	0	0	1	0	0	0	0	0	1
		5%	1	0	1	1	0	0	1	1	1
		10%	1	0	1	1	0	0	1	1	1
	USDJPY	1%	-	0	-	-	0	0	1	0	0
		5%	-	0	-	-	1	0	1	0	0
		10%	-	0	-	-	1	0	1	0	0
4-Hourly	EURUSD	1%	1	0	1	0	0	1	1	1	1
		5%	1	0	1	0	0	1	1	1	1
		10%	1	0	1	0	0	1	1	1	1
	GBPUSD	1%	0	1	1	0	0	1	1	1	0
		5%	0	1	1	0	0	1	1	1	0
		10%	0	1	1	0	1	1	1	1	0
	USDJPY	1%	1	1	1	0	0	1	1	1	0
		5%	1	1	1	0	0	1	1	1	0
		10%	1	1	1	0	0	1	1	1	0
Hourly	EURUSD	1%	0	0	0	0	1	1	1	1	1
		5%	0	0	0	0	1	1	1	1	1
		10%	0	0	0	0	1	1	1	1	1
	GBPUSD	1%	1	1	1	1	1	0	1	1	1
		5%	1	1	1	1	1	0	1	1	1
		10%	1	1	1	1	1	0	1	1	1
	USDJPY	1%	0	1	1	1	1	1	0	1	1
		5%	0	1	1	1	1	1	0	1	1
		10%	0	1	1	1	1	1	0	1	1

Exhibit 23: meaningfulness of profit (after confirmation)

According to exhibit 9 the rate of success after the first candle (in the 1st scenario) is not significant almost in all the time zones and about all patterns. Exhibits 13 and 16 show that this rate is significant in none of the time zones after the second and third candles (in the 2nd and 3rd scenario), thus it is obvious that “a candle with an inverted color does not proceed by any mentioned patterns”. All the hypotheses A1 to A9 are rejected.

As it is shown in exhibits 11 (the 1st scenario), 14 (the 2nd scenario) and 17 (the 3rd scenario) the profit is sometimes significant and sometimes insignificant. The profits of hourly USDJPY (the 1st scenario) are almost significant about all patterns except patterns 7 and 8. On the other hand the profits after patterns 6 and 7 are significant in daily data of all currency-pairs. There is not obvious different in various time zones and

B. Meaningfulness of ‘Success Rates’ (After a Confirmation)

The figures in the previous exhibit are tested whether or not they are significant. Those have been tested in three different confidence levels (90%, 95%, and 99%). The figure ‘0’ represent if the result is not meaningful and ‘1’ represent if the result is meaningful. The hyphen sign was intercalated when the result was not possible (exhibit 22). For example as it is shown, the success rates is significant in daily data of GBPUSD, after pattern 9 in 90% of confidence level.

Pattern			1	2	3	4	5	6	7	8	9
Daily	EURUSD	1%	0	0	0	0	0	0	0	0	0
		5%	0	0	0	0	0	0	0	0	0
		10%	0	0	0	0	0	0	0	0	0
	GBPUSD	1%	0	0	0	0	0	0	0	0	0
		5%	0	0	0	0	0	0	0	0	0
		10%	0	0	0	0	0	0	0	0	1
	USDJPY	1%	0	0	-	0	0	0	0	0	0
		5%	0	0	-	0	0	0	0	0	0
		10%	0	0	-	0	0	0	0	0	0
4-Hourly	EURUSD	1%	0	0	0	0	0	0	0	0	0
		5%	0	0	0	0	0	0	1	0	0
		10%	0	0	0	0	0	0	1	0	0
	GBPUSD	1%	0	0	0	0	0	0	0	0	0
		5%	0	0	0	0	0	0	0	0	0
		10%	0	0	0	1	0	0	0	0	0
	USDJPY	1%	0	0	0	0	0	0	0	0	0
		5%	0	0	0	0	0	0	0	0	0
		10%	0	0	0	0	0	0	0	0	0
Hourly	EURUSD	1%	0	0	0	0	0	0	0	0	0
		5%	0	0	0	0	0	0	0	0	0
		10%	0	0	0	0	0	0	0	0	0
	GBPUSD	1%	0	0	0	0	0	0	0	0	0
		5%	0	0	0	0	0	0	0	0	0
		10%	0	0	0	0	0	0	0	0	0
	USDJPY	1%	0	0	0	0	0	0	0	0	0
		5%	0	0	0	0	0	0	0	0	0
		10%	0	0	0	0	0	0	0	0	0

Exhibit 22: meaningfulness of success rates (after confirmation)

C. Meaningfulness of the Profit (After a Confirmation)

The profit after each confirmed candlestick patterns have been calculated in all currency-pairs. In this scenario this figure is based on the third next candle.

The meaningfulness of the profits to the 3rd next closing price are tested in three confidence levels (90%, 95%, and 99%). The results are listed in the following exhibit (exhibit 23).

The figure ‘0’ represent if the result is not meaningful and ‘1’ represent if the result is meaningful. For example the profit is meaningful in GBPUSD daily data after the candlestick ‘Dark Cloud Cover’ pattern (P9).

Pattern			1	2	3	4	5	6	7	8	9
4-Hourly	EURUSD	1%	0	0	0	0	1	1	0	1	1
		5%	0	0	0	0	1	1	0	1	1
		10%	0	1	0	0	1	1	0	1	1
	GBPUSD	1%	1	0	1	0	0	1	1	1	1
		5%	1	1	1	0	0	1	1	1	1
		10%	1	1	1	0	0	1	1	1	1
	USDJPY	1%	1	1	1	0	1	0	1	1	1
		5%	1	1	1	0	1	0	1	1	1
		10%	1	1	1	1	1	0	1	1	1
Hourly	EURUSD	1%	1	1	1	1	1	1	1	1	1
		5%	1	1	1	1	1	1	1	1	1
		10%	1	1	1	1	1	1	1	1	1
	GBPUSD	1%	1	1	1	1	1	1	1	1	1
		5%	1	1	1	1	1	1	1	1	1
		10%	1	1	1	1	1	1	1	1	1
	USDJPY	1%	1	1	1	1	1	1	1	1	0
		5%	1	1	1	1	1	1	1	1	0
		10%	1	1	1	1	1	1	1	1	0

Exhibit 20: meaningfulness of profit (after confirmation)

Scenario 3

A. Rates of correct prediction of the next candle (After a Confirmation)

Success Rates' of prediction of the third next candle (in the case of confirmation of the first candle) in this scenario are calculated and listed below. One of the most important sign of power of patterns is when the first next candle be a confirmation of trend changing.

As it is shown, in 0% of cases in daily data of EURUSD, the color of the first next candle is predicted correctly after a confirmed 'hammer' pattern (exhibit 21).

