DHĀRANA

Vol : 4, 1 (2010)
ISSN 0974-0082

BHAVAN'S INTERNATIONAL JOURNAL OF BUSINESS

BHARATIYA VIDYA BHAVAN, Bangalore

आ नो भद्रा : क्रतवो यन्तु विश्वत : ।

"Let Noble Thoughts Come To Us From Every Side"

- Rig Veda 1-89-1

IN PURSUIT OF EXCELLENCE

Dr. K.M. Munshi, a man of letters and a veteran freedom fighter, started the Bharatiya Vidya Bhavan with the objective of spreading Indian Art, Culture and Education in 1938, with the blessings of Mahatma Gandhi. Bhavan publishes invaluable literature that deals with our heritage. It also runs educational institutions not only to teach General Science and Humanities, but also to impart specialised education in management, art, music, dance, drama, Veda and Sanskrit.

In the last seven decades, Bhavan has grown from strength to strength. The founder's avowed thinking was to make Bhavan a unique organization that serves the cause of Indian Art, Culture and Education. Today Bhavan serves through 119 Kendras in India and 7 Kendras abroad. It administers 361 educational institutions that have over 200,000 students, and has also published 1750 titles.

DHARANA a bi-annual journal, published in January and July, every year, by
Bharatiya Vidya Bhavan
43, Race Course Road
Bangalore 560 001, India

Phones: +91-80-2237 0445, 0446
Fax: +91-80-2237 0447

E-mail: nsv@bhavan-marshall.org

Submissions
Prospective authors should follow the guidelines provided at the end of this issue while preparing the manuscripts.

Reprints
Ten free reprints of the published article will be sent to the corresponding author. Additional reprints may be obtained at Rs. 20 / ($ 10 per reprint for requisition from abroad).

DHĀRANA
BHAVAN'S INTERNATIONAL JOURNAL OF BUSINESS
Vol : 4, 1 (2010) ISSN 0974-0082

Editorial Board

DHĀRANA
BHAVAN'S INTERNATIONAL JOURNAL OF BUSINESS
Vol:4, 1 (2010) 3-15 ISSN 0974-0082

Informational Efficiency of Indian Capital Market: A Study on Stock Market Indices for the Period 1995-96 to 2004-05

Charles Lasrado[1] and T.V. Narasimha Rao[2]
1. St. Joseph's Evening College (Autonomous), Bangalore 2. Department of Commerce, Manipal University

Abstract

In an informationally efficient market, stock prices fully reflect all available information. The present study examines whether the Indian stock market is informationally efficient in the weak form. The study attempts to test whether the information contained in the past stock prices fully reflected in the present prices. The ADF unit root test, DW test to measure the autocorrelations in the residuals, autocorrelation and cross correlation tests on the returns tests of the four major stock price indices viz., Sensex, Nifty, S&P CNX 500 and BSE 100 for the 10 year period (1-4-1995 to 31-3-2005) have been conducted. The test results overwhelmingly vouch for the existence of the stock market efficiency in the weak form.

Key words: ADF unit root test, Autocorrelation, Cross correlation

1. Introduction

The study of capital market efficiency can be broadly categorised into three. Viz., Allocational Efficiency, Investment Efficiency and Informational Efficiency. Allocational efficiency refers to the effectiveness with which a market channels capital is not to its most productive use. It is a process whereby society's scarce resources are allocated between competing real investments. Investment efficiency deals with the distribution of wealth between consumption and savings. It is a function of risk, return and total cost of an investment management structure. Informational Efficiency refers to a market environment wherein stock prices fully reflect all available information. It is a function of the speed, accuracy and quantum of new information translated into price. In this study we use the concept of informational efficiency to evaluate the efficiency of Indian capital market.

For the past four decades, the finance literature on capital market efficiency focused on informational efficiency. Though Louis Bachelier, Halbrook Working, Maurice Kendall, and Roberts have made pioneering contribution, it was Eugene Fama (1970) who laid the foundations for a systematic study of market efficiency. Initially he had categorised the study of market efficiency into three. Viz., Weak form, Semi-strong form and Strong form of market efficiency. Weak form of efficiency states that current stock prices fully reflect all the information contained in the history of past prices. If the market is weak form efficient, stock prices are not predictable based on the

past price data. The investors cannot gain abnormal returns by evolving trading rules based on past price data. Hence, the analysis of patterns in past price movement, popularly known as 'technical analysis' is redundant.

This study aims at evaluating the efficiency of Indian capital market using daily closing values of four major indices viz., Sensex, Nifty, S&P CNX 500 and BSE 100. This study employs econometric tools to investigate whether the market stands the tests for weak form of efficiency.

2. Review of Literature

The random nature of share prices and returns has been suspected by various researchers for a long time. One of the earliest and the most often cited works is by Louis Bachelier. In his pioneering study on the commodity prices 'Theorie de la Speculation' way back in 1900, he concluded that the price of a commodity today is the best estimate of its price in the future. However, the credit for the first systematic study on whether stock prices behaved in a random fashion goes to Maurice G. Kendall (1953). He analysed the behaviour of weekly changes in the indices of shares on the London stock market and of the prices of cotton and wheat on American commodity markets. He concluded that the price movements were random.

Osborne (1959) found a high degree of conformity between movements in share prices and the law governing Brownian motion. Although Osborne's findings were generally consistent with the thesis of weak form efficiency, he noted that the daily closing prices tended to be concentrated either at the day's highs or lows. In a later study, Niederhoffer and Osborne (1966) noted the reversals (pairs of price changes in the opposite direction) tended to be much more common than continuations (price changes in the same direction).

Alexander (1961) using filter technique attempted to show that historic price movements could be used to earn abnormal returns. However, when transaction costs were taken into account, the excess gains disappeared. Cootner (1962) argued that professional investors can observe the random walk in security prices produced by non-professional market participants, until the price wanders sufficiently far away from the intrinsic value of the security. At this point, the professionals can trade in such a way as to make abnormal gains.

Granger and Morgenstern (1963) used spectral analysis in an attempt to find cycles in share prices. They found no significant relationship between security returns in previous periods. Moore (1964) examined serial correlation between successive price changes and individual securities. He concluded that historic weekly price changes cannot be used to predict future price changes.

Fama (1965) studied the daily price changes of 30 stocks making up the Dow Jones Industrial Average for 5 years from 1957 to1962. He concluded that there is very little evidence of dependence. Samuelson (1965) proved that prices move in a random manner in a market in which all have similar time horizons and expectations, provided that all information is available to all market participants at a zero cost.

The bulk of the weak form tests have been concerned with examining the serial correlations between successive returns. Serial correlation (or autocorrelation) measures the coefficient between numerical observations in the same time series; i.e., the extent to which each observation is determined by its predecessors.

3. Tests of Market Efficiency in the Indian Scenario

In Indian market the first work on testing the hypothesis of independence of price changes was by Krishna Rao and Mukherjee (1971). They analysed the weekly averages of daily closing quotations of the Indian aluminium company's shares for the period of fifteen years (1955-1970). Spectral analysis of the data supported the hypothesis of randomness of price changes. Later, Sharma and Kennedy (1977) used spectral analysis to study the behaviour of NYSE, LSE and BSE. Spectral densities estimated for each index used confirmed the randomness of the series and no systematic cyclical component or periodicity was present.

Ray (1976) constructed index series for 6 industries as well as for all industries, and tested the hypothesis of independence on these series. He obtained mixed results, tilting towards rejection of the hypothesis. Barua (1983), Obaidullah (1990), Belgaumi (1995), Bodla (2005) used

Runs test and Auto correlation test to see whether the successive price changes are independent. The results supported the hypothesis of serial independence of price changes of securities. Chaudhuri (1991, 1991a) applied similar tests on price quotations of 13 industries and daily price quotations of 93 actively traded shares. His findings rejected the hypothesis.

Sharma (1983) and Karmekar (2003) applied Box-Jenkin's (ARIMA) methodology and concluded that the random walk model is an adequate model to represent the price behaviour of individual stocks traded at BSE. Gupta (1987) observed that Indian Capital Market is excessively speculative rather than inefficient, mainly because of low margins in carry forward transactions. In responding to the study of Barua and Raghunathan (1986), he was of the opinion that the violation of risk – return parity might be due to the excessive speculation and not due to the inefficiency of the market. On the other hand, Rao (1988) had employed serial correlation, Runs tests and Filter Tests on the week-end share price data of 10 blue chip companies between the years 1982-87. His results supported the weak form efficiency of the Indian capital market.

Raghunathan and Subramanian (1993) used frequency domain approach of spectral analysis. Their study shows that there are some periodic cycles in the price movements which run counter to the assertion of weak form of market efficiency. Using unit root test and variance ratios Barman and Madhusoodanan (1993) analysed the permanent and temporary components of Indian Stock market returns. They found that the fluctuations in returns were permanent in the long run, while for short and medium term they were temporary. The results indicate lack of efficiency.

Arumugham (1998) made a comprehensive study on the day of the week effect by taking 19 year data (April 1979 to March 1997) of daily returns based on the closing prices of BSE Sensex. The study examined the causes of the anomaly and implications for the efficiency of the stock market. Parimal (2001) found interday as well as intraday volatility as non-random. Hence he concludes that the markets are not efficient. He asserts that there is discernable "day of the week effect" on the daily returns depending upon the trading cycles of the respective bourses. Thiriplraju and Amanulla (2001) investigated whether the CAPM along with week-end effect explain the stock return variations across the week in Indian stock market. Their result supports the traditional form of week-end effect during the period of ban on badla transactions, but followed a different pattern of week-end effect in the rest of the sub-sample periods.

Ramasastri (2001) used daily returns of Sensex for a period of 3 years (January 1996-December 1998) applied Correlogram and Spectral analysis to conclude that Indian capital market is efficient in weak form. Barman and Samanta (2001) used martingale tests, volatility test and cointegration tests between real price index and real dividend to test the efficient market hypothesis in the Indian capital market and concluded that the Indian stock market as inefficient. Sehgal (2003) made a study on the common factors in stock returns. The study shows that there are market size and book to market equity factors in stock returns. Pandey (2003) investigated the existence of seasonality in Indian stock market. He used the monthly return data of BSE Sensex for the period April 1991 to March 2002 for analysis. The results of the study imply that the stock market in India is not informationally efficient, and hence, investors can time their share investments to earn abnormal returns.

Deb (2003) applied a series of parametric and non-parametric tests on daily closing values of five market indices viz., Nifty, Junior Nifty, Sensex, BSE 100 and BSE 200 and observed that Indian Capital Market does not follow random walk model. Using the ADF unit root test, the study also showed that all these indices were non-stationary. Similarly Alimov, Chakraborthy, Cox and Jain (2004) used the daily closing values of indices BSE 500, BSE 100, and the daily closing price of 14 stocks data and found the data is non-stationary. On the other hand, Ramasastri (2000) applied the same test on daily closing data of BSE Sensex for 8 years, Panda and Narasimahan (2005) for a 10 year period and found that data as stationary.

