

INTEGRATED FOREX AND TREASURY OPERATIONS BY BANKS IN INDIA

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INTRODUCTION

Profile of Banking Industry in India

India's economic development and financial sector liberalization have led to a transformation of the Indian banking sector over the past two decades. The sector has undergone significant developments in technological application. The Indian banking sector is a mixture of public, private and foreign ownerships.

One of the most important functions of a bank in India is Treasury and FOREX Operations—All the banks in India are involved in treasury operations. If they are Authorized Dealers then they are engaged in FOREX operations also. Apart from FOREX operation the treasury operation involves Investment in Bonds, Debentures, Equity, Mutual Funds, Derivates and Commodities. FOREX operations are mainly conducted with Indian currency and USD. Treasury operation concentrates on maintaining Cash Reserve Ratio (CRR) and Statutory Liquidity Ratio (SLR) as per the directives of the regulator, namely, Reserve Bank of India.

Post Liberalization Scenario

With the rise in globalization and the integration of markets world over, treasury operations have undergone an enormous change. Treasury and FOREX management in India are integrated similar to the banking in developed countries. With the advanced application of Technology exotic derivative products are introduced in the market. Sophisticated forecasting tools are introduced more and more in banking and in academic curriculum thus driving the Treasury and FOREX operation in any bank in India at par with that of the bank in developed countries in the world. This change has been sweeping India and making integration of treasury operations extremely vital for Indian banks. The basic aim of this integration is to improve the profitability of banks and insulate against risks. Banks are changing their organizational structures and their way of functioning to maximize their gains from these operations and simultaneously insulate against market risks. However, there still exist certain challenges that need to be addressed.

In general terms and from the perspective of commercial banking, treasury refers to the fund and revenue in possession of the bank for day-to-day management. Idle funds are usually

source of loss, real or opportune, and, thereby need to be managed, invested, and deployed with intent to improve profitability. There is no profit or reward without attendant risk. Thus treasury operations seek to maximize profit and earning by investing available funds at an acceptable level of risks. Both Returns and risks need to be managed.

In this context, treasury operations are becoming more and more important to the banks and a need for integration of Treasury and FOREX, both horizontal and vertical, has come to the attention of the corporate as well. The basic purpose of integration is to improve portfolio profitability, risk-insulation and also to synergize banking assets with trading assets. In horizontal integration, dealing/trading rooms engaged in the same trading activity are brought under the same policy, hierarchy, technological and accounting platform, while in vertical integration, all existing and diverse trading and arbitrage activities are brought under one control with one common pool of funding and contributions.

NEED FOR STUDY

As mentioned earlier a sizable portion of income for every bank is from FOREX and Treasury operations. Even after lending a bank has sufficient funds for investment. Part of the funds is invested in SLR bonds. The bank also holds foreign currency assets in various currencies. The foreign currency asset may be in the form of FCNR (B) accounts, balances in NOSTRO accounts, overbought positions and outstanding forward purchase contracts..The bank will also have foreign currency liabilities in the form of overdraft in NOSTRO accounts, oversold positions and outstanding forward sale contracts. These rupee funds and foreign currency funds must be invested in such a manner so that the bank gets maximum income out of them. Hence the study of integrated Treasury and FOREX becomes all the more important for a bank.

Risk management is of great importance in this department. There are many types of risks involved in FOREX and Treasury dealing like: credit risk, interest rate risk, exchange rate fluctuation risk, liquidity risk country risk, counter party risk and operational risk.

Every bank needs to maintain a certain portion of their demand and time liabilities (DTL), (at present it is 4% of DTL), as Cash Reserve Ratio (CRR). An additional portion of DTL has to be kept in terms of gold, dated securities, T- bills and any other instrument notified by RBI as Statutory Liquidity Ratio (at present it is 23%). The surplus funds after maintaining CRR and SLR and lending are invested in Capital market and/or Money market securities like bonds and any other securities that would yield the bank a good return. The main function of the treasury department is to deploy these surplus funds in a security that would yield a good return and easily liquid. Excess money can be lent in call money market also where the lending should not exceed 50% of the bank's capital funds in a day.

LITERATURE REVIEW

Indian Money Market, Foreign Exchange Market and Foreign Money Market

The Treasury and FOREX operation calls for constant monitoring of three markets, namely, Indian Money market, Foreign Exchange market and Foreign Money market. The following situation will describe how the three markets are integrated. For example when the dollar is at a premium, the rupee will be at a discount. The premium or discount is decided by the

interest rates in the domestic money market, foreign money market and the foreign exchange market.

Types of Risks Involved In FOREX Operations

Exchange rate risk

It is also called position risk or currency risk. When a dealer buys or sells foreign exchange, the bank gets into a position of overbought or oversold. Since these positions are taken at a particular rate and if the rate moves adversely, then the bank can suffer a loss. In an overbought position, when the value of that currency is depreciating, it will result in exchange loss. Similarly in an oversold position, when the value of that currency is appreciating, this will also create an exchange loss.

Credit risk

Credit risk is the risk of loss due to inability of the counterparty to meet its obligation. It can be Pre-settlement risk, Settlement risk, called Herstatt risk and Country risk.

Market risk

It is defined as the possibility of loss to a bank caused by the changes in the market variables. This risk can be reduced by the bank by diversified security holdings. The different types of market risks are Liquidity risk, Interest rate risk and Exchange rate fluctuation risk.

Hedging against risks

To protect against the above said market risks hedging instruments called derivative instruments are used. The prices of derivate instruments are derived from the underlying assets. It protects the market risks of these assets. The following are the hedging instruments:

- Forward contracts
- Options
- Swaps
- Futures
- Customer default risk

FOREX operations

- Cover operations pertaining to merchant transactions like export, import, inward remittances and outward remittances.
- Trading operations pertaining to buying and selling of foreign exchange or entering into swap market based on speculation.

Treasury Operations

A bank can invest in *capital market* where it is a long term investment, usually for more than a year. It can invest in equity shares, debentures, bonds and mutual funds where it would fetch a return on investments. The risk factors involved are credit and market risk. The price fluctuations are high in this market.

Another market where investors can invest is in *money market*. This market deals with short term funds usually less than or equal to one year, that are used for working capital requirements. The money market instruments are Money at call and short notice Treasury bills, Certificate of deposits and Commercial Paper

Classification of Rupee investment

As per the regulator's directions investments are to be classified into three categories as under:

- Held To Maturity (HTM)
- Held For Trading (HFT)
- Available For Sale (AFS)

As the price fluctuations are very high in these markets a thorough knowledge of forecasting tools is absolutely necessary before attempting to invest in these markets.

FORECASTING TOOLS

There are two basic types of approaches in forecasting price fluctuation. One is the fundamental analysis and the other is the technical analysis.