Pattern		1	2	3	4	5	6	7	8	9
Daily	EURUSD	0%	25%	33%	100%	100%	25%	50%	50%	50%
	GBPUSD	75%	50%	80%	67%	0%	11%	45%	50%	100%
	USDJPY	100%	0%	0%	100%	67%	50%	71%	0%	25%
4-Hourly	EURUSD	71%	38%	50%	25%	20%	56%	81%	47%	73%
	GBPUSD	50%	50%	43%	100%	67%	41%	46%	56%	55%
	USDJPY	50%	50%	75%	0%	25%	48%	63%	43%	43%
Hourly	EURUSD	40%	41%	37%	14%	50%	53%	52%	51%	49%
	GBPUSD	50%	47%	51%	39%	55%	43%	52%	56%	53%
	USDJPY	38%	63%	53%	68%	71%	43%	39%	51%	63%

Exhibit 21: rates of correct prediction of the next candle (after confirmation)

Pattern			1	2	3	4	5	6	7	8	9
4-Hourly	EURUSD	1%	0	0	0	0	0	0	0	0	0
		5%	0	0	0	0	0	0	0	0	0
		10%	0	0	0	0	0	0	0	0	0
	GBPUSD	1%	0	0	0	0	0	0	0	0	0
		5%	0	0	0	0	0	0	0	0	0
		10%	0	0	0	1	0	0	0	0	0
	USDJPY	1%	0	0	0	0	0	0	0	0	0
		5%	0	0	0	0	0	0	0	0	0
		10%	0	0	0	0	0	0	0	0	0
Hourly	EURUSD	1%	0	0	0	0	0	0	0	0	0
		5%	0	0	0	0	0	0	0	0	0
		10%	0	0	0	0	0	0	0	0	0
	GBPUSD	1%	0	0	0	0	0	0	0	0	0
		5%	0	0	0	0	0	0	0	0	0
		10%	0	0	0	0	0	0	0	0	0
	USDJPY	1%	0	0	0	0	0	0	0	0	0
		5%	0	0	0	0	0	0	0	0	0
		10%	0	0	0	0	0	0	0	0	0

Exhibit 19: meaningfulness of success rates (after confirmation)

A. Meaningfulness of the Profit (After a Confirmation)

The profit after each confirmed candlestick patterns have been calculated in all currency-pairs. In this scenario this figure is based on the second next candle.

The meaningfulness of the profits to the 2nd next closing price are tested in three confidence levels (90%, 95%, and 99%). The results are listed in the following exhibit (exhibit 20).

The figure ‘0’ represent if the result is not meaningful and ‘1’ represent if the result is meaningful. For example the profit is meaningful in EURUSD daily data after the first candlestick ‘bullish engulfing’ pattern (P6).

Pattern			1	2	3	4	5	6	7	8	9
Daily	EURUSD	1%	0	0	0	-	-	1	1	0	0
		5%	0	1	0	-	-	1	1	0	1
		10%	0	1	0	-	-	1	1	0	1
	GBPUSD	1%	0	0	0	0	0	1	1	1	0
		5%	0	0	0	1	0	1	1	1	1
		10%	0	0	0	1	0	1	1	1	1
	USDJPY	1%	0	0	0	0	0	1	1	0	0
		5%	0	1	0	0	0	1	1	0	0
		10%	0	1	0	0	0	1	1	0	0

as a successful one. In this part only the confirmed cases are analyzed in two different scenarios. It is obvious that the first scenario can be eliminated because the first candle has been used as the confirmation sign.

Scenario 2

A. Rates of correct prediction of the next candle (After Confirmation)

'Success Rates' of prediction of the second next candle (in the case of confirmation of the first candle) in this scenario are calculated and listed below. As it is shown, in 33% of cases in daily data of EURUSD, the color of the second next candle is predicted correctly after a 'hammer' pattern that pursued by a confirmation candle (exhibit 18).

Pattern		1	2	3	4	5	6	7	8	9
Daily	EURUSD	33%	50%	33%	100%	0%	63%	60%	0%	50%
	GBPUSD	25%	50%	20%	67%	50%	67%	64%	100%	67%
	USDJPY	0%	100%	0%	100%	33%	63%	43%	50%	0%
4-Hourly	EURUSD	43%	63%	30%	25%	60%	44%	32%	59%	67%
	GBPUSD	50%	50%	29%	100%	0%	41%	46%	52%	64%
	USDJPY	67%	30%	42%	50%	75%	43%	48%	71%	50%
Hourly	EURUSD	51%	50%	51%	57%	44%	50%	47%	49%	51%
	GBPUSD	53%	57%	47%	39%	68%	46%	40%	50%	47%
	USDJPY	49%	47%	47%	58%	48%	47%	47%	47%	34%

Exhibit 18: rates of correct prediction of the next candle (after confirmation)

B. Meaningfulness of 'Success Rates' (After a Confirmation)

The figures in the previous exhibit are tested whether they are significant. Those have been tested in three different confidence levels (90%, 95%, and 99%). The figure '0' represent if the result is not meaningful and '1' represent if the result is meaningful. The hyphen sign was intercalated when the result was not possible (exhibit 19). For example as it is shown, the success rates is significant in daily data of GBPUSD, after pattern 8 in 95% and 90% of confidence levels.

Pattern			1	2	3	4	5	6	7	8	9	
Daily	EURUSD	1%	0	0	0	0	0	0	0	0	0	
		5%	0	0	0	0	0	0	0	0	0	
		10%	0	0	0	0	0	0	0	0	0	
	GBPUSD	1%	0	0	0	0	0	0	0	0	0	
		5%	0	0	0	0	0	0	0	0	1	0
		10%	0	0	0	0	0	0	0	0	1	0
	USDJPY	1%	0	0	-	0	0	0	0	0	0	0
		5%	0	0	-	0	0	0	0	0	0	0
		10%	0	1	-	0	0	0	0	0	0	0

The meaningfulness of the profits to the 3rd next closing price are tested in three confidence levels (90%, 95%, and 99%). The results are listed in the following exhibit (exhibit 17).

The figure ‘0’ represent if the result is not meaningful and ‘1’ represent if the result is meaningful. For example the profit is meaningful in GBPUSD daily data after the third candlestick ‘Piercing’ pattern (P8).

Pattern			1	2	3	4	5	6	7	8	9
Daily	EURUSD	1%	0	0	0	0	0	0	0	0	0
		5%	0	0	0	0	0	0	0	0	0
		10%	0	0	0	1	0	0	0	1	0
	GBPUSD	1%	0	0	0	1	0	0	0	1	0
		5%	0	0	0	1	0	0	1	1	0
		10%	0	0	0	1	0	0	1	1	0
	USDJPY	1%	1	0	0	0	0	0	1	0	0
		5%	1	0	0	1	1	0	1	0	0
		10%	1	0	0	1	1	0	1	0	0
4-Hourly	EURUSD	1%	0	0	1	0	0	0	1	0	1
		5%	0	0	1	0	0	0	1	0	1
		10%	0	0	1	0	0	0	1	0	1
	GBPUSD	1%	0	0	0	1	0	0	0	1	0
		5%	0	0	0	1	0	0	0	1	0
		10%	0	0	1	1	0	0	0	1	0
	USDJPY	1%	1	0	1	0	0	1	1	1	0
		5%	1	0	1	0	0	1	1	1	0
		10%	1	0	1	0	0	1	1	1	0
Hourly	EURUSD	1%	0	0	1	0	0	0	0	0	1
		5%	0	0	1	0	0	0	0	0	1
		10%	0	0	1	0	0	0	0	0	1
	GBPUSD	1%	1	1	1	1	0	0	0	1	1
		5%	1	1	1	1	0	0	0	1	1
		10%	1	1	1	1	0	0	0	1	1
	USDJPY	1%	0	1	1	1	1	0	0	0	1
		5%	0	1	1	1	1	0	0	0	1
		10%	0	1	1	1	1	0	0	0	1

Exhibit 17: meaningfulness of the profit

Hypothesis B

One of the most important sign of power of a specific pattern is when the first next candle be a confirmation of trend changing. It means some traders do not enter just after observing a specific pattern. They pursue the color of the next candle. If the next candle has a reversal color they take a suitable position, else they do not consider that pattern

a. Meaningfulness of ‘Success Rates’

The figures in the previous exhibit are tested whether or not they are significant. Those have been tested in three different confidence levels (90%, 95%, and 99%). The figure ‘0’ represent if the result is not meaningful and ‘1’ represent if the result is meaningful (exhibit 16).