4. Rationale of the Present Study

In the era of financial liberalisation where there is a free flow of capital beyond the geographical and

political boundaries, it is necessary to have an efficient capital market to attract investors around the globe. The researchers of the developed economies in the West, the United States and Australia have done substantial work in the field of testing capital market efficiency. In the Indian context, the studies in this direction are very minimal.

After eighteen years of experiment on financial liberalisation, the atmosphere in the capital market has certainly changed. The Indian capital market is on its march towards occupying a place among the leading capital markets of the world. Testing of market efficiency is not a 'timeless' study; continuous research is required to keep the market informationally efficient. Hence it is necessary to test its efficiency.

5. Objectives of the Study

1. To study the return distribution pattern in the select indices viz., Sensex, Nifty, S&P CNX 500 and BSE 100.
2. To test the Random Walk Hypothesis with reference to the select stock price indices
3. To study cross-correlation between the returns of the select indices
4. To evaluate the "lead-lag" relationship amongst the major stock price indices

6. Scope of the study

The study is to assess the efficiency of the Indian capital market in the liberalisation era. Hence the study is based on the daily closing values of four major stock price indices viz., Sensex, Nifty, S&P CNX 500 and BSE 100 for the 10 year period (1-4-1995 to 31-3-2005)

7. Research Methodology

7.1 . Sources of Data and Sample

The daily closing values of the four indices for the 10 year period starting from April 1, 1995 to March 31, 2005 has been procured from CMIE's Prowess data base. There are a total of 2501 observations representing all the trading days during the period under study. The daily compounded logarithmic returns were calculated for the analysis.

$$R_{it} = \log I_t - \log I_{t-1}$$

Where

R_{it} = return of the index on day t

I_t = Closing value of the index on day t

I_{t-1} = Closing value of the index on day t-1

7.2 . Statistical and Econometric tests employed

The continuously compounded log returns of daily closing prices of indices taken as the basis for all the statistical and econometric analysis. The following tests have been employed.

a. **Augmented Dickey Fuller unit root test** to verify the stationarity of the data.

b. **Durbin-Watson** statistics to test the autocorrelations in the returns of the indices.

c. Test of **autocorrelation** in the daily returns of the indices upto 10 lags.

d. Test of **cross correlation** between the returns of the indices upto 10 lags between the four indices for all the 2501 trading days under study.

8. Important Findings of the Study

8.1 . Descriptive Statistics of the daily compounded log returns of the indices:

The examination of the summary statistics of daily compounded log returns of all the four indices under study viz., Sensex, Nifty, BSE 100 and NSE 500 **(table no. 1A, B, C, D)** reveals that the values of skewness and kurtosis are high. These values indicate that the series is not normally distributed. The series is negatively skewed and heavy tailed i.e., leptokurtic. Jarque-Bera test statistic also confirms the non-normality of the distribution of the series. When we categorise the data into annual sub-periods and examine the summary statistics, it is evident that during six out of the ten years the skewness has been negative. The leptokurtic trend in the distribution of the data could be seen in all the annual sub-periods.

The standard deviations of returns are ranging between 0.010 and 0.024 during the 10 year period under study. The standard deviation was highest (0.024) in the year 2000-01 and lowest (0.010) in the year 2001-03. This also indicates that the markets were highly volatile in the year

2000-01 and relatively moderate in the year 2002-03. The high volatility in the market in the year 2000-01 is further strengthened by the fact that the returns were ranging between a high of 0.070 and a low of -0.074. In the year 2004-05 though the returns were fluctuating between a high of 0.079 and a low of -0.118, the standard deviation was moderate 0.015.

8.2. Stationarity of the data

The ADF test carried on daily closing values of four indices at varying time periods viz., all ten years' data under study, first five years, last five years, last three years and 10 year annual data. In all sub-periods, the ADF test values show that the series is non-stationary at 1%, 5% and 10% level of significance with the exception of BSE 100 annual data of the year 1995-96 and CNX 500 annual data for the year 2000-01 where the series appears to be stationary at 5% and 1% level of significance respectively. (Cf. Table No.2). Thus the ADF unit root test on daily closing values of the select indices for various time periods indicates that the closing values of the indices are non-stationary; in other words, they follow random walk.

If a time series is non-stationary, we can study its behaviour only for the time period under consideration. Each set of time series data will therefore be for a particular episode. As a consequence, it is not possible to generalise it to other time periods. Therefore, for the purpose of forecasting, non-stationary series are of little practical use. Hence, the daily compounded log returns of the indices were put to the ADF test. The result overwhelmingly suggested that the data is stationary (Cf. Table No.3). Therefore for all the statistical/econometric tests, the daily compounded log returns of the select indices have been used.

8.3. Durbin-Watson test results

Durbin –Watson statistics which measures the serial correlation in the residuals is computed as

$$DW = \frac{\sum_{t=2}^{T}(\varepsilon_t - \varepsilon_{t-1})^2}{\sum_{t=1}^{T}\varepsilon^2_t}$$

In the table No 4 it could be observed that the DW statistic is almost 2. For Sensex it is ranging between 1.9150 and 1.9982 and for the Nifty it is ranging between 1.8915 to 1.9924 Similarly the DW values of CNX 500 and BSE 100 indices are very close to 2 (except for the year 1995-96). Thus the Durbin-Watson test overwhelmingly suggests no evidence of first order autocorrelation in the continuously compounded log returns on select stocks as well as the returns on the select indices. Hence the DW test statistics clearly indicate that the residuals are not correlated.

8.4. Autocorrelation of Returns on the Indices

One of the ways to test the randomness in the price changes in the indices is to look at their autocorrelations. The autocorrelation coefficient provides a measure of relationship between the value of a random variable ( ) in time t and its value k period earlier. In other words, it tells whether the price changes in one period are correlated with the price changes in some other earlier period. In the present context, it will indicate whether the changes in the value of index on day t are influenced by the changes in the value of the index k days earlier, where the k = 1, 2, 3, ….If such autocorrelations are negligible, the price changes are said to be serially independent. In this study we have considered the time lag of 10 trading days. i.e., k = 1, 2, ….16

The autocorrelation function

$$r_k = \frac{\text{cov}(y_t, y_{t-k})}{\sigma_y^2}$$

Alternatively,
$r_k = C_k / C_o$

where

$C_k = \frac{1}{n}\sum_{t=1}^{n-k}(y_t - \overline{Y})\ (y_{t+k} - \overline{Y})$ k = 1, 2, 3, …upto 10

C_o = variance of y_t i.e., $\sigma_{y_t}^2$

$\overline{Y} = \frac{1}{n}\sum_{t=1}^{n} y_t$

t value = $\frac{r_k}{S.E.of\ r_k}$

$S.E.of\ r_k = \frac{1}{\sqrt{n-k}}$

The t values of the autocorrelations of the continuously compounded log returns of the daily closing values of the select indices viz., Sensex, Nifty, CNX 500 and BSE 100 have been calculated upto 10 lags and the t values of the same are tabulated. **(Cf. Table Nos. 5)**

The **table No.5** affirms that the returns of the indices for various lags is not autocorrelated. Though a few t values are significant at 1% degree of freedom, their respective values are negligible. Hence the results vindicate the findings of the DW test.

8.5. Cross correlation between the indices

The cross correlations between the two series x and y

$$r_{xy} = \frac{C_{xy}(l)}{\sqrt{C_{xx}}\sqrt{C_{yy}}} \text{ where } l = 0, \pm 1, \pm 2, \ldots\ldots$$

And

$$C_{xy}(l) = \begin{cases} \sum_{t=1}^{T-l} ((x_t - \overline{X})(y_{t+l} - \overline{Y}))/T & l = 0, 1, 2, \ldots. \\ \sum_{t=1}^{T+l} ((y_t - \overline{Y})(x_{t-1} - \overline{X}))/T & l = 0, -1, -2, \ldots. \end{cases}$$

$$\textbf{t value} = \frac{r_{xy}}{S.E.of\ r_{xy}}$$

$$S.E.of\ r_{xy} = \frac{1}{\sqrt{n-l}}$$

Cross correlation among the four indices under study viz., Sensex, Nifty, CNX 500 and BSE 100 is presented in **table No.6**. Obviously, at lag 0 there is a high degree of correlation between the indices. What is significant to note is that with regard to the indices Sensex, Nifty and BSE 100 the explanatory power of the independent variable is very high. It ranges between 77.3% and 89.3%. But with regard to the correlation between the NSE 500 and other three indices at lag 0 though statistically significant, the independent variable's explanatory power is only about 22%. Conversely, at lag 1, there is a very high degree of correlation between the Sensex & NSE 500 and Nifty & NSE 500, and the explanatory power of the independent variables viz., the Sensex and Nifty is also very high, 33.8% and 35.9% respectively. This phenomenon is not observed in the cases of other indices. Hence, the CNX 500 emerges as the lagger compared to the other three indices under study when we take into consideration cross correlations between the daily returns for the ten year period.

9. Conclusion

The ADF unit root test on the daily closing values of the four indices under study viz. Sensex, Nifty, CNX 500 and BSE 100 indicates that the time series data is non-stationary. In other words, it follows random walk. For all other tests such as DW test for testing the first order correlation of the residuals, testing for Autocorrelation at various lags and Cross-correlation tests between the indices, the daily compounded log returns were used (the data was tested for stationarity) and all the test results lead us to conclude that the Indian capital market as represented by the indices data, is informationally efficient at weak form.

The results of the study lead us to conclude the futility of technical analysis for the Indian capital market. The technical analysis is founded on the premise that the stock prices move in trends that persist. The present study overwhelmingly affirms that no patterns are found in the indices return data, and they are not autocorrelated. Therefore there is no point in studying the historical price movements of Indian stock market in order to form trading strategies.

10. References

Arumugam S, "Day of the Week Effects in Stock Returns: An Empirical Evidence from Indian Equity Market", Prajnan, Vol XXVII, No. 2, 1998-99. pp 171-191

Alexander S S, " Price movements in speculative markets: trends or random walks", Industrial Management Review, Vol.2 May, 1961. pp 7-26

Alimov Azizjon A, Chakraborty Debasish, Cox Raymond, A and Jain Adishwar K, " The Random walk Hypothesis on the Bombay Stock Exchange", Finance India, Vol. XVIII, No. 3, September 2004, pp 1251-1258.

Bachelier L., Theorie de la speculation, in P.H. Cootner (ed.): The Random Character of Stock Prices, Cambridge, Mass., MIT press, 1964. pp 17-78

Barman R. B and Samanta G.P, "On Eficiency of Indian Stock Market: A Statistical Revaluation", The ICFAI Journal of Applied Finance, Vol. 7, No.3, July 2001. pp 17-28

Barman R.B, and Madhusoodanan T.P "Permanent and Temporary Components of Indian Stock Market Returns", Reserve Bank of India Occasional Papers, Vol. 14, No. 2, June 1993. pp 81-119

Barua S.K., "The Short Run Price Behaviour of Securities: Some Evidence on Efficiency of Indian Capital Market", Vikalpa, Vol 6, No. 2, April 1981. pp 93-100

Belgaumi, M.S, "Efficiency of the Indian Stock Market: An Empirical Study", Vikalpa, Vol 20, No.2, April –June 1995. pp 43 – 52.