Fundamental analysis

Fundamental analysis is a method of forecasting the future price movements of a financial instrument based on economic, political, environmental and other relevant factors and statistics that will affect the basic supply and demand of whatever underlies the financial instrument. Fundamental analysis focuses on what ought to happen in a market. Factors involved in price analysis: Supply and demand, seasonal cycles, weather and government policy. Fundamental analysis is a macro or strategic assessment of where a currency should be trading based on any criteria but the movement of the currencies price itself. These criteria often include the economic condition of the country that the currency represents, monetary policy, and other "fundamental" elements. Many profitable trades are made moments prior to or shortly after major economic announcements.

Technical analysis

Technical Analysis is the forecasting of future financial price movements based on an examination of past price movements. Like weather forecasting, technical analysis does not result in absolute predictions about the future. Instead, technical analysis can help investors anticipate what is "likely" to happen to prices over time. Technical analysis uses a wide variety of charts that show price over time.

At the turn of the century, the Dow Theory laid the foundations for what was later to become modern technical analysis. Dow Theory was not presented as one complete amalgamation, but rather pieced together from the writings of Charles Dow over several years. Of the many theorems put forth by Dow, three stand out:

- Price Discounts Everything
- Price Movements are Not Totally Random

- "What" Is More Important than "Why"

Technical analysis utilizes the information captured by the price to interpret what the market is saying with the purpose of forming a view on the future.

A technician believes that it is possible to identify a trend, invest or trade based on the trend and make money as the trend unfolds. Because technical analysis can be applied to many different time frames, it is possible to spot both short-term and long-term trends. The IBM chart illustrates Schwinger's view on the nature of the trend. The broad trend is up, but it is also interspersed with trading ranges. In between the trading ranges are smaller up trends within the larger uptrend. The uptrend is renewed when the stock breaks above the trading range. A downtrend begins when the stock breaks below the low of the previous trading range.

For our study we have taken a set of select forecasting tools. The forecasting indicators that are chosen and the reasons for choosing them are shown in the table. Few of these indicators are leading, a few others lagging and a couple of them are good reflectors of the sentiment and the momentum prevailing in the markets.

The indicators were chosen with the aim of making the models as comprehensive as possible so that the models work under different market conditions. We have also taken the study of exchange rate fluctuation by applying these models. In fact the models can be applied for price fluctuation of any asset that one may prefer to invest.

These technical analysis tools are described in the following chapter:

DATA ANALYSIS

In the enclosure we have given the historic data of exchange rates for INR/USD for the period 1st April 2012 to 31st March 2013. We apply various tools for forecasting and test the efficiency. It is to be noted that the analysis applies to various securities as it forecasts only price levels. A set of tools of technical analysis are studied below:

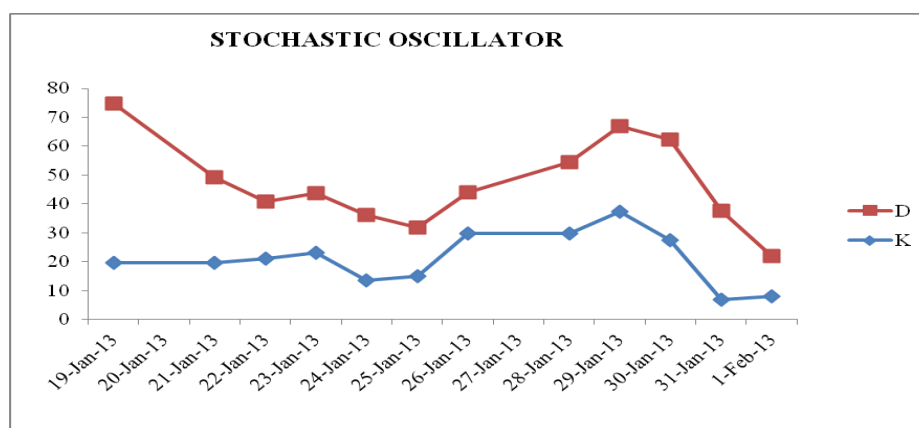
Stochastic Oscillator

This is used to indicate overbought/oversold conditions on a scale of 0-100%. The indicator is based on the observation that in a strong up trend, period closing prices tend to concentrate in the higher part of the period's range. Conversely, as prices fall in a strong down trend, closing prices tend to be near to the extreme low of the period range. Stochastic calculations produce two lines, %K and %D that are used to indicate overbought/oversold areas of a chart. Divergence between the stochastic lines and the price action of the underlying instrument gives a powerful trading signal.

Calculation of Stochastic oscillator

Date	High	Low	Highest High 14	Lowest Low 14	Close	K	D
1-Jan-13	55.001	54.675			54.685		
2-Jan-13	54.688	54.150			54.355		
3-Jan-13	54.597	54.170			54.505		
4-Jan-13	55.185	54.361			54.930		
7-Jan-13	54.930	54.930			54.930		
8-Jan-13	55.340	54.930			55.225		
9-Jan-13	55.383	54.931			54.990		
10-Jan-13	55.086	54.705			54.775		
11-Jan-13	54.846	54.425			54.566		
12-Jan-13	54.866	54.359			54.876		
14-Jan-13	54.876	54.876			54.876		
15-Jan-13	54.876	54.420			54.501		
16-Jan-13	54.691	53.346			54.620		
17-Jan-13	54.861	54.471	55.383	53.346	54.696	66.274	
18-Jan-13	54.781	54.150	55.383	53.346	54.355	49.534	
19-Jan-13	54.355	54.715	55.383	53.346	53.745	19.588	55.114
21-Jan-13	53.745	53.745	55.383	53.346	53.745	19.588	29.570
22-Jan-13	53.975	53.645	55.383	53.346	53.776	21.109	19.588
23-Jan-13	53.870	53.383	55.383	53.346	53.816	23.073	20.602
24-Jan-13	53.886	53.557	55.383	53.346	53.625	13.697	22.419
25-Jan-13	53.885	53.600	55.086	53.346	53.605	14.885	16.822
26-Jan-13	53.876	53.600	54.876	53.346	53.800	29.673	14.489
28-Jan-13	53.800	53.800	54.876	53.346	53.800	29.673	24.744
29-Jan-13	53.056	53.710	54.876	53.346	53.916	37.255	29.673
30-Jan-13	53.691	53.545	54.876	53.346	53.766	27.451	34.728
31-Jan-13	53.766	53.195	54.861	53.195	53.310	6.903	30.719
1-Feb-13	53.376	53.075	54.861	53.075	53.221	8.175	13.752

Representation of stochastic oscillator



Method of Calculation

For studying stochastic oscillator, 31-day historic data of USD in terms of INR are taken. The high, low and closing rates of each day are taken. 14 days highest high moving averages are taken and 14 days lowest low moving averages are taken. The two values k and d are calculated as under,

$\%K = (\text{current close} - \text{lowest low}) / (\text{highest high} - \text{lowest low}) * 100$ and

$\%D = 3\text{-day simple moving average of } k$

Interpretation

The stochastic oscillator measures the level of the close relative to the high-low range over a given period of time. Here in the example, the highest high equals 55.383 and the lowest low equal 55.075 and the close equal 53.221. The high-low range 2.308 which is the denominator in the %K formula. The close less the low equals 0.156, this is the numerator. 0.156 divided by 2.308 equals 0.6759. Multiply this number by 100 to find %K that would be equal to 6.759, if the close was at 53.221. If the stochastic oscillator is above 50 then the close is in the upper half of the range and below 50 when the close is in the lower half low readings (below 20) indicate that the rate is near its low for its given time period. High readings (above 80) indicate that the rate is high for its given time period. The stochastic oscillator equals 6.759 so the close was near the bottom of the range.