For example as it is shown, the success rates is not significant in any of the daily data of EURUSD, GBPUSD, and USDJPY after all nine patterns in none of the confidence levels.

Pattern			1	2	3	4	5	6	7	8	9
Daily	EURUSD	1%	0	0	0	0	0	0	0	0	0
		5%	0	0	0	0	0	0	0	0	0
		10%	0	0	0	0	0	0	0	0	0
	GBPUSD	1%	0	0	0	0	0	0	0	0	0
		5%	0	0	0	0	0	0	0	0	0
		10%	0	0	0	0	0	0	0	0	0
	USDJPY	1%	0	0	0	0	0	0	0	0	0
		5%	0	0	0	0	0	0	0	0	0
		10%	0	0	0	0	0	0	0	0	0
4-Hourly	EURUSD	1%	0	0	0	0	0	0	0	0	0
		5%	0	0	0	0	0	0	0	0	0
		10%	0	0	0	0	0	0	0	0	0
	GBPUSD	1%	0	0	0	0	0	0	0	0	0
		5%	0	0	0	0	0	0	0	0	0
		10%	0	0	0	0	0	0	0	0	0
	USDJPY	1%	0	0	0	0	0	0	0	0	0
		5%	0	0	0	0	0	0	0	0	0
		10%	0	0	0	0	0	0	0	0	0
Hourly	EURUSD	1%	0	0	0	0	0	0	0	0	0
		5%	0	0	0	0	0	0	0	0	0
		10%	0	0	0	0	0	0	0	0	0
	GBPUSD	1%	0	0	0	0	0	0	0	0	0
		5%	0	0	0	0	0	0	0	0	0
		10%	0	0	0	0	0	0	0	0	0
	USDJPY	1%	0	0	0	0	0	0	0	0	0
		5%	0	0	0	0	0	0	0	0	0
		10%	0	0	0	0	0	0	0	0	0

Exhibit 16: Meaningfulness of ‘success rates’

b. Meaningfulness of the Profit

The profit after each candlestick patterns have been calculated in all currency-pairs. In this scenario this figure is based on the third next candle.

Pattern			1	2	3	4	5	6	7	8	9
Daily	EURUSD	1%	0	0	0	1	0	0	1	0	0
		5%	0	0	0	1	0	0	1	0	1
		10%	0	0	0	1	0	0	1	0	1
	GBPUSD	1%	0	0	0	1	1	1	1	1	0
		5%	0	0	0	1	1	1	1	1	0
		10%	0	0	0	1	1	1	1	1	0
	USDJPY	1%	0	1	1	0	1	1	0	1	0
		5%	0	1	1	0	1	1	0	1	0
		10%	0	1	1	0	1	1	0	1	0
4-Hourly	EURUSD	1%	0	1	0	0	0	0	0	0	1
		5%	0	1	0	0	0	0	0	0	1
		10%	0	1	0	0	0	0	0	0	1
	GBPUSD	1%	0	0	1	0	1	0	0	1	1
		5%	0	0	1	0	1	0	0	1	1
		10%	0	0	1	0	1	0	0	1	1
	USDJPY	1%	1	1	0	0	0	0	0	1	1
		5%	1	1	0	0	0	0	0	1	1
		10%	1	1	0	0	0	0	0	1	1
Hourly	EURUSD	1%	0	1	1	0	1	0	0	1	0
		5%	0	1	1	0	1	0	0	1	0
		10%	0	1	1	0	1	0	0	1	0
	GBPUSD	1%	1	1	0	0	1	0	0	1	1
		5%	1	1	0	0	1	0	0	1	1
		10%	1	1	0	0	1	0	0	1	1
	USDJPY	1%	0	1	1	0	1	1	0	1	0
		5%	0	1	1	0	1	1	0	1	0
		10%	0	1	1	0	1	1	0	1	0

Exhibit 14: meaningfulness of the profit

Scenario 3

a. Rates of correct prediction of the next candle

‘Success Rates’ of prediction of the next candle in this scenario are calculated and listed below. As it is shown, in 25% of cases in daily data of EURUSD, the color of the third next candle is predicted correctly after a ‘hammer’ pattern (exhibit 15).

%Success		hammer	engulfing	Marubozu	Legged	average	stochastic	Dog	only	Doji	Engulfing	Shen	Engulfing	Pat	CI	ou	d
Daily	EURUSD	25%	25%	33%	100%	67%	31%	45%	67%	33%							
	GBPUSD	43%	50%	60%	60%	0%	20%	47%	50%	60%							
	USDJPY	80%	33%	67%	100%	50%	50%	71%	38%	43%							
4-Hourly	EURUSD	52%	39%	57%	20%	33%	47%	60%	46%	65%							
	GBPUSD	55%	47%	43%	60%	67%	44%	48%	44%	48%							
	USDJPY	52%	40%	52%	14%	31%	50%	62%	50%	30%							
Hourly	EURUSD	43%	46%	54%	37%	45%	51%	50%	47%	51%							
	GBPUSD	53%	51%	54%	45%	58%	57%	51%	55%	52%							
	USDJPY	44%	55%	51%	59%	73%	46%	46%	51%	61%							

Exhibit 15: rates of correct prediction of the third next candle

Pattern			1	2	3	4	5	6	7	8	9
Daily	EURUSD	1%	0	0	0	0	0	0	0	0	0
		5%	0	0	0	0	0	0	0	0	0
		10%	0	0	0	0	0	0	0	0	0
	GBPUSD	1%	0	0	0	0	0	0	0	0	0
		5%	0	0	0	0	0	0	0	0	0
		10%	0	0	0	0	0	0	0	0	0
	USDJPY	1%	0	0	0	0	0	0	0	0	0
		5%	0	0	0	0	0	0	0	0	0
		10%	0	0	0	0	0	0	0	0	0
4-Hourly	EURUSD	1%	0	0	0	0	0	0	0	0	0
		5%	0	0	0	0	0	0	0	0	0
		10%	0	0	0	0	0	0	0	0	0
	GBPUSD	1%	0	0	0	0	0	0	0	0	0
		5%	0	0	0	0	0	0	0	0	0
		10%	0	0	0	0	0	0	0	0	0
	USDJPY	1%	0	0	0	0	0	0	0	0	0
		5%	0	0	0	0	0	0	0	0	0
		10%	0	0	0	0	0	0	0	0	0
Hourly	EURUSD	1%	0	0	0	0	0	0	0	0	0
		5%	0	0	0	0	0	0	0	0	0
		10%	0	0	0	0	0	0	0	0	0
	GBPUSD	1%	0	0	0	0	0	0	0	0	0
		5%	0	0	0	0	0	0	0	0	0
		10%	0	0	0	0	0	0	0	0	0
	USDJPY	1%	0	0	0	0	0	0	0	0	0
		5%	0	0	0	0	0	0	0	0	0
		10%	0	0	0	0	0	0	0	0	0

Exhibit 13: Meaningfulness of ‘success rates’

c. Meaningfulness of the Profit

The profit after each candlestick patterns have been calculated in all currency-pairs. In this scenario this figure is based on the second next candle.