Bodla, B.S "Efficiency of the Indian Capital Market: An Empirical Work", Vision-the Journal of Business Perspective, Vol. 9, No. 3, July – September 2005. pp 55-63.

Cootner P.H., "Stock Prices: random Vs. systematic changes" Industrial Management Review, No..3, Spring 1962. pp. 24-45

Deb S.S, "In Search of Weak Form of Efficient Capital Market", The ICFAI Journal of Applied Finance, Vol. 9, No.9, December 2003. pp 31-50

Debashish Satya Swaroop & Mishra Bishnupriya, "Testing Random Walk Hypothesis in Indian Stock Market – Empirical evidence based on BSE and NSE", The ICFAI Journal of Applied Finance, Vol.9, No.3., May 2003.

Fama E. F, " The behaviour of stock prices", Journal of Business, Vol. 21 No.38, January 1965. pp 34-105

Fama E, Fisher L, Jensen M and Roll R, "The adjustment of stock prices to new information", International Economic Review, Vol.10, February 1969.

Fama E.F "Efficient Capital Markets: A review of theory and empirical work" Journal of Finance, Vol 25, 1970, pp 383-417.

Fama E.F "Efficient Capital Markets II" Journal of Finance, Vol XLVI, No. 5, Dec. 1991, pp 1575-1617

Godfrey M.D., Granger C.W.J., and Morgenstern, O., "Random Walk Hypothesis of Stock Market Behaviour", Kyklos, Vol.17, No. 1, 1964. pp 1-30.

Granger C and Morgenstern O, "Spectral analysis of New York stock market Prices", Kyklos, No. 54, October 1963. pp 1-27.

Gupta Pradeep, "A Study of Stock Market Efficiency in India", abstract of Doctoral Dissertation, Finance India, Vol. XV, No. 2, June 2001. pp 665-673

Gupta Ramesh, " Is the Indian Capital Market Inefficient or Excessively Speculative?", Vikalpa, Vol 12, No.2, April – June 1987. pp 21-28.

Jensen M and Bennington G., "Random walks and technical theories: some additional evidence", Journal of Finance, Vol.25, 1970.

Karmakar Madhusudan and Chakraborty Madhumita, "Stock Market Anamolies : Evidence from India", Prajnan, Vol XXXII, No. 1, 2003-04, pp 37-53

Karmakar Madhusudan, " Test of Random Walk and Predictability of the Indian Stock Market", The ICFAI Journal of Applied Finance, Vol.9, No.3, May 2003

Katati M, "Price Performance of Bonus Issues" Finance India, Vol. XV, No. 4, December 2001. pp 1183-1190.

Kendall M.G, "The Analysis of Economic Time Series, Part 1: Prices", Journal of the Royal Statistical Society, Vol. 116, 1953.

Krishna Rao, N and Mukherjee, K, " Random Walk Hypothesis: An Empirical Study", Arthaniti, Vol 14, Jan-July 1971.

Lukose Jijo P.Jand Rao Narayan S, "Does Bonus Issue Signal Superior Profitablity? A Study of the BSE Listed Firms', Decision, Vol. 32, No. 1, January – June 2005. pp 39-64.

Mishra A.K, "An Empirical Analysis of Market Reaction Around the Bonus Issues in India", The ICFAI Journal of Applied Finance, August 2005. pp 21-39.

Moore A: "Some characteristics of changes in common stock prices" in P.Cootner (ed): The Random Character of Stock Prices, Cambridge, Mass.,MIT Press, 1964.

Niederhoffer F.M. and Osborne M.F.M: Market Making and Reversal on the Stock Exchange", Journal of the American Statistical Association, 61, December 1966, pp 897-916.

Obaidulla Mohammed, "Price Reversals in Indian Stock Markets: Evidence on Overreaction Hypothesis", Chartered Financial Analyst, July – Aug 1991. pp 17-19.

Obaidulla Mohammed: "Stock Market Efficiency in India – A Statistical Enquiry", Chartered Financial Analyst, July 1990. pp 10-14

Osborne, M.F.M, "Brownian motion in the stock market", Operations Research, March – April 1959. pp 145-173.

Panda Chakradhara and Narasimahan V, "Horizon Effect on the Prediction Performance of Artificial Neural Network: A Study in Indian Stock Market", The ICFAI Journal of Applied Finance, October 2005. pp 29-39.

Pandey I.M, "The Monthly Effect in Stock Returns: The Indian Evidence", The ICFAI Journal of Applied Finance, Vol. 8, No.6, November 2002. pp 53-67

Parimal, Jayant "Study of Volatility and 'Day of the Week Effect' in Indian Markets", The ICFAI Journal of Applied Finance, Vol. 7, No. 5, November 2001 pp 1-17.

Raghunathma M and Subramanian V, "Weak Form of Efficient Markets Hypothesis: A Spectral Analytic Investigation", Vikalpa, Vol. 18, No.2, April –June, 1993. pp 25-30.

Ramasastri A.S, "Market Efficiency in the Nineties: Testing Through Unit Roots", Prajnan, Vol XXVIII, No. 2, 1999-2000, pp 155-161.

Ramasastri A.S, "Stock Market Efficiency – Spectral Analysis" Finance India, Vol. XV, No. 3, September 2001. pp 885-890

Samuelson P.A., "Proof that properly anticipated prices fluctuate randomly", Industrial Management Reviw, No.6, spring, 1965. pp. 41-49

Sharma Jandhyala L., "Efficient Capital Markets and Random Character of Stock Price Behaviour in a Developing Economy", Indian Journal of Economics, Vol LXIII, Part IV, Issue No. 251, April 1983. pp 395-419.

Sharma, J.L., and Kennedy. E., "A Comparative Analysis of Stock Price Behaviour on the Bombay, London, and New York Stock Exchanges", Journal of Financial and Quantitative Analysis, September 1977.

Srinivasan, R, "Tax Motivated Trading Strategies and Stock Performance around the Ex-Bonus Day and Ex-Rights Day", The ICFAI Journal of Applied Finance, Vol. 8, No. 1, January 2002. pp 19-25.

Thiripalraju M and Amanulla S, "The CAPM and Week-end Effect: Do they Explain Return Variation in Indian Stock Market Efficiently?" Prajnan, Vol. XXX, No. 3, 2001-02, pp 237-261.

11. APPENDIX

Table 1A : Descriptive Statistics of daily compounded log returns of Sensex											
	1995-2005	1995-96	1996-97	1997-98	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05
Mean	0.000	0.000	0.000	0.000	0.000	0.001	-0.001	0.000	-0.001	0.002	0.001
Median	0.001	-0.001	0.000	0.000	0.000	0.002	0.001	-0.001	0.000	0.004	0.001
Std. Deviation	0.016	0.013	0.016	0.015	0.019	0.019	0.022	0.015	0.010	0.013	0.015
Skewness	-0.249	0.602	0.380	-0.372	-0.031	0.208	-0.361	-0.487	0.155	-0.302	-1.918
Kurtosis	6.363	5.103	4.372	7.342	4.128	4.013	3.986	5.154	4.266	2.928	21.610
Jarque-Bera Stat	1204.20	59.941	25.604	197.311	13.355	12.689	15.629	57.503	17.773	3.910	3806.01
Probability	0.000	0.000	0.000	0.000	0.001	0.002	0.000	0.000	0.000	0.142	0.000
No. of observations	2501	245	250	244	251	254	251	247	251	254	253

Table 1B : Descriptive Statistics of daily compounded log returns of Nifty											
	1995-2005	1995-96	1996-97	1997-98	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05
Mean	0.000	0.000	0.000	0.001	0.000	0.001	-0.001	0.000	-0.001	0.002	0.001
Median	0.001	-0.001	0.000	0.000	-0.001	0.001	0.002	-0.001	0.000	0.005	0.002
Std. Deviation	0.016	0.013	0.017	0.015	0.018	0.019	0.020	0.014	0.010	0.014	0.016
Skewness	-0.272	0.706	0.432	-0.266	0.036	0.084	-0.279	-0.566	0.092	-0.349	-2.249
Kurtosis	7.920	5.580	9.347	7.180	4.245	5.108	4.544	5.354	3.710	3.121	22.323
Jarque-Bera Stat	2553.29	88.296	427.374	180.511	16.266	47.308	28.207	70.193	5.629	5.312	4149.17
Probability	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.060	0.070	0.000
No. of observations	2501	245	250	244	251	254	251	247	251	254	253

Table 1C : Descriptive Statistics of daily compounded log returns of CNX 500											
	1995-2005	1995-96	1996-97	1997-98	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05
Mean	0.000	-0.001	0.000	0.000	0.000	0.002	-0.002	0.000	0.000	0.003	0.001
Median	0.001	-0.001	-0.001	0.000	0.000	0.003	0.000	0.000	0.000	0.005	0.003
Std. Deviation	0.017	0.010	0.014	0.014	0.018	0.020	0.023	0.018	0.011	0.016	0.017
Skewness	-0.407	0.694	1.237	-0.351	-0.057	-0.011	-0.551	-0.631	-0.241	-0.507	-1.600
Kurtosis	7.117	5.936	10.609	7.142	4.003	4.176	4.448	6.839	3.273	3.339	13.844
Jarque-Bera Stat	1835.07	107.695	666.837	179.390	10.658	14.642	34.645	168.042	3.206	12.115	1347.48
Probability	0.000	0.000	0.000	0.000	0.005	0.001	0.000	0.000	0.201	0.002	0.000
No. of observations	2501	245	250	244	251	254	251	247	251	254	253

Table 1D : Descriptive Statistics of daily compounded log returns of BSE 100											
	1995-2005	1995-96	1996-97	1997-98	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05
Mean	0.000	0.000	0.000	0.000	0.000	0.002	-0.002	0.000	-0.001	0.003	0.001
Median	0.001	-0.001	-0.001	0.000	-0.001	0.004	0.000	0.000	0.000	0.005	0.002
Std. Deviation	0.016	0.011	0.015	0.015	0.019	0.020	0.024	0.016	0.010	0.015	0.015
Skewness	-0.326	0.574	1.042	-0.283	-0.036	-0.077	-0.323	-0.566	0.123	-0.442	-2.119
Kurtosis	6.823	5.224	9.542	6.822	4.196	3.880	3.673	5.662	4.163	3.605	21.953
Jarque-Bera Stat	1567.70	63.930	491.142	151.728	15.011	8.452	9.105	86.118	14.772	12.157	3975.80
Probability	0.000	0.000	0.000	0.000	0.001	0.015	0.011	0.000	0.001	0.002	0.000
No. of observations	2501	245	250	244	251	254	251	247	251	254	253