Exponential Weighted Moving Average (EMA) and Moving Average Convergence Divergence (MACD)

This indicator involves plotting two momentum lines. The MACD line is the difference between two exponential moving averages and the signal or trigger line, which is an exponential moving average of the difference. If the MACD and trigger lines cross, then this is taken as a signal that a change in the trend is likely. Moving averages are used to smooth price information in order to confirm trends and support and resistance levels. They are also useful in deciding on a trading strategy, particularly in futures trading or a market with a strong up or down trend.

For the purpose of calculation of MACD, Exponential Moving Average (EMA) needs to be calculated.

Calculation of Exponential Moving Average

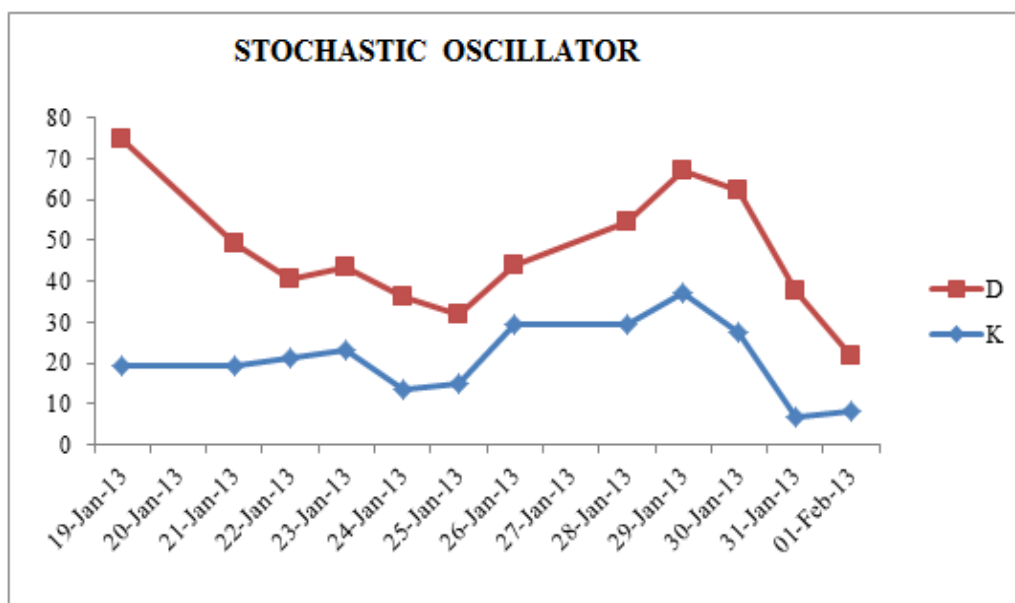
DATE	CLOSING	SMOOTHED	FORECAST	RESIDUAL
25-Feb-13	54.285	54.308	54.310	-0.025
26-Feb-13	54.285	54.306	54.308	-0.023
27-Feb-13	54.395	54.314	54.306	0.089
28-Feb-13	54.370	54.318	54.314	0.056
1-Mar-13	54.175	54.306	54.318	-0.143
2-Mar-13	54.350	54.310	54.306	0.044
4-Mar-13	54.350	54.313	54.310	0.040
5-Mar-13	54.285	54.311	54.313	-0.028
6-Mar-13	54.400	54.318	54.311	0.089
7-Mar-13	54.376	54.323	54.318	0.058

Calculation of Exponential Moving Average (Contd....)

DATE	CLOSING	SMOOTHED	FORECAST	RESIDUAL
8-Mar-13	54.081	54.303	54.323	-0.242
9-Mar-13	54.031	54.280	54.303	-0.272
11-Mar-13	54.031	54.259	54.280	-0.249
12-Mar-13	54.361	54.267	54.259	0.102
13-Mar-13	54.370	54.276	54.267	0.103
14-Mar-13	54.150	54.265	54.276	-0.126
15-Mar-13	54.416	54.278	54.265	0.151
16-Mar-13	54.350	54.284	54.278	0.072
18-Mar-13	54.350	54.290	54.284	0.066
19-Mar-13	54.566	54.313	54.290	0.276
20-Mar-13	54.721	54.348	54.313	0.408
21-Mar-13	54.925	54.397	54.348	0.577
22-Mar-13	54.925	54.442	54.397	0.528
23-Mar-13	54.865	54.478	54.442	0.423
25-Mar-13	54.906	54.514	54.478	0.428
26-Mar-13	54.906	54.547	54.514	0.392
27-Mar-13	54.370	54.532	54.547	-0.177
28-Mar-13	53.865	54.476	54.532	-0.667
29-Mar-13	54.096	54.443	54.476	-0.380
30-Mar-13	53.870	54.395	54.443	-0.573
1-Apr-13	54.721	54.422	54.395	0.326

K = 0.0849

Representation of Exponential Moving Average



Method of Calculation

To calculate EMA, we have taken 18 days opening, closing, high and low exchange rates for USD/INR during the months of February and March 2013. The formula used for calculation is $EMA = Price(t) * k + EMA(y) * (1-k)$

Where,

$t = \text{today}$, $y = \text{yesterday}$, $N = \text{number of days in EMA}$, $k = 2/(N+1)$

The closing prices have to be added for the first six days and then be divided by 6. The first EMA is calculated by taking the following day's (day 7) closing price multiplied by k , then multiply the previous day's moving average by $(1-k)$ and add the two. This has to be done for the rest of the days.

Interpretation

The moving average can be used to generate buy or sell signals and this process is very simple. The charting software plots the moving average as a line directly into the price chart. Signals are generated in places where prices intersect these lines. When the price crosses above the moving average line, it implies the start of a new upward trend and hence it means buy signal. On the other hand, if the price crosses under the moving average line and the market also closes in this area, it signals the start of a downward trend and hence it constitutes a selling signal.