The meaningfulness of the profits to the 2nd next closing price are tested in three confidence levels (90%, 95%, and 99%). The results are listed in the following exhibit (exhibit 14).

The figure ‘0’ represent if the result is not meaningful and ‘1’ represent if the result is meaningful. For example the profit is meaningful in EURUSD daily data to the second closing price after a candlestick ‘bearish engulfing’ pattern (P7).

Pattern			1	2	3	4	5	6	7	8	9	
Hourly	EURUSD	1%	0	1	0	0	0	0	0	0	0	
		5%	0	1	0	0	0	0	0	0	0	
		10%	0	1	0	0	0	0	0	0	0	
	GBPUSD	1%	0	0	1	1	1	1	1	0	1	1
		5%	0	0	1	1	1	1	1	0	1	1
		10%	0	0	1	1	1	1	1	0	1	1
	USDJPY	1%	1	1	1	1	1	1	1	0	0	1
		5%	1	1	1	1	1	1	1	0	0	1
		10%	1	1	1	1	1	1	1	0	0	1

Exhibit 11: meaningfulness of the profit

Scenario 2

a. Rates of correct prediction of the next candle

‘Success Rates’ of prediction of the next candle in this scenario are calculated and listed below. As it is shown, in 50% of cases in daily data of EURUSD, the color of the second next candle is predicted correctly after a ‘hammer’ pattern (exhibit 12)

%Success		P1	P2	P3	P4	P5	P6	P7	P8	P9
Daily	EURUSD	50%	50%	33%	100%	50%	56%	60%	0%	50%
	GBPUSD	29%	50%	20%	60%	67%	67%	58%	75%	60%
	USDJPY	20%	67%	67%	50%	50%	50%	50%	75%	29%
4-Hourly	EURUSD	48%	67%	24%	40%	58%	43%	42%	43%	59%
	GBPUSD	45%	47%	52%	80%	56%	49%	44%	49%	62%
	USDJPY	65%	45%	48%	43%	62%	47%	37%	69%	52%
Hourly	EURUSD	51%	55%	52%	50%	52%	50%	50%	53%	48%
	GBPUSD	53%	53%	49%	42%	64%	50%	44%	56%	51%
	USDJPY	50%	63%	51%	53%	55%	51%	47%	53%	44%

Exhibit 12: rates of correct prediction of the next candle

b. Meaningfulness of ‘Success Rates’

The figures in the previous exhibit are tested whether or not they are significant. Those have been tested in three different confidence levels (90%, 95%, and 99%). The figure ‘0’ represent if the result is not meaningful and ‘1’ represent if the result is meaningful. (Exhibit13)

For example as it is shown, the success rates is not significant in any of the daily data of EURUSD, GBPUSD, and USDJPY after all nine patterns in none of the confidence levels.

EURUSD-H1		P1	P2	P3	P4	P5	P6	P7	P8	P9
Candle 1	Prft Ave.	-0.01587	0.00652	-0.00535	-0.00249	0.00004	-0.05038	-0.02563	-0.05203	-0.01414
	stdev	0.00137	0.00142	0.00252	0.00158	0.00161	0.00198	0.00195	0.00202	0.00217
	Stat	-108.36	41.9374	-20.2253	-8.60932	0.1429	-483.863	-246.803	-363.177	-84.9735
Candle 2	Prft Ave.	-0.01792	0.03075	0.05456	-0.01149	0.00323	-0.04265	-0.05544	0.02460	-0.00429
	stdev	0.00208	0.00214	0.00461	0.00244	0.00134	0.00305	0.00279	0.00303	0.00320
	Stat	-80.8788	131.389	112.914	-25.7996	13.8356	-266.703	-372.469	114.505	-17.4587
Candle 2	Prft Ave.	-0.04481	-0.02614	0.02460	-0.03320	-0.00559	-0.07184	-0.07921	-0.00354	0.03973
	stdev	0.00231	0.00242	0.00495	0.00247	0.00203	0.00370	0.00347	0.00366	0.00411
	Stat	-181.784	-98.8258	47.3859	-73.5912	-15.8313	-369.576	-427.258	-13.6289	125.969

Exhibit 10: a part of profit

These figures are for daily EURUSD in all patterns. In the first part the first next candle is the basis of calculations. The second and third parts are related to the calculations of profit/loss to the second and third next candles.

There are three rows in each part. The first row shows the amount of profit and loss. The second row shows ‘standard deviation’ of profits and losses. In the third row, the statistic is calculated based on amount of profit or loss, standard deviation, and the sample size. This statistic has been compared with three P-Values of 1%, 5%, and 10%. The meaningfulness of profits to the next closing price are tested in three confidence levels (90%, 95%, and 99%). The results are listed in the following exhibit (exhibit 11).

The figure ‘0’ represent if the result is not meaningful and ‘1’ represent if the result is meaningful. For example the profit is meaningful in EURUSD daily data after a candlestick ‘hammer’ pattern.

Pattern			1	2	3	4	5	6	7	8	9
Daily	EURUSD	1%	1	0	0	0	0	1	1	0	0
		5%	1	0	1	0	0	1	1	0	0
		10%	1	0	1	0	0	1	1	1	1
	GBPUSD	1%	0	0	1	1	0	1	1	0	0
		5%	0	0	1	1	0	1	1	0	1
		10%	0	0	1	1	0	1	1	0	1
	USDJPY	1%	0	0	0	0	1	0	1	0	1
		5%	0	0	0	0	1	1	1	0	1
		10%	0	0	0	0	1	1	1	0	1
4-Hourly	EURUSD	1%	0	0	1	1	0	0	0	1	0
		5%	0	0	1	1	0	0	0	1	0
		10%	0	0	1	1	0	0	0	1	0
	GBPUSD	1%	1	0	0	0	0	1	0	1	1
		5%	1	0	0	0	0	1	1	1	1
		10%	1	0	0	0	0	1	1	1	1
	USDJPY	1%	0	0	1	0	0	1	0	0	0
		5%	0	0	1	0	0	1	0	0	0
		10%	0	0	1	0	0	1	0	0	0