Table No. 2 : ADF test τ values on the daily closing values of indices					
	No. of observations	Sensex	Nifty	CNX 500	BSE 100
1995-2005	2501	-0.7896	-0.5854	0.1349	-1.7235
1995-2000	1245	-1.2168	-0.8940	0.7621	-2.3369
2000-2005	1256	-0.2459	-0.2444	-0.0099	-0.2831
2002-2005	758	0.0264	-0.1039	-0.0754	0.0394
1995-96	246	-1.7704	-1.7496	-1.6875	**-10.4333**
1996-97	250	-1.4357	-1.4356	-1.0687	-1.2434
1997-98	244	-1.7567	-1.9731	-1.4996	-1.6677
1998-99	251	-1.6047	-1.6526	-1.1983	-1.5551
1999-00	254	-1.6248	-1.4271	-0.5792	-0.7346
2000-01	251	-2.1615	-2.1759	**-2.9055**	-2.4474
2001-02	247	-1.6764	-1.5885	-1.4214	-1.3095
2002-03	251	-2.0404	-1.9211	-1.8879	-1.8396
2003-04	254	-0.8707	-0.8613	-1.1355	-0.8576
2004-05	253	-0.6224	-0.7483	-0.7025	-0.6124
Critical values		**10 Years**	**5 years**	**3 years**	**1 year**
	1% level	-3.4328	-3.4354	-3.4388	-3.4570
	5% level	-2.8625	-2.8637	-2.8651	-2.8731
	10% level	-2.5673	-2.5679	-2.5687	-2.5730

Table No. 3 : ADF test τ values on the Continuously compounded daily returns on the indices				
	All 10 years data (1-4-1995 to 31-3-2005)			
	Sensex	**Nifty**	**CNX 500**	**BSE 100**
ADF test t values	-46.0281	-46.2357	-45.6486	-44.3840
R-squared	0.4589	0.4611	0.4548	0.4409
Adjusted R-squared	0.4587	0.4609	0.4546	0.4407
S.E. of regression	0.0161	0.0160	0.0166	0.0163
Sum squared residuals	0.6445	0.6398	0.6867	0.6654
Log likelihood	6781.83	6791.06	6702.54	6741.93
Durbin-Watson stat	1.9952	1.9915	1.9902	1.9928
Mean dependent variable	0.0000	0.0000	0.0000	0.0000
S.D. dependent variable	0.0218	0.0218	0.0225	0.0218
F-statistic	2118.59	2137.74	2083.79	1969.94
Prob(F-statistic)	0.0000	0.0000	0.0000	0.0000
Critical Values	1%	5%	10%	
	-3.4328	-2.8625	-2.5673	

Table No. 4 : Durbin-Watson Test Statistics				
Year	**Sensex**	**Nifty**	**CNX 500**	**BSE 100**
1995-96	1.9150	1.9324	1.8586	1.8808
1996-97	1.9982	1.9044	1.9986	1.9938
1997-98	1.9133	1.9772	1.9196	1.9207
1998-99	1.9900	1.9924	1.9915	1.9889
1999-00	1.9794	1.9908	1.9728	1.9882
2000-01	1.9161	1.8915	1.9876	1.9632
2001-02	1.9841	1.9724	1.9743	1.9784
2002-03	1.9830	1.9769	1.9969	1.9738
2003-04	1.9906	1.9771	1.9837	1.9791
2004-05	1.9891	1.9570	2.0149	1.9701

Table No. 5 : Autocorrelations of Daily Compounded Log Returns of the Closing Values of the Indices						
	Sensex (1-4-1995 to 31-3-2005)			Nifty (1-4-1995 to 31-3-2005)		
lag	r	t values	R^2	r	t values	R^2
1	0.082	***4.100**	0.007	0.078	***3.900**	0.006
2	-0.024	-1.200	0.001	-0.046	-2.300	0.002
3	0.015	0.750	0.000	0.022	1.100	0.000
4	0.051	2.550	0.003	0.049	2.450	0.002
5	-0.021	-1.050	0.000	0.011	0.550	0.000
6	-0.062	***-3.100**	0.004	-0.057	***-2.850**	0.003
7	0.014	0.700	0.000	-0.008	-0.400	0.000
8	0.022	1.100	0.000	0.005	0.250	0.000
9	0.030	1.500	0.001	0.036	1.800	0.001
10	0.026	1.300	0.001	0.059	***2.950**	0.003

	CNX 500 (1-4-1995 to 31-3-2005)			BSE 100 (1-4-1995 to 31-3-2005)		
lag	r	t values	R^2	r	t values	R^2
1	0.090	***4.500**	0.008	0.118	***5.900**	0.014
2	-0.046	-2.300	0.002	-0.016	-0.800	0.000
3	0.064	***3.200**	0.004	0.033	1.650	0.001
4	0.053	***2.650**	0.003	0.040	2.000	0.002
5	-0.003	-0.150	0.000	0.001	0.050	0.000
6	-0.033	-1.650	0.001	-0.038	-1.900	0.001
7	0.007	0.350	0.000	0.016	0.800	0.000
8	0.046	2.300	0.002	0.028	1.400	0.001
9	0.045	2.250	0.002	0.051	2.550	0.003
10	0.056	***2.800**	0.003	0.054	***2.700**	0.003

*significant at 1% degree of freedom

Table No.6 : Cross Correlation between the Indices on the Daily Compounded log returns (1-4-1995 to 31-3-2005)									
	Sensex & Nifty			Sensex & CNX 500			Sensex & BSE 100		
lags	r	t values	R^2	r	t values	R^2	r	t values	R^2
0	**0.906**	***45.300**	0.821	**0.453**	***22.650**	0.205	**0.945**	***47.250**	0.893
1	0.135	**6.750**	0.018	0.581	***29.050**	0.338	0.117	***5.850**	0.014
2	-0.024	-1.200	0.001	0.045	2.250	0.002	-0.017	-0.850	0.000
3	0.015	0.750	0.000	0.005	0.250	0.000	0.023	1.150	0.001
4	0.044	2.200	0.002	0.040	2.000	0.002	0.049	2.450	0.002
5	-0.002	-0.100	0.000	0.024	1.200	0.001	0.004	0.200	0.000
6	-0.054	***-2.700**	0.003	-0.025	-1.250	0.001	-0.051	-2.550	0.003
7	0.001	0.050	0.000	-0.015	-0.750	0.000	0.013	0.650	0.000
8	0.008	0.400	0.000	0.026	1.300	0.001	0.019	0.950	0.000
9	0.031	1.550	0.001	0.015	0.750	0.000	0.036	1.800	0.001
10	0.037	1.850	0.001	0.041	2.050	0.002	0.039	1.950	0.002
	Nifty & Sensex			Nifty & CNX 500			Nifty & BSE 100		
lags	r	t values	R^2	r	t values	R^2	r	t values	R^2
0	**0.906**	***45.300**	0.821	**0.447**	***22.350**	0.200	**0.879**	***43.950**	0.773
1	0.095	***4.750**	0.009	0.599	***29.950**	0.359	0.138	***6.900**	0.019
2	-0.028	-1.400	0.001	0.025	1.250	0.001	-0.036	-1.800	0.001
3	0.029	1.450	0.001	-0.002	-0.100	0.000	0.041	2.050	0.002
4	0.050	2.500	0.003	0.040	2.000	0.002	0.047	2.350	0.002
5	-0.028	-1.400	0.001	0.033	1.650	0.001	-0.004	-0.200	0.000
6	-0.045	-2.250	0.002	-0.011	-0.550	0.000	-0.041	-2.050	0.002
7	0.006	0.300	0.000	-0.028	-1.400	0.001	0.004	0.200	0.000
8	0.027	1.350	0.001	0.018	0.900	0.000	0.028	1.400	0.001
9	0.026	1.300	0.001	0.021	1.050	0.000	0.033	1.650	0.001
10	0.038	1.900	0.001	0.047	2.350	0.002	0.047	2.350	0.002

Table No.6 (Contd.) : Cross Correlation between the Indices on the Daily Compounded log returns (1-4-1995 to 31-3-2005)									
	CNX 500 & Sensex			CNX 500 & Nifty			CNX 500 & BSE 100		
lags	r	t values	R^2	r	t values	R^2	r	t values	R^2
0	**0.453**	***22.650**	0.205	**0.448**	***22.400**	0.201	**0.469**	***23.450**	0.220
1	-0.020	-1.000	0.000	-0.034	-1.700	0.001	0.001	0.050	0.000
2	0.006	0.300	0.000	0.026	1.300	0.001	0.014	0.700	0.000
3	0.067	***3.350**	0.004	0.061	***3.050**	0.004	0.070	***3.500**	0.005
4	-0.009	-0.450	0.000	0.003	0.150	0.000	0.004	0.200	0.000
5	-0.028	-1.400	0.001	-0.021	-1.050	0.000	-0.020	-1.000	0.000
6	-0.007	-0.350	0.000	-0.015	-0.750	0.000	-0.008	-0.400	0.000
7	0.025	1.250	0.001	0.014	0.700	0.000	0.032	1.600	0.001
8	0.046	2.300	0.002	0.030	1.500	0.001	0.047	2.350	0.002
9	0.033	1.650	0.001	0.050	2.500	0.003	0.047	2.350	0.002
10	0.010	0.500	0.000	0.010	0.500	0.000	0.011	0.550	0.000
	BSE 100 & Sensex			BSE 100 & Nifty			BSE 100 & CNX 500		
lags	r	t values	R^2	r	t values	R^2	r	t values	R^2
0	**0.945**	***47.250**	0.893	**0.879**	***43.950**	0.773	**0.469**	***23.450**	0.220
1	0.083	***4.150**	0.007	0.123	***6.150**	0.015	0.620	***31.000**	0.384
2	-0.024	-1.200	0.001	-0.017	-0.850	0.000	0.061	***3.050**	0.004
3	0.025	1.250	0.001	0.024	1.200	0.001	0.017	0.850	0.000
4	0.041	2.050	0.002	0.029	1.450	0.001	0.041	2.050	0.002
5	-0.019	-0.950	0.000	-0.003	-0.150	0.000	0.021	1.050	0.000
6	-0.046	-2.300	0.002	-0.039	-1.950	0.002	-0.016	-0.800	0.000
7	0.018	0.900	0.000	0.008	0.400	0.000	-0.016	-0.800	0.000
8	0.029	1.450	0.001	0.017	0.850	0.000	0.025	1.250	0.001
9	0.044	2.200	0.002	0.041	2.050	0.002	0.034	1.700	0.001
10	0.038	1.900	0.001	0.042	2.100	0.002	0.050	2.500	0.003

* significant at 1% degree of freedom

DHĀRANA
BHAVAN'S INTERNATIONAL JOURNAL OF BUSINESS
Vol:4, 1 (2010) 16-27 ISSN 0974-0082

Price Discovery in NSE Spot and Futures Markets of India: Evidence from selected IT Industries

P. Srinivasan
Christ University, Bangalore

Abstract

Johansen's Cointegration technique followed by the Vector Error Correction Model (VECM) was employed to examine the lead-lag relationship between NSE spot and futures markets of selected eight IT sector stocks of India. The empirical analysis was conducted for the daily data series from 20th April, 2005 to 15th September, 2008. The analysis reveals the bidirectional relationship between spot and futures markets in case of five selected IT stocks. This is followed by spot leads to futures and futures leads to spot markets in case of two and one selected IT stocks in India respectively. The present study suggests that depending on the relative proportions of informed to uninformed (noise) traders migrating from the spot market to the futures market, the lead-lag relationship between futures and spot market of selected IT sector stocks may differ.