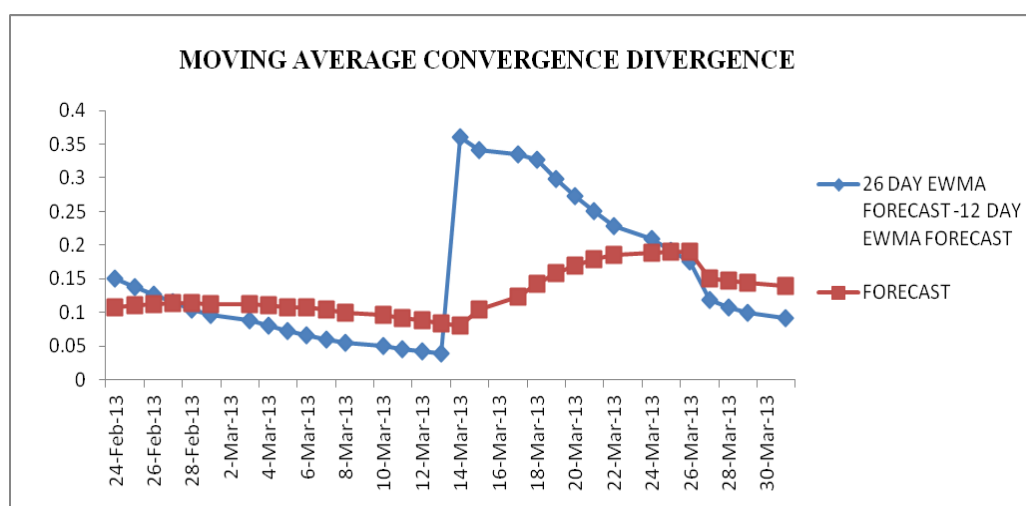
Calculation of Moving Average Convergence Divergence (MACD)

DATE	CLOSING	SMOOTH	12 DAY EWMA FORECAST	SMOOTH	26 DAY EWMA FORECAST	26 DAY EWMA FORECAST -12 DAY EWMA FORECAST	SMOOTH	FORECAST
24-Feb-13	54.285	54.282	54.282	54.419	54.432	0.150	0.111	0.108
25-Feb-13	54.285	54.282	54.282	54.408	54.419	0.137	0.113	0.111
26-Feb-13	54.395	54.292	54.282	54.407	54.408	0.126	0.114	0.113
27-Feb-13	54.370	54.299	54.292	54.404	54.407	0.115	0.114	0.114
28-Feb-13	54.175	54.288	54.299	54.385	54.404	0.105	0.113	0.114
1-Mar-13	54.350	54.294	54.288	54.382	54.385	0.097	0.112	0.113
3-Mar-13	54.350	54.299	54.294	54.379	54.382	0.088	0.110	0.112
4-Mar-13	54.285	54.298	54.299	54.371	54.379	0.080	0.107	0.110
5-Mar-13	54.400	54.307	54.298	54.373	54.371	0.073	0.104	0.107
6-Mar-13	54.376	54.313	54.307	54.373	54.373	0.066	0.104	0.108
7-Mar-13	54.081	54.293	54.313	54.348	54.373	0.060	0.100	0.104
8-Mar-13	54.031	54.271	54.293	54.321	54.348	0.055	0.096	0.100
10-Mar-13	54.031	54.251	54.271	54.296	54.321	0.050	0.092	0.096
11-Mar-13	54.361	54.260	54.251	54.302	54.296	0.045	0.088	0.092
12-Mar-13	54.370	54.269	54.260	54.308	54.302	0.042	0.084	0.088
13-Mar-13	54.150	54.259	54.269	54.295	54.308	0.039	0.080	0.084
14-Mar-13	54.416	54.272	54.259	54.603	54.620	0.361	0.104	0.080
15-Mar-13	54.350	54.279	54.272	54.592	54.614	0.342	0.124	0.104
17-Mar-13	54.350	54.285	54.279	54.592	54.614	0.335	0.142	0.124

Calculation of Moving Average Convergence Divergence (MACD) (Contd....)

DATE	CLOSING	SMOOTH	12 DAY EWMA FORECAST	SMOOTH	26 DAY EWMA FORECAST	26 DAY EWMA FORECAST -12 DAY EWMA FORECAST	SMOOTH	FORECAST
18-Mar-13	54.566	54.291	54.265	54.590	54.592	0.327	0.158	0.142
19-Mar-13	54.721	54.328	54.291	54.601	54.590	0.299	0.170	0.158
20-Mar-13	54.925	54.379	54.328	54.629	54.601	0.273	0.179	0.170
21-Mar-13	54.925	54.425	54.379	54.654	54.629	0.250	0.185	0.179
22-Mar-13	54.865	54.462	54.425	54.672	54.654	0.229	0.189	0.185
24-Mar-13	54.906	54.500	54.462	54.692	54.672	0.210	0.191	0.189
25-Mar-13	54.906	54.534	54.500	54.710	54.692	0.192	0.191	0.191
26-Mar-13	54.370	54.520	54.534	54.681	54.710	0.176	0.190	0.191
27-Mar-13	53.865	54.464	54.520	54.572	54.638	0.118	0.147	0.150
28-Mar-13	54.096	54.433	54.464	54.532	54.572	0.108	0.144	0.147
29-Mar-13	53.870	54.385	54.433	54.476	54.532	0.099	0.140	0.144
31-Mar-13	54.721	54.414	54.385	54.497	54.476	0.091	0.136	0.140

Representation of Moving Average Convergence Divergence



Method for Calculation

First, the 12-day EMA of closing prices need to be calculated. Then 26-day EMA of closing prices need to be calculated. The 26-day EMA needs to be subtracted from the shorter EMA. For that, the 9-day EMA needs to be calculated. This is the MACD line. This needs to be done for all the values.

Interpretation

As its name implies, the MACD is all about the convergence and divergence of the two moving averages. Convergence occurs when the moving averages move towards each other. Divergence occurs when the moving averages move away from each other. The shorter

moving average (12-day) is faster and responsible for most MACD movements. The longer moving average (26-day) is slower and less reactive to price changes in the underlying security.

The MACD Line oscillates above and below the zero line, which is also known as the centerline. These crossovers signal that the 12-day EMA has crossed the 26-day EMA. The direction, of course, depends on the direction of the moving average cross. Positive MACD indicates that the 12-day EMA is above the 26-day EMA. Positive values increase as the shorter EMA diverges further from the longer EMA. This means upside momentum is increasing. A negative MACD value indicates that the 12-day EMA is below the 26-day EMA. Negative values increase as the shorter EMA diverges further below the longer EMA. This means downside momentum is increasing.

In the example above, the area after 1 show the MACD line in negative territory as the 12-day EMA trades below the 26-day EMA. The initial cross occurred at the beginning and the MACD moved further into the negative territory as the 12-day EMA diverged further from the 26-day EMA. After this period, the 12-day EMA is slightly above the 26-day EMA and hence this highlights the positive period of MACD values. The points after 34 indicate that the 12-day EMA and the 26-day EMA overlap. This means the distance between them is less than 1 point, which is not a big difference.

Number Theory (Fibonacci Numbers)

Fibonacci numbers: The Fibonacci number sequence (1, 1, 2,3,5,8,13,21,34...) is constructed by adding the first two numbers to arrive at the third. The ratio of any number to the next larger number is 62%, which is a popular Fibonacci retracement number. The inverse of 62%, which is 38%, is also used as a Fibonacci retracement number.