Pattern			1	2	3	4	5	6	7	8	9
Daily	EURUSD	1%	0	0	0	0	0	0	0	0	0
		5%	0	0	0	0	0	0	0	0	0
		10%	0	0	1	0	0	0	0	0	0
	GBPUSD	1%	0	0	0	0	0	0	0	0	0
		5%	0	0	0	0	0	0	0	0	0
		10%	0	0	0	0	0	0	0	0	0
	USDJPY	1%	0	0	0	0	0	0	0	0	0
		5%	0	0	0	0	0	0	0	0	0
		10%	0	0	0	0	0	0	0	0	0
4-Hourly	EURUSD	1%	0	0	0	0	0	0	0	0	0
		5%	0	0	0	0	0	0	0	0	0
		10%	0	0	0	0	0	0	0	0	0
	GBPUSD	1%	0	0	0	0	0	0	0	0	0
		5%	0	0	0	0	0	0	0	0	0
		10%	0	0	0	0	0	0	0	0	0
	USDJPY	1%	0	0	0	0	0	0	0	0	0
		5%	0	0	0	0	0	0	0	0	0
		10%	0	0	0	0	0	0	0	0	0
Hourly	EURUSD	1%	0	0	0	0	0	0	0	0	0
		5%	0	0	0	0	0	0	0	0	0
		10%	0	0	0	0	0	0	0	0	0
	GBPUSD	1%	0	0	0	0	0	0	0	0	0
		5%	0	0	0	0	0	0	0	0	0
		10%	0	0	0	0	0	0	0	0	0
	USDJPY	1%	0	0	0	0	0	0	0	0	0
		5%	0	0	0	0	0	0	0	0	0
		10%	0	0	0	0	0	0	0	0	0

Exhibit 9: Meaningfulness of ‘success rates’

c. Meaningfulness of the Profit

The profit after each candlestick patterns have been calculated in all currency-pairs. In this scenario this figure is based on the first next candle. A part of these figures are shown in the following exhibit (exhibit 10).

SELL Sgnls.	P1	P2	P3	P4	P5	P6	P7	P8	P9
EURUSD-D1	0	8	1	2	0	0	20	0	6
GBPUSD-D1	0	4	3	5	0	0	19	0	5
USDJPY-D1	0	3	0	2	0	0	14	0	7
EURUSD-H4	0	18	7	10	0	0	77	0	37
GBPUSD-H4	0	19	9	5	0	0	80	0	42
USDJPY-H4	0	20	6	7	0	0	90	0	27
EURUSD-H1	0	84	24	30	0	0	351	0	170
GBPUSD-H1	0	92	34	31	0	0	354	0	172
USDJPY-H1	0	67	33	32	0	0	353	0	158

Exhibit 7: Number of observed patterns with a selling signal

7. Findings

Hypothesis A

Scenario 1

a. Rates of correct prediction of the next candle

‘Success Rates’ of prediction of the next candle in this scenario are calculated and listed below (exhibit 8). As it is shown, in 75% of the cases in daily data of EURUSD, the color of the first next candle is predicted correctly after a ‘hammer’ pattern.

Pattern		1	2	3	4	5	6	7	8	9
Daily	EURUSD	75%	50%	100%	50%	17%	50%	50%	67%	67%
	GBPUSD	57%	50%	50%	60%	67%	60%	58%	50%	60%
	USDJPY	20%	67%	0%	50%	75%	50%	50%	25%	57%
4-Hourly	EURUSD	30%	44%	48%	80%	42%	51%	40%	49%	41%
	GBPUSD	60%	32%	33%	20%	33%	48%	44%	60%	52%
	USDJPY	52%	50%	44%	57%	31%	52%	48%	48%	52%
Hourly	EURUSD	51%	55%	47%	47%	55%	41%	48%	48%	50%
	GBPUSD	57%	55%	53%	58%	67%	50%	50%	50%	51%
	USDJPY	50%	48%	51%	59%	53%	46%	49%	49%	55%

Exhibit 8: rates of correct prediction of the next candle

b. Meaningfulness of ‘Success Rates’

The figures in the previous exhibit are tested whether or not they are significant. Those have been tested in three different confidence levels (90%, 95%, and 99%). The figure ‘0’ represent if the result is not meaningful and ‘1’ represent if the result is meaningful (exhibit 9).

For example as it is shown, the profit is not significant in daily data of EURUSD, after a ‘hammer’ pattern (pattern 1) in none of the confidence levels. The only significant profit is about daily EURUSD data, after the third pattern (Long-Leged DOJI) in confidence level of 90%.

position is closed after closing the second and third next candles. All the tests are analyzed in different categories based on these various scenarios.

Abbreviations used in Exhibits

In the exhibits of this part some abbreviations are used. They are listed here (exhibit 3):

P1	Pattern 1, Hammer	P2	Pattern 2, Hanging Man
P3	Pattern 3, Long-Leged DOJI	P4	Pattern 4, Gravestone DOJI
P5	Pattern 5, Dragonfly DOJI		
P6	Pattern 6, Bullish Engulfing	P7	Pattern 7, Bearish Engulfing
P8	Pattern 8, Piercing Pattern	P9	Pattern 9, Dark Cloud Cover

Exhibit 3: The abbreviations used in Exhibits

The following exhibits (exhibit 4) shows the volume of downloaded data of three currency-pairs in three different time-zones.

	daily	4-hourly	hourly
Daily	2605	11593	61950
4-Hourly	2602	11582	61918
Hourly	2602	11581	61929

Exhibit 4: Volume of downloaded data

The number of observed patterns are summarized in the following exhibits (exhibit 5 to 7):

ALL Sgnls.	P1	P2	P3	P4	P5	P6	P7	P8	P9
EURUSD-D1	4	8	3	2	6	16	20	3	6
GBPUSD-D1	7	4	10	5	3	15	19	8	5
USDJPY-D1	5	3	3	2	4	16	14	8	7
EURUSD-H4	23	18	21	10	12	70	77	35	37
GBPUSD-H4	20	19	21	5	9	77	80	45	42
USDJPY-H4	23	20	27	7	13	88	90	58	27
EURUSD-H1	88	84	91	30	33	363	351	199	170
GBPUSD-H1	70	92	81	31	33	375	354	215	172
USDJPY-H1	78	67	142	32	40	408	353	202	158

Exhibit 5: Number of observed patterns

BUY Sgnls.	P1	P2	P3	P4	P5	P6	P7	P8	P9
EURUSD-D1	4	0	2	0	6	16	0	3	0
GBPUSD-D1	7	0	7	0	3	15	0	8	0
USDJPY-D1	5	0	3	0	4	16	0	8	0
EURUSD-H4	23	0	14	0	12	70	0	35	0
GBPUSD-H4	20	0	12	0	9	77	0	45	0
USDJPY-H4	23	0	21	0	13	88	0	58	0
EURUSD-H1	88	0	67	0	33	363	0	199	0
GBPUSD-H1	70	0	47	0	33	375	0	215	0
USDJPY-H1	78	0	109	0	40	408	0	202	0

Exhibit 6: Number of observed patterns with a buying signal

	Candles	Color ₁	Color ₀	RB ₁	RB ₀	LS	US	PT	NT	Other Criteria			Power Indices		
Hammer	1	-	ND	-	Sh	Ln	VS	DT	UT	LS>= 2*RB			Volume		
Hanging Man	1	-	ND	-	Sh	Ln	VS	UT	DT	LS>= 2*RB			Volume		
Doji Long Leged	1	-	ND	-	VS	VL	VL	ND	ND				Volume		
Doji Gravestone	1	-	ND	-	VS	VS	Ln	UT	DT				Volume		
Doji Dragomfly	1	-	ND	-	VS	Ln	VS	DT	UT				Volume		
Bullish Engulfing	2	B	W	-	Ln	ND	ND	DT		C ₁ >=O ₀	O ₁ <C ₀		Volume	2nd Length	1st is short
Bearish Engulfing	2	W	B	-	Ln	ND	ND	UT		C ₁ >=O ₀	O ₁ <C ₀		Volume	2nd Length	1st is short
Piercing Pattern	2	B	W	Ln	Ln	ND	ND	DT		O ₀ <=C ₁	C ₀ >0.5*RB ₁	C ₀ <O ₁	Volume	Length 1st	2nd Length
Dark Cloud Cover	2	W	B	Ln	Ln	ND	ND	UT		O ₀ >=C ₁	C ₀ <0.5*RB ₁	C ₀ >O ₁	Volume	Length 1st	2nd Length

Exhibit1, Properties of Patterns

The abbreviations of the previous table are in exhibit2.