Key words : Stock Futures, Spot Market, Lead-lag Relationship, Cointegration, Vector Error Correction Model, Informational efficiency

JEL Classification : C32, G13, G14

1. Introduction

The future market trading in Indian financial markets was introduced in June 2000 and options index was commenced from June 2001 and subsequently the options and futures on individual securities trading was commenced from July 2001 and November 2001, respectively. The future derivative trading on stock indexes has grown rapidly since inception and provides important economic functions such as price discovery, portfolio diversification and opportunity for market participants to hedge against the risk of adverse price movements. Hence, the movements of spot market price have been largely influenced by the speculation, hedging and arbitrage activity of futures markets. Thus, understanding the influence of one market on the other and role of each market segment in price discovery is the central question in market microstructure design and has become increasingly important research issue among academicians, regulators and practitioners alike as it provides an idea about the market efficiency, volatility, hedging effectiveness and arbitrage opportunities, if any. Price discovery is the process of revealing information about future spot prices through the future markets.

The essence of the price discovery function hinges on whether new information is reflected first in changes of future prices or changes of spot prices. Hence, there exists lead-lag relationship between spot and futures market by information dissemination. All the information available in the market place is immediately incorporated in the prices of assets in an efficient market. So, new information disseminating into the market should be reflected immediately in spot and futures prices simultaneously. This will lead to perfect positive contemporaneous comovement between the prices of those markets and there will be no systematic lagged response and therefore no arbitrage opportunity. This prediction arises directly from the Cost of Carry (COC) model of future pricing which postulates that

$$F_t = S_t e^{(r-y)(T-t)} \quad \ldots\ldots\ldots\ldots \textit{(1)}$$

where, Ft is the futures price of the index at time t, St is the spot price of the index at time t, r is the interest rate foregone while carrying the underlying stocks, y is the dividend yield on the stocks and T – t is the remaining life of the futures contract. Equation (1) is justified by a "no-arbitrage" assumption, since $F_t > S_t e^{(r-y)(T-t)}$ would enable investors to profit by selling futures and buying stocks, while $S_t e^{(r-y)(T-t)} > F_t$ would allow profits by buying futures and short selling stocks. The assumptions that underlie these arguments are that future and spot markets are perfectly efficient, and that transaction costs are zero. This simple version of the model also assumes that the interest rate and dividend yield are constant over the life of the futures contract, although in practice they will vary, as will $r - y$, the net cost of carry of the underlying stocks. Most importantly, in the real world, the existence of market frictions such as transaction costs, margin requirements, short-sale constraints, liquidity differences and non-synchronous trading effects may induce lead-lag relationship between the futures contract and its underlying spot market. In addition, if there are economic incentives for traders to use one market over the other, a price discovery process between the two markets is likely to happen (Zou and Pinfold, 2001). This implies that futures and spot market prices are inter-related and can be traced under different market frictions through price discovery mechanism.

Accordingly, there exist diversified theoretical arguments pertaining to the causal relationship between spot and futures markets by information dissemination and raises the major question that which market price reacts first (lead) whether (a) futures prices tend to influence spot prices or (b) spot prices tend to lead futures prices or (c) a bidirectional feedback relationship exists between spot and futures prices.

(a) Futures prices tend to influence spot prices

The main arguments in favour of futures market leads spot market are mainly due to the advantages provided by the futures market includes higher liquidity, lower transaction costs, lower margins, ease leverage positions, rapid execution and greater flexibility for short positions. Such advantages attract larger informed traders and make the futures market to react first when market- wide information or major stock-specific information arrives. Thus, the future prices lead the spot market prices.

(b) Spot prices tend to lead futures prices

On the other hand, the low cost contingent strategies and high degree of leverage benefits in futures market attracts larger speculative traders from a spot market to a more regulated futures market segments. Hence, this ultimately reduces informational asymmetries of the spot market through reducing the amount of noise trading and helps in price discovery, improve the overall market depth, enhance market efficiency and increase market liquidity. This makes spot market to react first when market-wide information or major stock- specific information arrives. Hence, spot market leads the futures market.

(c) Bidirectional feedback relationship exists between spot and futures prices

Besides, there exists a bidirectional relationship between the futures and spot markets through price discovery process (see, Turkington and Walsh 1999; Chris, Alistar and Stuart 2001; Ryoo and Graham Smith 2004; Kenourgios 2004 and Chang and Lee 2008). This may be mainly due to future markets attracts larger informed traders to enjoy the advantages of higher liquidity, lower transaction costs, lower margins and greater flexibility for short positions. Hence, these advantages make futures markets to lead the spot markets around macro-

economic or major stock-specific information releases. Consequently, the spot markets will lead the futures market under the circumstances that these advantages of futures markets attracts larger speculative traders from a spot market and reduces informational asymmetries of the spot market through reducing the amount of noise trading and helps in price discovery, improve the overall market depth, enhance market efficiency and increase market liquidity. This makes spot market to react fast when market-wide information or major stock- specific information arrives. Thus, both the spot and futures markets are said to be informationally efficient and reacts more quickly to each other.

2. Review of Literature

An overwhelming number of studies have examined the price discovery process involving well established United States, European and Asian futures markets providing different results. Broadly speaking, Stock index futures contracts were first studied by Zeck Lauser and Niederoffer (1983) with reference to United States. The correlation technique was employed to examine the objective and the analysis reveals that future leads to spot market. A similar kind of correlation technique was employed by Finnerty and Park (1987) to examine the hypothesis that Major Market Index (MMI) futures price changes determine cash index changes. It was pointed out that correlation analysis provides only unidirectional results without any evidence for a causal relationship.

Further, Kawaller, Koch and Koch (1987) examined the intraday price relationship between the S&P 500 futures and index prices for the year 1984-1985. Three-stage-least-square regression analysis was employed to examine the objective. The analysis revealed that futures price movements consistently lead the spot index movements by up to 45 minutes. Herbst, McCormack and West (1987) employed cross correlation analysis to determine that futures lead the cash index for S&P 500 and value line futures contracts. They found that future index lead the spot index between 0 to 16 minutes. Similarly, Harris (1989) examined the relationship between S&P 500 index and futures during the October 1987 stock market crash using five-minute data. A correlation technique and weighted least squires (WLS) model have been employed to examine the objective. The analysis revealed that futures market leads the spot market. An ARMA (p, q) process has been employed by Stoll and Whaley (1990) to study the intraday price relationship between S&P 500 and the Major Market Index (MMI) futures for the year 1982-1987. They found a strong evidence of futures market leading the spot market. Similarly, other studies by Cheung and Ng (1990), Chan (1992), Tang, Mak and Choi (1992), Antoniou and Garrett (1993), Ghosh (1993), Fleming, Ostdiek and Whaley (1996), Pizzi, Economopoulos and O' Neal (1998), Shyy, Vijayraghavan and Scott-Quinn (1996), Yu (1997), Abhyankar (1998), Booth, So and Tse (1999), Min and Najand (1999), Roope and Zurbruegg (2002), Pattarin and Ferretti (2004) and Floros and Vougas (2007) supports the primacy of future markets in the price discovery process.

On the other hand, Wahab and Lashgari (1993) used daily data to examine the causal nexus between index and stock index futures for both S&P 500 and FTSE 100 Index for the period 1988-1992. Cointegration and Error Correction model were employed to examine the objective and the analysis reveals that spot leads to future markets appear to be more pronounced across days relative to the futures lead to spot. Similarly, Abhyankar, A. H. (1995) had investigated the lead–lag relationship between FT-SE 100 stock index futures and cash index using hourly data for the period 1986-1990. They employed an AR (2) and Exponential GARCH (1, 1) model to evaluate the lead-lag relations for periods of differential transactional costs, spot volumes and volatility, good and bad news (measured by the size of returns). The empirical results revealed that the futures lead the spot index reduced, when transaction costs for underlying asset declines. It also observed that futures market leads spot market returns during periods of high volatility.

Besides, Turkington and Walsh (1999) employed ARMA (p, q), Bivariate VEC, VAR models and impulse response functions to examine the high frequency causal relationship between Shares Prices Index (SPI) futures and the All-Ordinaries Index (AOI) for Australia. The analysis reveals bi-directional causality between the SPI futures and spot AOI index. Similarly, the study

of Chris, Alistar and Stuart (2001) of UK finds feedback relationship between FTSE 100 stock index futures and the FTSE 100 index. Further, recent studies by H-J Ryoo and Graham Smith (2004) for Korea, Kenourgios (2004) for Athens and Chang and Lee (2008) for Taiwan finds bidirectional relationship between spot index and future prices.

At national level, an attempt has been made by Thenmozhi, M (2002) to investigate the empirical relationship between S&P CNX nifty futures and S&P CNX nifty index for the period 2000-2002. Ordinary least squares and two stage least squares regression methods were employed to examine the objective. The analysis reveals that futures returns lead the spot index returns. On the other hand, Raju and Karande (2003) examined the price discovery between the S&P CNX Nifty and its corresponding futures during the period 2000-2002. Cointegration technique and Error Correction models were employed for examining the objectives. The analysis revealed that price discovery occurs in the both futures and the spot market. Similarly, the study of Sah and Kumar (2006) had employed Cointegration and Error Correction models for the daily data series from June 2000 to March 2005 and finds a feedback mechanism between nifty spot and nifty futures in India. Further, Mukherjee and Mishra (2006) employed cross correlation and error correction model to investigate the intra day lead-lag relationship between nifty futures and spot index from April to September 2004. They found bidirectional relationship between future and spot markets. However, the study results reveals that spot market had a major role in price discovery and leads over the futures market. Kapil Gupta and Balwinder Singh (2006) investigate the hypothesis that the established Nifty Index Futures Market effectively serves the price discovery function in the underlying spot market. Johansen's Cointegration, Vector Error Correction Model and Generalized Impulse Response Analysis are applied to test the hypothesis on daily data from NSE. Bilateral causality is observed between Nifty Index and Nifty Index Futures. The evidence supports the hypothesis suggesting that the futures market in India is a useful price discovery vehicle. Recent study by Shalini Bhatia (2007) employed Cointegration and error correction model to examine the intra day lead-lag relationship between S&P CNX nifty futures and S&P CNX nifty index for the period April, 2005-March, 2006. The analysis reveals that nifty futures lead the spot index by 10 to 25 minutes.

The above existing literatures pertaining to lead-lag relationship between price changes in international futures and spot markets are well established by information dissemination. However, the results pertaining to price discovery process were seems to be mixed and reveal the following lacunae: Firstly, all of the studies have adopted index futures for the purpose of analysing the price discovery process between the spot and futures price. Therefore, there exists a scope for further analysis of employing the stock futures on individual securities. This can give the detail analysis of price discovery between the spot and futures on each individual security. Secondly, most of the studies employed Cointegration test and Vector Error Correction Model (VECM) to examine the causal nexus between futures and spot market. It revealed that Johansen's Cointegration test and Vector Error Correction Model are the superior techniques to investigate the issue because it indicates the possibility of long-run equilibrium between future and spot markets which gives the chance for equilibrium price for investors and traders after adjusting the short-run price fluctuations. Further, it is important for investors and traders for trading in the leading market in the short-run. So they can make arbitrage profit by trading in the leading market. The Error correction model estimates the leading market between spot and futures markets. Thus, the study can be done by employing Johansen's Cointegration test and Vector Error correction model to investigate the causality between spot and futures of the selected banking stocks and this will be immensely useful for the traders to hedge their market risk.