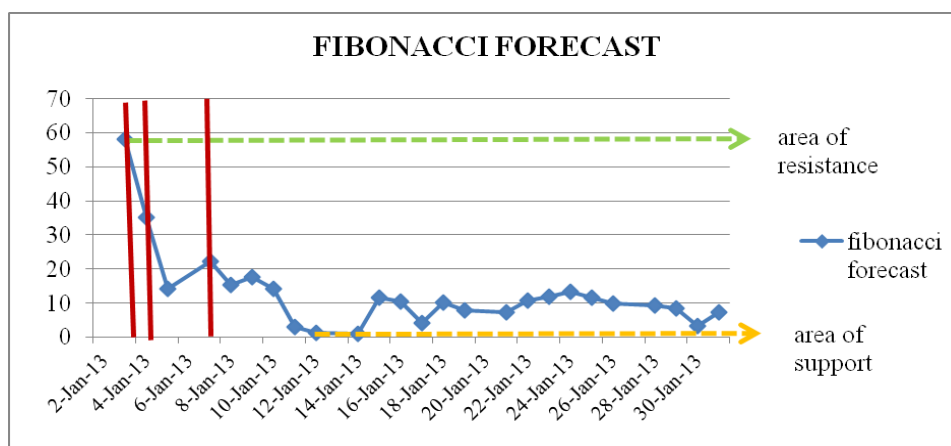
Calculation of Fibonacci

Date	Closing	Taken After The Decimal	Sum	Fibonacci Forecast
2-Jan-13	54.285	0.285	0.285	
3-Jan-13	54.395	0.395	0.680	58.0882
4-Jan-13	54.370	0.370	1.050	35.2381
6-Jan-13	54.175	0.175	1.225	14.2857
7-Jan-13	54.350	0.350	1.575	22.2222
8-Jan-13	54.285	0.285	1.860	15.3226
9-Jan-13	54.400	0.400	2.260	17.6991
10-Jan-13	54.376	0.376	2.636	14.2640
11-Jan-13	54.081	0.081	2.717	2.9812
13-Jan-13	54.031	0.031	2.748	1.1281
14-Jan-13	54.031	0.031	2.779	1.1155
15-Jan-13	54.361	0.361	3.140	11.4968
16-Jan-13	54.370	0.370	3.510	10.5413
17-Jan-13	54.150	0.150	3.660	4.0984

Calculation of Fibonacci (Contd....)

Date	Closing	Taken After The Decimal	Sum	Fibonacci Forecast
18-Jan-13	54.416	0.416	4.076	10.2061
20-Jan-13	54.350	0.350	4.426	7.9078
21-Jan-13	54.350	0.350	4.776	7.3283
22-Jan-13	54.566	0.566	5.342	10.5953
23-Jan-13	54.721	0.721	6.063	11.8918
24-Jan-13	54.925	0.925	6.988	13.2370
25-Jan-13	54.925	0.925	7.913	11.6896
27-Jan-13	54.865	0.865	8.778	9.8542
28-Jan-13	54.906	0.906	9.684	9.3556
29-Jan-13	54.906	0.906	10.590	8.5552
30-Jan-13	54.370	0.370	10.960	3.3759
31-Jan-13	53.865	0.865	11.825	7.3150

Representation of Fibonacci forecast



Method of Calculation

The closing rates are taken after the decimal point for accurate calculation. First, the sum of the values is calculated for every two days. This is done for all the values. Then, every second value is subtracted from the first value and the resultant is divided with the second value and then multiplied with 100 to obtain the Fibonacci forecast.

Interpretation

The above illustration explains the exchange rate forecast for over a period of time. The dotted line in green is the area of resistance. This is plotted on the highest point on the graph. Similarly, the yellow dotted line is the area of support, which is plotted on the lowest point on the graph. The trading of currencies has to be controlled within these two points. Anything over and beyond is a position of overbought and oversold respectively. The

vertical lines indicate the Fibonacci retracements. This trend line indicates that the value of rupee is becoming weaker as it is visible from the graph and after touching the 23.6% key Fibonacci point, it becomes even weaker. After the trend line touches the area of resistance it is an upward movement, indicating that the rupee is on a slightly stronger position.

Fibonacci analysis gives us a way to forecast levels of support and resistance and project exchange rate price targets. It can be used to set stop loss and book profit levels as well as timing entries, however, the most valuable information is what it can tell us about risk. A term used in technical analysis that refers to areas of support (price stops going lower) or resistance (price stops going higher). The Fibonacci retracement is the potential retracement of a financial asset's original move in price. Fibonacci retracements use horizontal lines to indicate areas of support or resistance at the key Fibonacci levels before it continues in the original direction. These levels are created by drawing a trend line between two extreme points and then dividing the vertical distance by the key Fibonacci ratios of 23.6%, 38.2%, 50%, 61.8% and 100%.

Gann Numbers

W.D. Gann was a stock and a commodity trader working in the '50s who reputedly made over \$50 million in the markets. He made his fortune using methods that he developed for trading instruments based on relationships between price movement and time, known as time/price equivalents. There is no easy explanation for Gann's methods, but in essence he used angles in charts to determine support and resistance areas and predict the times of future trend changes. He also used lines in charts to predict support and resistance areas.

Closing rates for the financial year 2012-13

MONTH	CLOSING RATES	MONTH	CLOSING RATES
April-12	50.876	October-12	52.406
May-12	52.565	November-12	52.660
June-12	55.345	December-12	54.266
July-12	55.511	January-13	54.685
August-12	55.475	February-13	53.170
September-12	55.526	March-13	54.906

Construction of Gann Square of 9

85.56				87.89				90.25
	68.06			70.14			72.25	
		52.56		54.39	LTP 54.906	56.25		
			39.06	40.64	42.25			
83.26	66.01	50.76	37.52	36	43.89	58.14	74.39	92.64
			49	47.26	45.56			
		64		62.01		60.06		
	81			78.76			76.56	
100				97.51				95.06

Method for Calculation

The Last Traded Price (LTP) of INR/USD for the period needs to be taken for calculation. In the above illustration, the LTP for the year ended 2012-13 is 54.906. The square root for this needs to be found out, which is 7.41. Then two integers above 7.41 (8 and 9) and 2 integers below (6 and 7) 7.41 have to be taken. First, the square of 6 has to be taken, which is 36 and placed in the centre of the Gann square. Then for the next number, 6 is to be increased by 0.125 (45 degrees) and the square has to be found for this and is entered in the square adjacent to the left of the centre square. For the next number, 6.125 has to be increased by 0.125 and the square of this value needs to be found out and entered on top of the block where the previous value was entered. This has to be done for 8 values to complete one full square of this integer 6. Similarly, for other integers (7, 8 and 9) the values have to be found out by following the above said procedure and the values are entered by leaving out one square in between for 7, two squares in between for 8 and so on. When all the values are entered, Gann square is complete.