Abbr.	
RB	Real Body
UT	Up Trend
LS	Lower Shadow
US	Upper Shadow
NT	Next Trend
PT	Previous Trend
VS	Very Short
Sh	Short
Md	Medium
Ln	Long
VL	Very Long
H	High
L	Low
C	Close
O	Open
B	Black - Down
W	White- Up
ND	Not Definition

Exhibit2, the Abbreviations

Some criteria used for pattern recognition: length of bodies, length of shadows, comparative lengths of bodies, comparative lengths of shadows, previous trend, and next trend. Percentile indices are used to recognize comparative lengths of bodies and shadows. 10th, 30th, 70th, and 90th percentiles are used to recognize lengths and shadows as “very short”, “short”, “medium”, “long”, and “very long”.

6. Scenario Analysis

After emerging and forming a specific pattern, the trade can be started. The point that the position is closed is also a key factor in calculations of loss and profit of trades. It can be closed after the first, second, or other next candles. In each case the profit and loss can be different, while to define a profitable strategy we must specify the time point of inverse position taking.

As described in the last paragraph, On the other hand, for diagnosis of trend direction one to four previous candles have been used, so I considered the first, second, and the third candles as different possible points for finishing the trades. These three different points have different results, hence I’ve categorized them in three various scenarios and discussed about them separately.

The tests are done in each scenario separately. In the first scenario, the trade starts just right after closing the candle of recognized pattern and closes after closing of the first next candle. The position is taken with regard to some factors like color of candle pattern, direction of pattern, and previous trend. In the second and third scenario the

- B14. The profit of trading after a confirmed pattern of “Doji Dragonfly” is significantly profitable.
- B15. The profit of trading after a confirmed pattern of “Bullish Engulfing” is significantly profitable.
- B16. The profit of trading after a confirmed pattern of “Bearish Engulfing” is significantly profitable.
- B17. The profit of trading after a confirmed pattern of “Piercing Pattern” is significantly profitable.
- B18. The profit of trading after a confirmed pattern of “Dark Cloud Cover” is significantly profitable.

5. Research Methodology

“MetaTrader 4.0” is used for data downloading. In this paper I selected 1H (hourly), 4H (4-hourly), and 1D (daily) data, because firstly most of traders use these time intervals and secondly they include both short-term and long-term periods. Also three major currency pair are selected: EURUSD, USDJPY, and GBPUSD. The forex market is open 24 hours a day from 5pm EST on Sunday until 4pm EST Friday.

In this dissertation, for more accurate result, a vast range of data in each group of time frame are selected. Ten years of daily, every four hours (4-hourly), and hourly data are downloaded through the software. These data start from December 1st, 2002 till November 30th, 2012. It means there are about 2600 daily set of data, 15600 4-hourly, and 62400 hourly set of data include OHLC prices & volume for each EURUSD, GBPUSD, and USDJPY currency-pairs.

First of all the “color of candle body” is determined with regard to closing price of each candle and its opening price. The “length of body” is calculated by subtracting the closing price from the opening price. The “upper shadow” is equal to difference between high price and the upper side of candle body. And the “lower shadow” is calculated by subtracting the low price and the lower shadow of a candle.

For trend recognition the averages of last four closing prices are calculated. If the averages are in an ascending order, there is a bullish trend, vice versa if the averages are in a descending order, there is a bearish trend, and else there is not any trend.

With regard to previous calculations, nine different patterns are identified. The characteristics of each pattern are very critical to recognize them accurately. These characteristics are studied in different candlesticks books. Fortunately most of writers introduce patterns in a same way and mention similar criteria for them. One on the best books in this field is written by Thomas N. Bulkowski, “Encyclopedia of Candlestick Charts”. The summary of properties of these patterns are listed in the following table (Exhibit 1).

- A10. The profit of trading after a pattern of “Hammer” is significantly profitable.
- A11. The profit of trading after a pattern of “Hanging Man” is significantly profitable.
- A12. The profit of trading after a pattern of “Doji Long-Leged” is significantly profitable.
- A13. The profit of trading after a pattern of “Doji Gravestone” is significantly profitable.
- A14. The profit of trading after a pattern of “Doji Dragonfly” is significantly profitable.
- A15. The profit of trading after a pattern of “Bullish Engulfing” is significantly profitable.
- A16. The profit of trading after a pattern of “Bearish Engulfing” is significantly profitable.
- A17. The profit of trading after a pattern of “Piercing Pattern” is significantly profitable.
- A18. The profit of trading after a pattern of “Dark Cloud Cover” is significantly profitable.

- B1. A reversal pattern in Forex proceed by a pattern of “Hammer” that followed by a confirmation candle.
- B2. A reversal pattern in Forex proceed by a pattern of “Hanging Man” that followed by a confirmation candle.
- B3. A reversal pattern in Forex proceed by a pattern of “Doji Long-Leged” that followed by a confirmation candle.
- B4. A reversal pattern in Forex proceed by a pattern of “Doji Gravestone” that followed by a confirmation candle.
- B5. A reversal pattern in Forex proceed by a pattern of “Doji Dragonfly” that followed by a confirmation candle.
- B6. A reversal pattern in Forex proceed by a pattern of “Bullish Engulfing” that followed by a confirmation candle.
- B7. A reversal pattern in Forex proceed by a pattern of “Bearish Engulfing” that followed by a confirmation candle.
- B8. A reversal pattern in Forex proceed by a pattern of “Piercing Pattern” that followed by a confirmation candle.
- B9. A reversal pattern in Forex proceed by a pattern of “Dark Cloud Cover” that followed by a confirmation candle.