On the above background, the present article examines the lead-lag relationship between NSE spot and futures markets of the selected Information Technology (IT) sector stocks of India. The rest of the paper is organised as follows: Section–3 presents the methodology of the study. Section-4 gives empirical results and discussion. Finally, concluding remarks are presented in Section-5.

3. Methodology and Data

Johansen's (1988) Cointegration and Vector Error Correction Model (VECM) were employed to examine the lead-lag relationship between NSE spot and futures markets of the selected IT sector stocks. Augmented Dickey-Fuller (1979) and Phillips-Perron (1988) tests were employed to verify the stationarity of the data series. Further, the necessary lag length of the data series was selected on the basis of Schwarz Information Criterion (SC). Johansen's Cointegration test is employed to examine long-run relationship among the variables after they are integrated in an identical order. Then, Johansen's (1988) Vector Error Correction Model (VECM) is employed to investigate the price discovery and causal relationship between spot and future prices of selected IT industry stocks of India.

3.1 Johansen's Vector Error Correction Model (VECM)

Given the time-series nature of the data, the first step in the analysis is to determine the order of integration of each price series using Augmented Dickey-Fuller (ADF, 1981), and Phillips and Perron (PP, 1988) tests. Given a set of two I(1) series[1], Johansen (1988, 1991) tests are used to determine whether the series stand in a long-run relationship between them, i.e., they are cointegrated. The following VECM (Johansen, 1988) is estimated:

$$\Delta X_t = \sum_{i=1}^{p-1} \Gamma_i \Delta X_{t-i} + \Pi X_{t-1} + \varepsilon_t \quad ;$$

$$\varepsilon_t \mid \Omega_{t-1} \sim distr(0, H_t) \qquad (2)$$

where X_t is the 2x1 vector $(S_t, F_t)'$ of log-Spot and log-Futures prices, respectively, Δ denotes the first difference operator, ε_t is a 2x1 vector of residuals $(\varepsilon_{S,t}, \varepsilon_{F,t})'$ that follow an as-yet-unspecified conditional distribution with mean zero and time-varying covariance matrix, H_t. The VECM specification contains information on both the short- and long-run adjustment to changes in X_t, via the estimated parameters Γ_i and Π, respectively.

Johansen and Juselius (1990), show that the coefficient matrix Π contains the essential information about the relationship between S_t and F_t. Specifically, if rank (Π) = 0, then Π is 2x2 zero matrix implying that there is no cointegration relationship between S_t and $F_{t,t-n}$. In this case the VECM reduces to a VAR model in first differences. If Π has a full rank, that is rank (Π) = 2, then all variables in X_t are *I*(0) and the appropriate modelling strategy is to estimate a VAR model in levels. If Π has a reduced rank, that is rank (Π) = 1, then there is a single cointegrating relationship between S_t and F_t, which is given by any row of matrix Π and the expression ΠX_{t-1} is the error correction term. In this case, Π can be factored into two separate matrices α and β, both of dimensions 2x1, where 1 represents the rank of Π, such as $\Pi = \alpha\beta'$, where β' represents the vector of cointegrating parameters and α is the vector of error-correction coefficients measuring the speed of convergence to the long-run steady state[2].

If Spot and Futures prices are cointegrated then causality must exist in at least one direction (Granger, 1988). Granger causality can identify whether two variables move one after the other or contemporaneously. When they move contemporaneously, one provides no information for characterising the other. If "X causes Y", then changes in X should precede changes in Y. Consider the VECM specification of Equation (2), which can be written as follows:

---

[1] *I(1) stands for a price series which is integrated of order 1; that it is needed to be differenced once to become stationary.*

[2] *Since rank (Π) equals the number of characteristic roots (or eigenvalues) which are different from zero, the number of distinct cointegrating vectors can be obtained by estimating the number of these eigenvalues, which are significantly different from zero. The characteristic roots of the nxn matrix Π, are the values of λ which satisfy the following equation $|\Pi - \lambda \mathbf{I}_n| = 0$, where $\mathbf{I}_n$ is a nxn identity matrix. Johansen (1988), proposes the following two statistics to test for the rank of Π:*

$$\lambda_{trace}(r) = -T \sum_{i=r+1}^{n} ln\left(1 - \hat{\lambda}_i\right), \quad \lambda_{max}(r, r+1) = -T\, ln\left(1 - \hat{\lambda}_{r+i}\right)$$

where $\hat{\lambda}_i$ are the eigenvalues obtained from the estimate of the Π matrix and T is the number of usable observations. The λ_{trace} tests the null that there are at most r cointegrating vectors against the alternative that the number of cointe¬grating vectors is greater than r and the λ_{max} tests the null that the number of cointegrating vectors is r, against the alternative of r + 1. Critical values for the λ_{trace} and λ_{max} statistics are provided by Osterwald-Lenum (1992).

$$\Delta S_t = \sum_{i=1}^{p-1} a_{S,i}\Delta S_{t-i} + \sum_{i=1}^{p-1} b_{S,i}\Delta F_{t-i} + a_S z_{t-1} + \varepsilon_{S,t} \qquad (3)$$

$$\varepsilon_{i,t} \mid \Omega_{t-1} \sim distr(0, H_t)$$

$$\Delta F_t = \sum_{i=1}^{p-1} a_{F,i}\Delta S_{t-i} + \sum_{i=1}^{p-1} b_{F,i}\Delta F_{t-i} + a_F z_{t-1} + \varepsilon_{F,t} \qquad (4)$$

where $a_{S,i}$, $b_{S,i}$, a_{Fi}, b_{Fi} are the short-run coefficients, $z_{t-1} = \beta' X_{t-1}$ is the error- correction term, and $\varepsilon_{S,t}$ and ε_{Ft} are residuals.

In the above equations of Vector Error Correction Model, the unidirectional causality from Futures-to-Spot (F_t Granger causes S_t) requires: (i) that some of the bs, i coefficients, i = 1, 2, …, p-1, are non zero and/or (ii) aS, the error-correction coefficient in Equation (3), is significant at conventional levels. Similarly, unidirectional causality from Spot-to-Futures (S_t Granger causes F_t) requires: (i) that some of the $a_{F,i}$ coefficients, i = 1, 2, …, p-1, are non zero and/or (ii) a_F is significant at conventional levels. If both variables Granger cause each other, then it is said that there is a two-way feedback relationship between S_t and F_t (Granger, 1988)[3]. These hypotheses can be tested by applying Wald tests on the joint significance of the lagged estimated coefficients of ΔS_{t-i} and ΔF_{t-i}. When the residuals of the error-correction equations exhibit heteroskedasticity, the t-statistics are adjusted by White (1980) heteroskedasticity correction.

The vector error correction model (VECM) equation (2) and (3) provides a framework for valid inference in the presence of I(1) variable. Moreover, the Johansen (1988) procedure provides more efficient estimates of the cointegrating relationship than the Engle and Granger (1987) estimator (Gonzalo, 1994). Also Johansen (1988) tests are shown to be fairly robust to presence of non-normality (Cheung and Lai, 1993) and heteroscedasticity disturbances (Lee and Tse, 1996).

3.2 Research Hypotheses

Following hypotheses were taken for testing-

H_1: Futures markets provide an efficient price discovery mechanism, which supports the hypothesis that futures prices lead spot prices (futures prices contain useful information about cash prices of mature markets).

H_2: Spot markets provide an efficient price discovery mechanism, which supports the hypothesis that spot prices lead futures prices (spot prices contain useful information about future prices of mature markets).

H_3: Bidirectional causality exists between the two price series, then spot and futures have an important price discovery role.

3.3 Data

The data for the study consists of daily closing prices of spot and stock futures on eight IT stocks that traded in National Stock Exchange (NSE). The list of the selected IT sector stocks considered for the study had presented in Appendix-1. The data set has been comprised from 20th April, 2005 to 15th September, 2008. The near month contract of stock futures has been used for the study as they are mostly heavily traded as compared to next month and far month future contracts. All the required data information for the study has been retrieved from the National Stock Exchange (NSE) website.

4. Empirical Results and Discussions

As a preliminary investigation, Table -1 presents the result of summary statistics of spot and future market returns of selected IT stocks. The table result depicts that the mean returns of spot and futures markets of selected stocks are found to be positive and the standard deviations of both spot and future returns series of selected IT stocks were ranges between 0.169 and 0.339 which indicates

3 The Johansen (1988) procedure is preferred because it provides more efficient estimates of the cointegration vector than the Engle and Granger (1987) two-step approach. Toda and Phillips (1993) argue that causality tests based on OLS estimators of unrestricted levels VAR's are not very useful in general because of uncertainties regarding the relevant asymptotic theory and potential nuisance parameters in the limit. However, maximum likelihood estimators based on Johansen's (1988, 1991) ML method (for large samples of more than 100 observations) are asymptotically median unbiased, have mixed normal limit distributions and they take into account the information on the presence of unit roots in the system. Therefore, they are much better suited to perform inference.

that the volatility nature of the stocks was found to be higher. Further, the table result reveals that the skewness statistics of selected stocks are significantly different from zero for both the market return series i.e. they are skewed either to the right or to the left. Also, the excess kurtosis values of spot and future market return series of selected stocks are fat-tailed or leptokurtic compared to the normal distribution. In addition, the Jarque-Bera test statistics indicate that the null hypothesis of normality of spot and future return series of selected IT stocks had been rejected at one per cent significance level except POLARIS. Hence, it can be concluded that both the market return series of selected stocks except POLARIS were significantly departures from normality. However, the Augmented Dickey Fuller and Phillips-Perron tests result of Table-2 reveals that the hypothesis of a unit root in the spot and future return series of each selected IT stocks is strongly rejected. Therefore, spot and future returns follow a stationary process even though they fail to be normally distributed. Besides, the unit root tests result reveals that both the data series of future and spot price of each selected stocks are found to be stationary at first order level and integrated at the order of I(1). Johansen's Cointegration test is performed to examine the long-run relationship between spot and future market prices of selected IT stocks and its results are presented in Table-3. The table result reveals the presence of one cointegrating vector between the two market prices at one percent significance level in case of each IT stocks. The Johansen's cointegration test confirms the existence of long-run relationship between the spot and future prices of each selected IT stocks.

After identifying single cointegration vector between spot and future prices of the selected IT stocks, the Vector Error Correction Model (VECM) was employed to examine the causal nexus between future and spot market of selected IT stocks and its results are presented in Table-4. Besides, the vector error correction model is sensitive to the selection of optimal lag length and the necessary lag length of future and spot price series for the selected stocks is determined by the Schwarz Information Criterion (SC) and it reveals optimal lag of one and two in case of 3 and 5 IT stocks respectively.