Interpretation

After the Gann square is complete, the LTP (cell in yellow) needs to be entered in the cell where it fits between two values. If the price increases above the LTP it means that the stock needs to be bought, in anticipation of the future increase in price. On the other hand, if the price falls below LTP it determines the price at which the stock needs to be sold, in anticipation of further decrease in price. In the illustration above, the purple arrow represents that the stock needs to be bought and the orange arrow represents that the stock needs to be sold.

Elliot Wave Theory

The Elliott wave theory is an approach to market analysis that is based on repetitive wave patterns and the Fibonacci number sequence. An ideal Elliott wave patterns shows a five-wave advance followed by a three-wave decline.

DATE	CLOSING	DATE	CLOSING	DATE	CLOSING
2-Apr-12	54.285	4-May-12	54.096	6-Jun-12	53.685
3-Apr-12	54.285	5-May-12	53.87	7-Jun-12	53.675
4-Apr-12	54.395	7-May-12	54.281	8-Jun-12	53.816
5-Apr-12	54.37	8-May-12	54.281	9-Jun-12	53.776
6-Apr-12	54.175	9-May-12	54.475	11-Jun-12	53.745
7-Apr-12	54.35	10-May-12	54.075	12-Jun-12	53.745
9-Apr-12	54.35	11-May-12	54.17	13-Jun-12	54.355
10-Apr-12	54.285	12-May-12	54.185	14-Jun-12	54.696
11-Apr-12	50.876	14-May-12	54.325	15-Jun-12	54.62
12-Apr-12	50.876	15-May-12	54.325	16-Jun-12	54.501
13-Apr-12	54.376	16-May-12	53.925	18-Jun-12	54.876
14-Apr-12	54.081	17-May-12	53.825	19-Jun-12	54.876
16-Apr-12	54.031	18-May-12	53.855	20-Jun-12	54.566

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17-Apr-12	54.031	19- May-12	53.965	21-Jun-12	54.755
18-Apr-12	54.361	21- May-12	53.596	22-Jun-12	54.995
19-Apr-12	54.37	22- May-12	53.596	23-Jun-12	55.225
20-Apr-12	54.15	23- May-12	53.225	25-Jun-12	54.93
21-Apr-12	54.416	24- May-12	53.16	26-Jun-12	54.93
23-Apr-12	54.35	25- May-12	53.141	27-Jun-12	54.505
24-Apr-12	54.35	26- May-12	53.291	28-Jun-12	54.355
25-Apr-12	54.566	28- May-12	53.17	29-Jun-12	54.685
26-Apr-12	54.721	29- May-12	53.17	30-Jun-12	55.001
27-Apr-12	54.925	30- May-12	53.221	2-Jul-12	54.761
28-Apr-12	54.865	31- May-12	53.31	3- Jul-12	54.761
30-Apr-12	54.906	1-Jun-12	53.766	4- Jul-12	54.95
1-May-12	54.906	2-Jun-12	53.916	5- Jul-12	54.846
2-May-12	54.37	4- Jun-12	53.8	6- Jul-12	55.016
3-May-12	53.865	5- Jun-12	53.8	7- Jul-12	54.956

DATE	CLOSING	DATE	CLOSING	DATE	CLOSING
9-Jul-12	55.066	9-Aug-12	55.115	11-Sep-12	53.846
10-Jul-12	55.066	10-Aug-12	55.105	12-Sep-12	53.416
11-Jul-12	54.855	11-Aug-12	55.066	13-Sep-12	52.876
12-Jul-12	54.556	13-Aug-12	55.166	14-Sep-12	52.876
13-Jul-12	54.855	14-Aug-12	55.166	15-Sep-12	53.02
14-Jul-12	54.855	15-Aug-12	54.706	17-Sep-12	52.81
16-Jul-12	54.446	16-Aug-12	54.81	18-Sep-12	52.81
17-Jul-12	54.446	17-Aug-12	54.886	19-Sep-12	52.675
18-Jul-12	54.465	18-Aug-12	54.886	20-Sep-12	53.05
19-Jul-12	54.325	20-Aug-12	54.596	21-Sep-12	52.725
20-Jul-12	54.266	21-Aug-12	54.596	22-Sep-12	52.645
21-Jul-12	54.495	22-Aug-12	54.365	24-Sep-12	51.916
23-Jul-12	54.346	23-Aug-12	54.206	25-Sep-12	51.916
24-Jul-12	54.346	24-Aug-12	54.425	26-Sep-12	51.745
25-Jul-12	54.141	25-Aug-12	54.596	27-Sep-12	52.16
26-Jul-12	54.545	27-Aug-12	53.816	28-Sep-12	52.406
27-Jul-12	54.681	28-Aug-12	53.816	29-Sep-12	52.406
28-Jul-12	54.776	29-Aug-12	53.66	1-Oct-12	52.855
30-Jul-12	54.266	30-Aug-12	53.886	2-Oct-12	52.855
31-Jul-12	54.266	31-Aug-12	53.965	3-Oct-12	53.016
1-Aug-12	54.846	1-Sep-12	54.086	4-Oct-12	53.516
2-Aug-12	55.711	3-Sep-12	53.556	5-Oct-12	53.365
3-Aug-12	55.456	4-Sep-12	53.556	6-Oct-12	53.475
4-Aug-12	55.644	5-Sep-12	53.556	8-Oct-12	53.365

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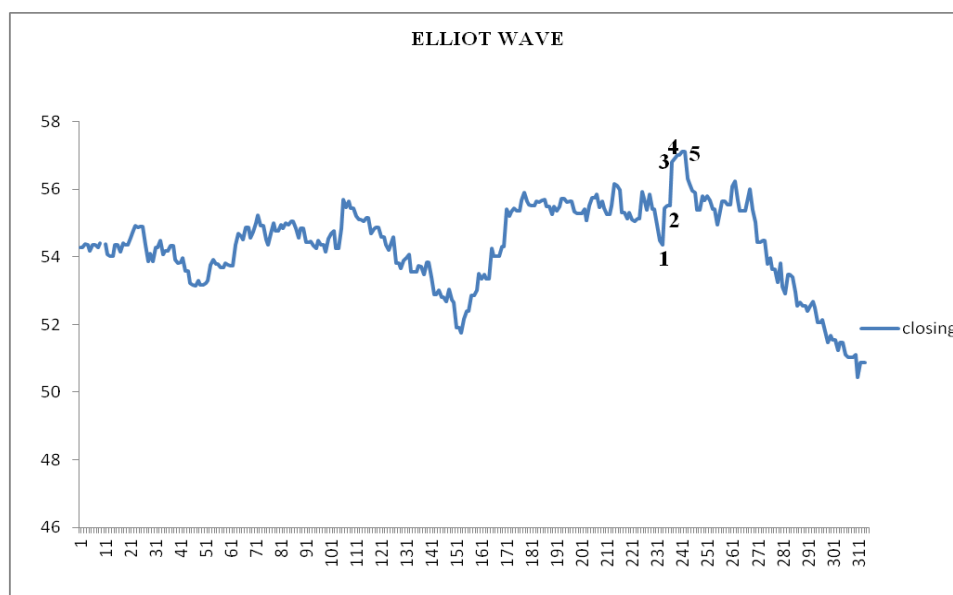
5-Aug-12	55.45	6-Sep-12	53.74	9-Oct-12	53.365
6-Aug-12	55.45	7-Sep-12	53.725	10-Oct-12	54.266
7-Aug-12	55.215	8-Sep-12	54.475	11-Oct-12	54.026
8-Aug-12	55.115	10-Sep-12	53.846	12-Oct-12	54.026