- B10. The profit of trading after a confirmed pattern of “Hammer” is significantly profitable.
- B11. The profit of trading after a confirmed pattern of “Hanging Man” is significantly profitable.
- B12. The profit of trading after a confirmed pattern of “Doji Long-Leged” is significantly profitable.
- B13. The profit of trading after a confirmed pattern of “Doji Gravestone” is significantly profitable.

and how each of them contributed to the movement of the price of the above mentioned four Forex pairs. This study has analyzed the daily and 4H prices of the four major pairs (EURUSD, GBPUSD, USDCHF and USDJPY) over a period of 8 years and 6 years respectively, up until 30th April, 2011. It has analyzed two different candlestick patterns and one general technical pattern. Candlestick patterns analyzed include the pin bar and the bearish/bullish engulfing patterns whereas the technical pattern analyzed includes number of successive up moves or down moves. It has analyzed the said patterns on two time frames i.e. on a daily chart and on a 4 hourly chart. This study acknowledged that there is no 100% accurate method of trading the Forex markets. The study was aimed towards understanding the behavioral patterns of price from a trader's perspective. The project extensively used secondary data and inferred certain logical conclusions based on the behavior shown by the data. In end it concluded that the project does accomplish its aim to understand the reasoning behind price moves and lends a credible insightful eye to any trader who wishes to trade successfully in the Foreign Exchange markets.

Ramadhani and Mashaushi (2006) in their paper "An Analysis of Technical Trading Strategies" extends the literature on the efficacy of technical analysis in the direction of the 'risk premium view' as an explanation for excess trading rule returns. The empirical analysis is based mainly on a sample of stocks drawn from the London Stock Exchange, (LSE), portfolios constructed from three US markets; the New York Stock Exchange, (NYSE), the American Stock Exchange, (ASE), and the National Association of Securities Dealers Automated Quotation market, (NASDAQ). Data from ten small emerging markets of Africa is also used in empirical analyses. Focusing on documented evidence of differences in risk levels among several markets or market segments, the empirical analyses examined whether these risk differentials can explain excess trading rule profits as compensation for bearing risk.

4. Hypotheses

Major Hypotheses:

- A. Various candlestick patterns predict candles and trends in Foreign Exchange Market effectively.
- B. Next candle confirmation (after emerging a specific pattern) make us trustful in the pattern.

Minors Hypotheses:

- A1. A candle with an inverted color proceed by a pattern of "Hammer".
- A2. A candle with an inverted color proceed by a pattern of "Hanging Man".
- A3. A candle with an inverted color proceed by a pattern of "Doji Long-Leged".
- A4. A candle with an inverted color proceed by a pattern of "Doji Gravestone".
- A5. A candle with an inverted color proceed by a pattern of "Doji Dragonfly".
- A6. A candle with an inverted color proceed by a pattern of "Bullish Engulfing".
- A7. A candle with an inverted color proceed by a pattern of "Bearish Engulfing".
- A8. A candle with an inverted color proceed by a pattern of "Piercing Pattern".
- A9. A candle with an inverted color proceed by a pattern of "Dark Cloud Cover".

and the next day reveals a long black real body day, opening on its high and closing on its low, then a shaven head and shaven bottom black day have occurred.

3. If the second body (that is, the black body) of the dark-cloud cover opens above a major resistance level and then fails, it would prove the bulls were unable to take control of the market.
4. If, on the opening of the second day there is very heavy volume, a buying blow off could have occurred. For example, heavy volume at a new opening high could mean that many new buyers have decided to jump aboard ship. Then the market sells off. It probably won't be too long before this multitude of new longs (and old longs who have ridden the uptrend) realize that the ship they jumped onto is the Titanic. For futures traders, very high opening interest can be another warning (Nison, 1991).

The bullish piercing pattern is akin to the bullish engulfing pattern. In the bullish engulfing pattern the white real body engulfs the previous black real body. With the bullish piercing pattern, the white real body only pierces the prior black body. In the piercing pattern, the greater the degree of penetration into the black real body, the more likely it will be a bottom reversal. An ideal piercing pattern will have a white real body that pushes more than halfway into the prior session's black real body. If the market closes under the lows of the bullish engulfing pattern or the piercing pattern by way of a long black candlestick, then another down leg should resume (Nison, 1991). To analyzing the prediction power of candlestick patterns we can consider these major and minor hypotheses.

3. Background

Marshal (2005) in his paper "Candlesticks Technical Trading Strategies: Can They Create Value for Investors?" examines the profitability of technical analysis, candlestick trading strategies. The literature review is divided into three major sections. In the first the extensive literature that covers the random walk and efficient market hypothesis, two of the most important concepts in modern finance are considered. In section Two, the finance literature in which attempts are made to explain financial phenomena using psychology literature is discussed. This emerging area, known as behavioral finance, suggest that seemingly irrational financial market behavior can be explained by looking at the psychological make-up of market participants. The extensive literature in which the profitability of technical trading strategies is considered is then discussed. In this section the empirical literature is divided into two categories: that which finds that technical trading strategies are not profitable once transaction costs and risk are taken into account, and that which finds that profitability of these strategies is robust to those adjustments. The former findings are consistent with market efficiency while the latter is not.

Varun Juneja (2011) in his essay "Price Behaviour Analysis of Major Forex Pairs" which include EURUSD, GBPUSD, USDCHF and USDJPY, aimed to study the four major factors - Fundamental Factors, Technical Factors, Time Factors and Correlation Factors which affect the movement of the price. The study covered these four factors

body of the hanging man is black. If a hammer has a white real body it means the market sold off sharply during the session and then bounced back to close at, or near, the session's high. This could have bullish ramifications. If a hanging man has a black real body, it shows that the close could not get back to the opening price level. This could have potentially bearish implications. (Nison, 1991)

The Doji is one of the most important signals in Candlestick analysis. It is formed when the open and the close are the same or nearly the same. The lengths of the shadows can vary. The longer the shadows are, the more significance the Doji becomes. The Dragonfly Doji occurs when trading opens, trades lower, and then closes at the open price that is the high of the day. At the top of the market, it becomes a variation of the Hanging Man. At the bottom of a trend, it becomes a specific Hammer. An extensively long shadow on a Dragonfly Doji at the bottom of a trend is very bullish.

The Long Legged Doji is comprised of long upper and lower shadows. The price opened and closed in the middle of the trading range. Throughout the day, the price moved up and down dramatically before it closed at or near the opening price. This reflects the great indecision that exists between the bulls and the bears. (Bigalow, 2002)

There are three criteria for an engulfing pattern:

1. The market has to be in a clearly definable uptrend or downtrend, even if the trend is short term.
2. Two candlesticks comprise the engulfing pattern. The second real body must engulf the prior real body (it need not engulf the shadows).
3. The second real body of the engulfing pattern should be the opposite color of the first real body. (The exception to this rule is if the first real body of the engulfing pattern is so small it is almost a doji (or is a doji). Thus, after an extended downtrend, a tiny white real body engulfed by a very large white real body could be a bottom reversal. In an uptrend, a minute black real body enveloped by a very large black real body could be a bearish reversal pattern) (Nison, 1991).