By and large, the table results of vector error correction model reveal the bidirectional relationship between spot and futures markets in case of five individual IT stocks, viz. HCLTECH, I-FLEX, INFOSYSTCH, PATNI and POLARIS. This shows that both the spot and future markets are said to be informationally efficient and reacts more quickly to each other. The analysis also confirms the spot leads to futures followed by futures leads to spot markets in case of TCS and WIPRO and SATYAMCOMP respectively. The variation of price discovery mechanism of the selected IT stocks depends on the relative proportions of informed to uniformed (noise) traders migrating from the spot market to the futures market. Hence, the lead-lag relationship between NSE futures and spot markets of selected IT sector stocks may differ.

5. Concluding remarks

Johansen's Cointegration technique followed by the Vector Error Correction Model (VECM) was employed to examine the lead-lag relationship between NSE spot and futures markets of selected eight individual IT sector stocks of India. The empirical analysis was conducted for the daily data series from 27th May, 2005 to 29th May, 2008. The analysis reveals the bidirectional relationship between spot and futures markets in case of five individual IT stocks. This is followed by spot leads to futures and futures leads to spot markets in case of two and one selected IT stocks in India respectively. The present study suggests that depending on the relative proportions of informed to uninformed (noise) traders migrating from the spot market to the futures market, the lead-lag relationship between futures and spot market of selected IT sector stocks may differ.

6. References

Abhyankar, A. (1998), "Linear and Nonlinear Granger Causality: Evidence from the U.K. Stock Index Futures Market", The Journal of Futures Markets, Vol. 18, No. 5, pp. 519–540.

Abhyankar, A.H. (1995), "Return and Volatility Dynamics in the FT-SE 100 Stock Index and Stock Index Futures Markets", Journal of Futures Markets, Vol. 15, No.4, pp. 457-488.

Antoniou, A. and I. Garrett (1993), "To What Extend did Stock Index Futures Contribute to the October 1987 Stock Market Crash?", The Economic Journal, Vol.103, pp. 1444-1461.

Booth G. G., R. W. So and Y Tse (1999), "Price Discovery in the German equity Index derivatives markets", The Journal of Futures Markets, Vol. 19, No. 6, pp. 619-643.

Chan Kalok (1992), "A Further Analysis of the Lead-Lag Relationship between the Cash Market and Stock Index Futures Market", Review of Financial Studies, Vol. 5, No. 1, pp. 123-152.

Chang, C. C. and Lee, Y. H. (2008), "Asymmetric Causal Relationship between Spot and Futures in Taiwan", International Research Journal Finance and Economics, Issue 14, pp. 113-121.

Cheung, Y. and Lai, K. (1993), "Finite sample sizes of Johansen's Likelihood Ratio Tests for Cointegration", Oxford Bulletin of Economics and Statistics, Vol. 55, pp. 313-328.

Cheung, Y. W. and Ng, L. K., (1990), "The dynamics of S&P 500 index and S&P 500 futures intraday price volatilities", Review of Futures Markets, Vol. 2, pp. 458-486.

Chris, B., Alistar, G.W., and Stuart, T. (2001), "A trading strategy based on the lead-lag relationship between the spot index and futures contract for the FTSE 100", International Journal of Forecasting, Vol.17, pp. 31- 44.

Dickey, D.A. and W.A. Fuller, (1979), "Distribution of the Estimators for Autoregressive Time Series with a Unit Root", Journal of the American Statistical Association, Vol. 74, pp. 427-431.

Engel, R.F. and Granger, C.W.J. (1987), ""Cointegration and Error-Correction, Representation, Estimation, and Testing", Econometrica, Vol.55, pp. 251-276.

Finnerty J. and Park H. (1987), "Stock index futures: Does the tail way the dog?" Financial Analysts Journal, Vol. 43, pp. 57-61.

Fleming J., Ostdiek B. and Whaley R. (1996), "Trading Costs and the Relative Rates of Price Discovery in Stock Futures and Option Markets", Journal of Futures Markets, Vol.16, No. 4, pp.353-387.

Floros, C. and Vougas D. V. (2007), "Lead-Lag Relationship between Futures and Spot Markets in Greece: 1999 – 2001", International Research Journal of Finance and Economics, Issue 7, pp. 168-174.

Ghosh, Asim (1993), "Cointegration and Error Correction Models: Intertemporal Causality between Index and Futures Prices", Journal of Futures Markets, Vol.13, No. 2, pp.193-198.

Gonzola, J. (1994), "Five Alternative Methods of Estimating Long-Run Equilibrium Relationship", Econometrica, Vol. 60, pp. 203-233.

Granger, C. W. J. (1988), "Some Recent Developments in a Concept of Causality," Journal of Econometrics, Vol. 16, No. 1, pp. 121-130.

Harris, C. (1989), "The October 1987 S&P 500 Stock-Futures Basis", The Journal of Finance, Vol. 44, No. 1, pp. 77 – 99.

Herbst, A. F., McCormack, J. P. and West, E. N., (1987), "Investigation of lead-lag relationship between spot stock indices and their futures contract", The Journal of Futures Markets, Vol. 7, pp. 373-382.

Johansen, S. (1991), "Estimation and Hypothesis Testing of Cointegration Vectors in Gaussian Vector Autoregressive Models," Econometrica, Vol.59, pp. 1551-1580.

Johansen, S. (1988), "Statistical Analysis and Cointegrating Vectors", Journal of Economic Dynamics and Control, Vol.12, pp. 231–254.

Johansen, S. and Juselius, K. (1990),"Maximum Likelihood Estimation and Inference on

Cointegration-with Applications to the Demand for Money," Oxford Bulletin of Economics and Statistics, Vol. 52, 169-210.

Kapil Gupta and Balwinder Singh (2006), "Price Discovery and Causality in Spot and Futures Markets in India", ICFAI Journal of Derivatives Markets, Vol. 3, No. 1, pp. 30-41.

Kawaller, I.P., Koch, P., and Koch T. (1987), "The Temporal Price Relationship between S&P 500 Futures and S&P 500 Index", Journal of Finance, Vol. 41, pp. 107–125.

Kenourgios, D. F. (2004), "Price Discovery in the Athens Derivatives Exchange: Evidence for the FTSE/ASE-20 Futures Market", Economic and Business Review, Vol. 6, No. 3, pp. 229-243.

Lee, T. and Tse, Y. (1996), "Cointegration Tests with Conditional Heteroscedasticity", Journal of Econometrics, Vol. 73, pp. 401-410.

Min, J.H and Najand, M. (1999), "A further investigation of lead-lag relationship between the spot market and stock index futures: Early evidence from Korea", The Journal of Futures Markets, Vol. 19, No.1, pp. 217-232.

Mukherjee, K.N and Mishra, R.K. (2006), "Lead-Lag Relationship between Equities and Stock Index Futures Market and its Variation around Information Release: Empirical Evidence from India", NSE Research Paper, National Stock Exchange, India.

Osterwald-Lenum, M. (1992), "A Note with the Quantiles of the Asymptotic Distribution of the Maximum Likelihood Cointegration Rank Test Statistics," Oxford Bulletin of Economics and Statistics, Vol.54, pp. 461-472.

Pattarin, F. and Ferretti, R. (2004), "The Mib30 index and futures relationship: econometric analysis and implications for hedging", Applied Financial Economics, Vol.14, No. 18, pp.1281-1289.

Phillips, P. and Perron, P. (1988), "Testing for a Unit Root in Time Series Regression", Biometrica, Vol.75, pp. 335-346.

Pizzi M A, A J. Economopoulos and H M. O'Neill (1998), "An Examination of the Relationship between Stock Index Cash and Futures Markets: A Co-integration Approach", The Journal of Futures Markets, Vol. 18, No. 3, pp. 297 – 305.

Raju, M. T. and Karande, K. (2003), "Price Discovery and Volatility on NSE Futures Market", SEBI Bulletin, Vol. 1, No.3, pp. 5-15.

Roope, M. and R. Zurbruegg (2002), "The intra day price discovery process between the Singapore exchange and Taiwan futures exchange", The Journal of Futures Markets, Vol. 22, No. 3, pp 219 – 240.

Ryoo, Hyun-Jung and Smith, Graham (2004), "The impact of stock index futures on the Korean stock market", Applied Financial Economics, Vol. 14, No. 4, pp. 243-251.

Sah, A. N. and Kumar, A. A. (2006), "Price Discovery in Cash and Futures Market: The Case of S&P Nifty and Nifty Futures, The ICFAI Journal of Applied Finance, Vol. 12, No. 4, pp. 55-63.

Shalini Bhatia (2007), "Do the S&P CNX Nifty Index And Nifty Futures Really Lead/Lag? Error Correction Model: A Co-integration Approach", NSE Research Paper no. 183, National Stock Exchange, India.

Shyy G., Vijayraghavan V. and Scott-Quinn B. (1996), "A Further Investigation of the Lead-Lag Relationship between the Cash Market and Stock Index Futures Market with the Use of Bid/Ask Quotes: The Case of France", Journal of Futures Markets, Vol.16, No. 4, pp. 405 – 420.

Stoll, H.R., and Whaley, R.E., (1990), "The dynamics of stock index and stock index futures returns", Journal of Financial and Quantitative Analysis, Vol. 25, No. 4, pp. 441-468.

Tang, Y.N, Mak, S.C and Choi, D. F. S. (1992), "The causal relationship between stock index and cash index prices in Hong Kong", Applied Financial Economics, Vol. 2, pp. 187-190.

Thenmozhi M. (2002), "Futures Trading, Information and Spot Price Volatility of NSE-50 Index Futures Contract", NSE Research Paper, National Stock Exchange, India.

Turkington, J. and Walsh, D. (1999), "Price Discovery and Causality in the Australian Share Price Index Futures Market", Australian Journal of Management, Vol. 24, No. 2, pp. 97-113.

Wahab M and M Lashgari (1993), "Price dynamics and error correction in stock Index and stock Index futures markets: A cointegration approach", Journal of Futures Markets, Vol. 13, No. 7, pp. 711–742.

White, H. (1980), "A Heteroskedasticity-Consistent Covariance Matrix Estimator and a Direct Test for Heteroskedasticity," Econometrica, Vol.48, pp.817–838.

Yu, S. W., (1997), "Price discovery and lead-lag effect in Nikkei 225 stock index futures", The Journal of Security Development, Vol. 9, pp. 29-62.

Zeck Lauser, R. and Niederoffer, V. (1983) "The performance of market index futures contracts", Financial analysts journal, Jan-Feb, pp. 59-65.

Zou, L. and Pinfold, J. (2001)," Price functions between NZSE 10 index, index futures and TENZ, A cointegration approach and error correction model", Working Paper Series no.1, Department of commerce, Massey University, Auckland, pp. 1-31.