DATE	CLOSING	DATE	CLOSING	DATE	CLOSING
13-Oct-12	54.016	1-Dec-12	55.431	19-Jan-13	55.666
15-Oct-12	54.306	3-Dec-12	55.255	21-Jan-13	55.425
16-Oct-12	54.306	4-Dec-12	55.255	22-Jan-13	55.425
17-Oct-12	55.425	5-Dec-12	55.526	23-Jan-13	54.946
18-Oct-12	55.215	6-Dec-12	56.166	24-Jan-13	55.365
19-Oct-12	55.346	7-Dec-12	56.115	25-Jan-13	55.645
20-Oct-12	55.446	8-Dec-12	55.971	26-Jan-13	55.656
22-Oct-12	55.365	10-Dec-12	55.325	28-Jan-13	55.545
23-Oct-12	55.365	11-Dec-12	55.325	29-Jan-13	55.545
24-Oct-12	55.666	12-Dec-12	55.126	30-Jan-13	56.086
25-Oct-12	55.91	13-Dec-12	55.321	31-Jan-13	56.236
26-Oct-12	55.656	14-Dec-12	55.105	1-Feb-13	55.675
27-Oct-12	55.353	15-Dec-12	55.056	2-Feb-13	55.376
29-Oct-12	55.526	17-Dec-12	55.145	4-Feb-13	55.376
30-Oct-12	55.526	18-Dec-12	55.145	5-Feb-13	55.376
31-Oct-12	55.636	19-Dec-12	55.935	6-Feb-13	55.61
1-Nov-12	55.63	20-Dec-12	55.626	7-Feb-13	56.001
2-Nov-12	55.67	21-Dec-12	55.395	8-Feb-13	55.395
3-Nov-12	55.696	22-Dec-12	55.85	9-Feb-13	55.035
5-Nov-12	55.505	24-Dec-12	55.41	11-Feb-13	54.425
6-Nov-12	55.505	25-Dec-12	55.41	12-Feb-13	54.425
7-Nov-12	55.266	26-Dec-12	54.946	13-Feb-13	54.475
8-Nov-12	55.501	27-Dec-12	54.486	14-Feb-13	54.495
9-Nov-12	55.37	28-Dec-12	54.365	15-Feb-13	53.795
10-Nov-12	55.505	29-Dec-12	55.435	16-Feb-13	53.965
12-Nov-12	55.736	31-Dec-12	55.511	18-Feb-13	53.636
13-Nov-12	55.736	1-Jan-13	55.511	19-Feb-13	53.636
14-Nov-12	55.626	2-Jan-13	56.806	20-Feb-13	54.261
15-Nov-12	55.656	3-Jan-13	56.9	21-Feb-13	53.825
16-Nov-12	55.656	4-Jan-13	57.016	22-Feb-13	53.126
17-Nov-12	55.346	5-Jan-13	57.016	23-Feb-13	52.91
19-Nov-12	55.285	7-Jan-13	57.126	25-Feb-13	53.475
20-Nov-12	55.285	8-Jan-13	57.126	26-Feb-13	53.475
21-Nov-12	55.276	9-Jan-13	56.306	27-Feb-13	53.416
22-Nov-12	55.425	10-Jan-13	56.156	28-Feb-13	52.965
23-Nov-12	55.071	11-Jan-13	55.956	1-Mar-13	52.565
24-Nov-12	55.526	12-Jan-13	55.91	2-Mar-13	52.666

26-Nov-12	55.755	14-Jan-13	55.395	4-Mar-13	52.545
27-Nov-12	55.755	15-Jan-13	55.395	5-Mar-13	52.545
28-Nov-12	55.846	16-Jan-13	55.806	6-Mar-13	52.41
29-Nov-12	55.475	17-Jan-13	55.685	7-Mar-13	52.545
30-Nov-12	55.656	18-Jan-13	55.806	8-Mar-13	52.681

DATE	CLOSING	DATE	CLOSING
9-Mar-13	52.505	21-Mar-13	51.465
11-Mar-13	52.075	22-Mar-13	51.48
12-Mar-13	52.075	23-Mar-13	51.1
13-Mar-13	52.146	25-Mar-13	51.041
14-Mar-13	51.796	26-Mar-13	51.041
15-Mar-13	51.475	27-Mar-13	51.041
16-Mar-13	51.675	28-Mar-13	51.115
18-Mar-13	51.55	29-Mar-13	50.45
19-Mar-13	51.55	30-Mar-13	50.876
20-Mar-13	51.236		

Representation of Elliot Wave



Method of Calculation

The closing price for the year ended 2012-13 are tabulated and plotted to obtain the wave pattern.

Interpretation

Elliot's pattern consists of 'impulsive waves' and 'corrective waves'. An impulsive wave is composed of five sub waves. It moves in the same direction as the trend of the next larger

size. A corrective wave is divided into three sub waves. It moves against the trend of the next larger size. In the above illustration, it can be seen that after every 5th wave, the pattern of the wave changes to an opposite direction, thus forming 'corrective waves'. The Elliot wave theory follows three basic rules; Wave 2 cannot exceed low of wave 1. Wave 3 cannot be the shortest. And Wave 4 cannot overlap Wave 1.

Cop pock Curve

Coppock Curve is an investment tool used in technical analysis for predicting bear market lows.

It is an oscillator that uses rate of change and a weighted moving average to measure momentum.