The following is a list of some factors that intensify the importance of dark-cloud covers:

1. The greater the degree of penetration of the black real body's close into the prior white real body, the greater the chance for a top. If the black real body covers the prior day's entire white body, a bearish engulfing pattern would occur. The dark-cloud cover's black real body only gets partially into the white body. Think of the dark-cloud cover as a partial solar eclipse blocking out part of the sun (that is, covers only part of the prior white body). The bearish engulfing pattern can be viewed as a total solar eclipse blocking out the entire sun (that is, covers the entire white body). A bearish engulfing pattern, consequently, is a more meaningful top reversal. If a long, white real body closes above the highs of the dark-cloud cover, or the bearish engulfing pattern, it could presage another rally.
2. During a prolonged uptrend, if there is a strong white day which opens on its low (that is, a shaven bottom) and closes on its high (that is, a shaven head)

2. Literature Review

The Foreign Exchange Market is where one currency is exchanged for another. Typically, a currency exchange is made when one travels to a foreign country or when a business purchases foreign goods. However, after 1994, the FOREX Market was also opened to speculators. The Forex is traded in currency pairs (e.g. USE/JPY, EUR/USD, and GBP/JPY). Each pair has a base currency and a quoted currency. The first currency is the base currency, and the second is the quoted currency. The current price of the currency pair is the amount it would cost to exchange from the quoted currency to the base currency (Purdy, 2009).

Technical analysis is widely used among traders and financial professionals and is very often used by active day traders, market makers and pit traders. Users hold that even if technical analysis cannot predict the future, it helps to identify trading opportunities (Schwager, 1999).

In the 18th century, the Japanese developed an approach to technical analysis that traced and predicted the prices of rice contracts. This technique was referred to as candlestick charting. If we put several single lines together, they can form continuation and reversal patterns. Continuation patterns indicate that the prevailing trend will continue, while reversal patterns suggest that there will be a change in trend. All single lines and most continuation and reversal patterns can be either of a bullish or bearish variety (Goo, et al., 2007).

There are some ways to classification of candlesticks. From one perspective they can be divided into two types of 'Reversal Patterns', and 'Continuation Patterns'. (Nison, 1991) There is another perspective that divides candlesticks to three distinct types: 'Single-Stick Patterns', 'Double-Stick Patterns', and 'Three-Stick Patterns'. (Rhoads, 2008)

Japanese Candlestick charts provide illustrative graphics. The open, close, high, and low are all that is required. Yet, the manner in which they are depicted provides a great amount of information to the Candlestick analyst. Horizontal lines represent the open and the close. Once both lines are added to the chart, they are boxed. This box is called the BODY. If the close is higher than the open, the body is white or empty. If the close is lower than the open, the body is black or filled. A candlestick chart and two black and white candlesticks are shown in diagram1. (Bigalow, 2002)

In this paper 9 different candlestick patters are analyzed. They include hammer, hanging man, doji gravestone, doji dragonfly, doji long-lagged, bearish and bullish engulfing, piercing pattern, and dark cloud cover. The hammer and hanging man can be recognized by three criteria:

1. The real body is at the upper end of the trading range. The color of the real body is not important.
2. A long lower shadow should be twice the height of the real body
3. It should have no, or a very short, upper shadow.

The longer the lower shadow, the shorter the upper shadow and the smaller the real body the more meaningful the bullish hammer or bearish hanging man. Although the real body of the hammer or hanging man can be white or black, it is slightly more bullish if the real body of the hammer is white, and slightly more bearish if the real

1. Introduction

Traders use technical studies to establish target points for buy and sell financial assets, whether to open or close trading positions. These traders include banks, hedge funds, equity and bond fund managers, multinational corporations, brokers, central banks, government agencies, and individuals. According to the Bank for International Settlements, as of April 2010, average daily turnover in global foreign exchange markets is estimated at \$3.98 trillion, a growth of approximately 20% over the \$3.21 trillion daily volume as of April 2007.

Technical analysis has become popular over the past several years, as more and more people believe that the historical performance of a stock is a strong indication of future performance. The use of past performance should not come as a big surprise. In contrast, people using fundamental analysis have always looked at the past performance by comparing fiscal data from previous quarters and years to determine future growth.

As I searched, there are very few researches those focus on candlesticks. These researches just discussed about very popular forms of patterns. There are many patterns of candlesticks that are not analyzed. Moreover I didn't find any research that focuses on applying candlesticks in Foreign Exchange Market. There were few researches about applying western instruments such as trend lines, resistance and persistence levels, various indicators, head and shoulder pattern, etc. But I didn't find any research about the profitability of candlesticks in Forex.

The keywords are defined as below:

- **Forex:**
The foreign exchange market (forex, FX, or currency market) is a global decentralized market for the trading of currencies.
- **Currency pair**
A currency pair is the quotation of the relative value of a currency unit against the unit of another currency in the foreign exchange market. The currency that is used as the reference is called the counter currency or quote currency and the currency that is quoted in relation is called the base currency or transaction currency
- **Major currency-pairs**
Currencies are traded in pairs and exchanged one against the other. The majority of currencies are traded against the US dollar (USD). The four currencies traded most frequently after the US dollar are the euro (EUR), Japanese yen (JPY), the British pound sterling (GBP), and the Swiss franc (CHF). Some sources also include the Australian dollar (AUD) and the Canadian dollar (CAD) within the group of major currencies.
- **Candlestick Patterns**

In technical analysis, a Candlestick pattern is a movement in prices shown graphically on a candlestick chart that some believe can predict a particular market movement. The patterns analyzed in this paper are hammer, hanging man, dragonfly doji, gravestone doji, long-legged doji, bearish and bullish engulfing, piercing pattern, and dark cloud cover.



An Analysis of Prediction Power of Various Candlestick Patterns in Foreign Exchange Market

Fereydoon Rahnamay Roodposhti¹

Receipt: 2013, 0 , 0

Acceptance: 2014, 0 , 0

Mir Feiz Fallahshams²

Seyyed Behshad Yassini³

Abstract

The Foreign Exchange Market is where one currency is exchanged for another. In the 18th century, the Japanese developed an approach to technical analysis that traced and predicted the prices of rice contracts. There are some ways to classification of candlesticks. From one perspective they can be divided into two types of 'Reversal Patterns', and 'Continuation Patterns'. In this paper nine different reversal candlestick patterns are analyzed. They include hammer, hanging man, doji gravestone, doji dragonfly, doji long-lagged, bearish and bullish engulfing, piercing pattern, and dark cloud cover.

It is analyzed whether various candlestick patterns can predict candles and trends in Foreign Exchange Market. The first group of minor hypotheses include whether or not a candle with an inverted color proceed by these patterns. The second group analyze whether or not the profit of trading after various patterns is significantly profitable.

I considered the first, second, and the third candles as different possible points for finishing the trades. These three different points have different results, hence I've categorized them in three various scenarios and discussed about them separately.

One of the most important sign of power of a specific pattern is when the first next candle be a confirmation of trend changing. In this part only the confirmed cases are analyzed in two different scenarios.

At the end on the basis of minor hypotheses, it is concluded that there is not any evidence that we can say "various candlestick patterns predict candles and trends in Foreign Exchange Market effectively". Although the success rates of correct prediction of the next candle after a confirmed pattern is almost insignificant in all cases, but the profit of trading after this confirmation can be significant. We can conclude that a confirmed pattern could be profitable in all mentioned patterns

Keywords: Forex, Candlestick Charts, Candlestick Patterns

¹ - Full Professor of 'Science and Research Branch', Islamic Azad University, Tehran, Iran

² - Assistant Professor of 'Central Tehran Branch', Islamic Azad University, Tehran, Iran

³ - Ph.D. Student of 'Science and Research Branch', Islamic Azad University, Tehran, Iran
b.yassini@gmail.com