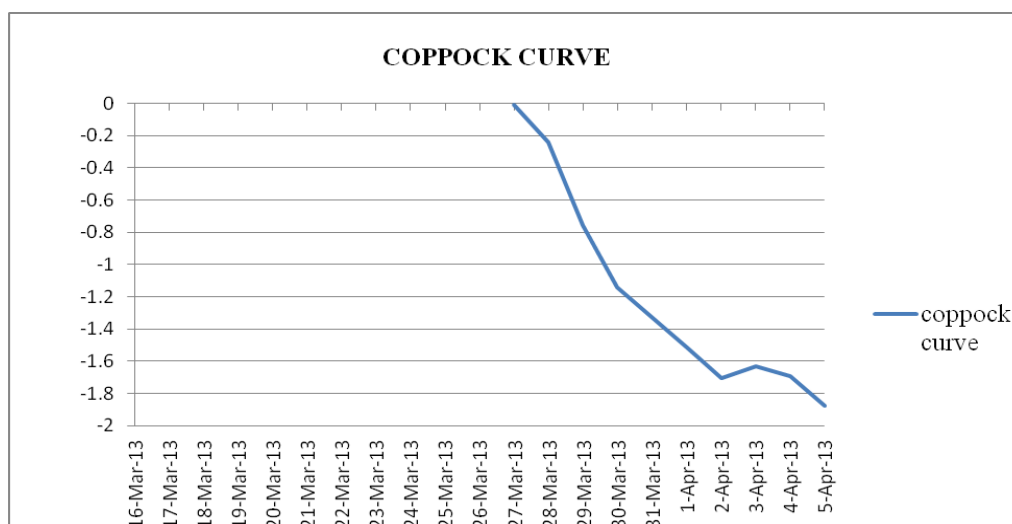
Calculation of Coppock curve

DATE	CLOSING	ROC11	ROC14	ROC 11 + ROC 14	WMA10 (Coppock curve)
19-Feb-13	54.285				
20-Feb-13	54.285				
21-Feb-13	54.395				
22-Feb-13	54.370				
23-Feb-13	54.175				
25-Feb-13	54.350				
25-Feb-13	54.350				
26-Feb-13	54.285				
27-Feb-13	54.400				
28-Feb-13	54.376				
1-Mar-13	54.081				
2-Mar-13	54.031	-0.467901			
4-Mar-13	54.031	-0.467901			
5-Mar-13	54.361	-0.062506			
6-Mar-13	54.370	0	0.156581008		
7-Mar-13	54.150	-0.046147	-0.24868748		
8-Mar-13	54.416	0.1214351	0.03860649		
9-Mar-13	54.350	0	-0.03678499		
11-Mar-13	54.350	0.1197384	0.323027227		
12-Mar-13	54.566	0.3051471	0.397424103		
13-Mar-13	54.721	0.6344711	0.682612695		
14-Mar-13	54.925	1.560622	1.178962881		
15-Mar-13	54.925	1.6546057	0.965073529	2.619679219	
16-Mar-13	54.865	1.5435583	0.899293806	2.442852134	

Calculation of Coppock curve (Contd....)

DATE	CLOSING	ROC11	ROC14	ROC 11 + ROC 14	WMA10 (Coppock curve)
18-Mar-13	54.906	1.002557	1.525489543	2.528046524	
19-Mar-13	54.906	0.9858378	1.619440691	2.60527847	
20-Mar-13	54.37	0.4062789	0.627417594	1.033696449	
21-Mar-13	53.865	-1.01257	-0.91241883	-1.924988662	
22-Mar-13	54.096	-0.467341	-0.50395439	-0.971295693	
23-Mar-13	53.87	-0.883165	-0.51708218	-1.400246853	
25-Mar-13	54.721	0.2840597	0.56050	0.844556584	
26-Mar-13	54.281	-0.804079	-0.12695	-0.931033795	
27-Mar-13	54.475	-0.819299	0.22999	-0.589308244	-0.01057
28-Mar-13	54.075	-1.547565	-0.89983	-2.447392593	-0.2422
29-Mar-13	54.170	-1.266746	-1.00693	-2.273671691	-0.75331
30-Mar-13	54.185	-1.313153	-1.34729	-2.660445151	-1.14393
1-Apr-13	54.325	-1.058172	-1.09240	-2.150570874	-1.51757
2-Apr-13	54.325	-0.082766	-0.98423	-1.06700026	-1.70276
3-Apr-13	53.925	0.1113896	-1.78669	-1.675300394	-1.63305
4-Apr-13	53.825	-0.500961	-1.96882	-2.469780691	-1.68953
5-Apr-13	53.855	-0.027845	-0.94721	-0.975058348	-1.87766

Representation of Coppock curve



Method of Calculation

The closing rates are taken for a period of time. The rate of change for 11 days is calculated for each value. Rate of change (ROC) for every 12th day is calculated by subtracting the first

day's closing rate from the 12th day's closing rate and dividing the resultant by the 12th day's closing rate and then multiplying the answer with 100. This is done for all the days. Similar calculation is to be done for calculating the rate of change for 14. At the end of this ROC 11 and ROC 14 are to be added. Coppock curve is determined by finding out the weighted mean average for 10 days and dividing the result by 55 (sum of 1 to 10). This will form the Coppock curve.

Interpretation

The Coppock Curve is simply a smoothed momentum oscillator. The Rate-of-Change indicator measures momentum and the weighted moving average smoothens the data. This means the indicator can be used on any timeframe. Intraday, daily and weekly data can be used to fit one's trading/investing style and time horizon. In the example, the curve is on the negative side indicating the sell signal. When it is on the positive side, it indicates the buy signal. A shorter Rate-of-Change setting will make the Coppock Curve more sensitive and faster, while a longer setting will make it less sensitive and slower. The main signals are generated with crosses above and below the zero line. Divergences do not always result in trend reversals because the trend can simply slow and continue in the same direction.

CONCLUSION

In India, the banking operations have been enormously deregulated. As pointed out in the earlier chapter, the various deregulating directives along with the introduction of most liberal Foreign Exchange Management Act 1999 have thrown up many opportunities to the bankers. The bankers are yet to make full use of the opportunities. The integrated FOREX and treasury management is almost in an experimental stage in many banks. It has become highly specialized and a technical subject only to a handful in any bank. Even though voluminous literature has been developed all over the world and research papers have been submitted, yet the full impact has not been felt in India as it warrants a combination of academic knowledge and practical application with technology background.. It is worthwhile for the banks to have a small research section to enhance the capability of scientific trading in FOREX and Treasury to substantially enhance the profit. It is relevant to mention here that Reserve Bank is about to bring out a new product called Inflation Indexed Bonds. This will be a floating rate bond and throws challenges to the forecasters.

This paper is a small attempt to study the integrated treasury and foreign exchange management. We have analyzed few tools. The identification and application of the proper tool is the prerogative of the forecaster. Even here the choice of the forecaster is not static but dynamic. The successful tool for a forecaster depends upon his success ratio.

Presently, one of the most popular non-linear applications is that of neural networks in the prediction of financial data, in particular the prediction of the exchange rate. The Random Walk Theory (RWT) is slowly pressurizes researchers towards neural net work. RWT states that stock price/exchange rate changes have the same distribution and are independent of each other, so the past movement or trend of a stock price or market cannot be used to predict its future movement.

With the introduction of neural network in the forecast of exchange rates the following scope arises in the matter of research in this field:

First is to combine methodology of linear models and neural networks. Secondly, to find the optimum use of network architecture through genetic algorithm. Thirdly, the robustness of neural network to the changing structure or turning points typically associated with exchange rates and stock prices can be investigated in further research by using multiple training and test samples systematically chosen from the original series. Fourthly, we use past returns as inputs to the network. However technical trading rules can be profitably used in the set of inputs to the network to make more accurate forecast of exchange rate and stock returns.

However the advanced research calls for a comprehensive knowledge of mathematics, statistics', computer technology and economics on the part of the researchers.

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