7. APPENDIX

Table-1: Summary statistics of spot and future markets return of the selected IT stocks

Name of the IT Stocks	Mean	Standard Deviation	Skewness	Kurtosis	Jarue-Bera Statistics
	Spot Market Returns				
HCLTECH	5.989	0.339	-0.025	1.648	64.94*
I-FLEX	7.194	0.336	-0.008	2.446	10.90*
INFOSYSTCH	7.646	0.215	0.299	2.231	33.72*
PATNI	5.907	0.253	-0.645	2.408	71.57*
POLARIS	4.773	0.258	0.189	3.144	3.825
SATYAMCOMP	6.256	0.234	0.760	2.198	104.8*
TCS	7.090	0.245	0.331	2.244	35.88*
WIPRO	6.221	0.169	0.346	2.873	17.65*
Futures Market Returns					
HCLTECH	5.986	0.337	-0.017	1.641	65.59*
I-FLEX	7.198	0.339	-0.009	2.449	10.77*
INFOSYSTCH	7.647	0.216	0.309	2.222	35.09*
PATNI	5.910	0.255	-0.653	2.409	73.03*
POLARIS	4.777	0.259	0.156	3.150	4.304
SATYAMCOMP	6.257	0.235	0.767	2.207	105.8*
TCS	7.091	0.244	0.325	2.240	35.56*
WIPRO	6.218	0.170	0.316	2.802	15.61*

*Note: * denote the significance at the one per cent level.*

Table 2 : Augmented Dickey-Fuller and Phillip-Perron Test Results

Name of the IT Stocks	Market	Augmented Dickey-Fuller Test Statistics			Phillips-Perron Test Statistics		
		Levels					
		Intercept	With Intercept and Trend	Without Intercept and Trend	Intercept	With Intercept and Trend	Without Intercept and Trend
HCLTECH	Spot	-0.94	-2.32	-0.58	-1.01	-2.44	-0.51
	Futures	-1.02	-2.45	-0.52	-1.04	-2.49	-0.50
I-FLEX	Spot	-2.40	-1.40	0.60	-2.52	-1.53	0.58
	Futures	-2.38	-1.54	0.50	-2.50	-1.56	0.57
INFOSYSTCH	Spot	-1.81	-3.38	-0.30	-1.87	-3.40	-0.28
	Futures	-1.96	-3.37	-0.29	-1.75	-3.36	-0.31
PATNI	Spot	-0.66	-1.71	-0.68	-0.77	-1.79	-0.64
	Futures	-0.64	-1.66	-0.69	-0.76	-1.80	-0.65
POLARIS	Spot	-2.05	-2.21	-0.35	-2.08	-2.24	-0.34
	Futures	-2.10	-2.26	-0.36	-2.13	-2.29	-0.33
SATYAMCOMP	Spot	-2.07	-3.19	-0.15	-1.96	-3.16	-0.09
	Futures	-1.74	-2.85	-0.16	-2.03	-3.21	-0.08
TCS	Spot	-1.52	-3.27	-0.45	-1.50	-3.26	-0.48
	Futures	-1.40	-3.10	-0.43	-1.27	-3.09	-0.46
WIPRO	Spot	-2.77	-2.94	-0.56	-2.80	-3.04	-0.48
	Futures	-2.82	-3.04	-0.49	-2.86	-3.13	-0.47
First Differences							
HCLTECH	Spot	-17.61*	-17.66*	-17.62*	-28.81*	-28.84*	-28.82*
	Futures	-21.26*	-21.30*	-21.26*	-29.27*	-29.31*	-29.28*
I-FLEX	Spot	-17.22*	-17.40*	-17.21*	-28.62*	-28.76*	-28.63*
	Futures	-20.39*	-20.53*	-20.39*	-28.23*	-28.38*	-28.24*
INFOSYSTCH	Spot	-18.61*	-18.60*	-18.62*	-30.89*	-30.90*	-30.91*
	Futures	-13.25*	-13.27*	-13.26*	-30.71*	-30.72*	-30.73*
PATNI	Spot	-11.97*	-12.06*	-11.96*	-26.70*	-26.73*	-26.71*
	Futures	-12.02*	-12.11*	-12.01*	-26.12*	-26.18*	-26.07*
POLARIS	Spot	-11.80*	-11.82*	-11.84*	-27.67*	-27.66*	-27.68*
	Futures	-14.68*	-14.69*	-14.65*	-28.12*	-28.11*	-28.13*
SATYAMCOMP	Spot	-21.72*	-21.75*	-21.73*	-28.66*	-28.69*	-28.68*
	Futures	-14.20*	-14.25*	-14.21*	-28.41*	-28.43*	-28.42*
TCS	Spot	-21.45*	-21.47*	-21.46*	-29.85*	-29.89*	-29.86*
	Futures	-16.36*	-16.40*	-16.37*	-29.93*	-29.95*	-29.94*
WIPRO	Spot	-12.96*	-12.95*	-12.18*	-29.64*	-29.63*	-29.66*
	Futures	-20.65*	-20.64*	-20.66*	-30.21*	-30.19*	-30.22*

Notes: * – indicates significance at one per cent level. Optimal lag length is determined by the Schwarz Information Criterion (SC) and Newey-West Criterion for the Augmented Dickey-Fuller Test and Phillips-Perron Test respectively.

Table 3 : Johansen's Cointegration Test Results

HCLTECH	r = 0	117.33*	116.23*	Cointegrated
	r ≤ 1	1.105	1.105	
I-FLEX	r = 0	118.08*	111.37*	Cointegrated
	r ≤ 1	6.715	6.715	
INFOSYSTCH	r = 0	248.43*	236.58*	Cointegrated
	r ≤ 1	11.84	11.84	
PATNI	r = 0	179.38*	174.09*	Cointegrated
	r ≤ 1	5.290	5.290	
POLARIS	r = 0	96.86*	91.87*	Cointegrated
	r ≤ 1	4.997	4.997	
SATYAMCOMP	r = 0	103.35*	92.87*	Cointegrated
	r ≤ 1	10.47	10.47	
TCS	r = 0	88.46*	86.44*	Cointegrated
	r ≤ 1	2.021	2.021	
WIPRO	r = 0	81.07*	71.26*	Cointegrated
	r ≤ 1	9.805	9.805	

Notes: *- denote the significance at the one per cent level.
r is the number of cointegrating vectors under the null hypothesis (Ho).

Table 4 : Test Results of Vector Error Correction Model

Name of the IT Stocks	Regression Equation	C	$\Delta SPOT_{t-1}$	$\Delta SPOT_{t-2}$	ΔFUT_{t-1}	ΔFUT_{t-2}	ECM_{t-1}	Log Likelihood	Inference
HCLTECH	ΔS on ΔF	0.0001	-0.143		-0.335		0.625**	1442.74	F⟷S
		-0.1129	(-0.796)	-	(-1.864)	-	-2.129		
	ΔF on ΔS	0.0001	-0.315		-0.162		-0.945*	1443.04	
		-0.1128	(-1.753)	-	(-0.906)	-	(-3.219)		
I-FLEX	ΔS on ΔF	0.0001	0.5126*		-0.935*		2.158*	1632.42	F⟷S
		-0.1442	-3.096	-	(-5.865)	-	-8.73		
	ΔF on ΔS	0.0001	0.420**		-0.882*		0.884*	1584.82	
		-0.1406	-2.402	-	(-5.233)	-	-3.383		
INFOSYSTCH	ΔS on ΔF	0.0001	0.042		-0.572*		1.525*	1571.6	F⟷S
		-0.089	-0.347	-	(-4.571)	-	-7.311		
	ΔF on ΔS	0.0001	-0.282**		-0.255**		-0.392**	1555.09	
		-0.084	(-2.267)	-	(-2.001)	-	(-1.990)		
PATNI	ΔS on ΔF	0.0001	0.122*	-0.019	-0.644*	-0.152*	1.614*	2712.94	F⟷S
		-0.394	-3.136	(-1.758)	(-10.49)	(-4.219)	-25.3		
	ΔF on ΔS	0.0001	-0.522*	-0.225*	0.113	0.05	-0.769*		
		-0.135	(-4.281)	(-6.493)	-0.589	-0.444	(-3.847)	1744.43	
POLARIS	ΔS on ΔF	0.0001	-2.692*	-1.629*	2.057*	1.293*	-3.152*		F⟷S
		-0.115	(-4.048)	(-4.147)	-3.131	-3.379	(-3.661)	1458.6	
	ΔF on ΔS	0.0001	-3.119*	-1.807*	2.469*	1.469*	-4.986*		
		-0.113	(-4.492)	(-4.406)	-3.6	-3.678	(-5.549)	1422.25	
SATYAM-COMP	ΔS on ΔF	0.0002	0.875	0.372	-1.472**	-0.702**	2.202*		F⟷S
		-0.169	-1.371	-1.036	(-2.327)	(-1.984)	-2.593	1528.45	
	ΔF on ΔS	0.0002	0.4	0.221	-1.017	-0.556	0.214		
		-0.17	-0.632	-0.621	(-1.619)	(-1.567)	-0.254	1534.83	
TCS	ΔS on ΔF	0.0001	0.099	0.115	-0.745	-0.432	0.51	1559.87	S⟷F
		-0.0013	-0.17	-0.337	(-1.290)	(-0.432)	-0.671		
	ΔF on ΔS	0.0001	-0.293	-0.047	-0.358	-0.27	-1.392**	1556.68	
		-0.0013	(-0.503)	(-0.137)	(-0.617)	(-0.795)	(-1.994)		
WIPRO	ΔS on ΔF	0.0001	-0.438	-0.151	-0.223	-0.144	0.308	1526.42	S⟷F
		-0.092	(-1.154)	(-0.680)	(-0.593)	(-0.661)	-0.623		
	ΔF on ΔS	0.0001	-0.905**	-0.355	0.221	0.054	-1.578*	1540.51	
		-0.106	(-2.342)	(-1.571)	-0.579	-0.244	(-3.139)		

Notes: Parenthesis shows t-statistics, * (**) – indicates significance at one and five per cent level, respectively.

Appendix-1

List of selected IT Sector Stocks considered for the study		
S. No.	**NSE Code/Name of the Stocks**	**Name of the IT Industries**
1.	HCLTECH	HCL Technologies Ltd.
2.	I-FLEX	I-FLEX Solutions Ltd.
3.	INFOSYSTCH	Infosys Technologies Ltd.
4.	PATNI	Patni Computer Syst Ltd.
5.	POLARIS	Polaris Software Lab Ltd.
6.	SATYAMCOMP	Satyam Computer Services Ltd.
7.	TCS	Tata Consultancy Services Ltd.
8.	WIPRO	Wipro Ltd.

DHĀRANA
BHAVAN'S INTERNATIONAL JOURNAL OF BUSINESS
Vol:4, 1 (2010) 28-37 ISSN 0974-0082

Research Opportunities in Workforce Management

Phillip Daniel Wright
Department of Management and Operations, Villanova University, Pennsylvania

Abstract

In this paper, we review a subset of the labor scheduling literature and discuss areas where additional research is warranted. The review, while not exhaustive, concludes that there are still rich research opportunities to contribute to an already large field. The areas that are still most attractive are those which provide models that solve more than one phase of the workforce management problem in an integrative fashion as has been called for by many researchers. We also present an example of an integrative model found in the literature. In addition, an application area for workforce management that has received much attention but still provides promising research opportunities is the area of nurse staffing. With continued nursing shortages, managers are faced with a difficult task of providing quality care while still maintaining costs.

Key words : *Nurse scheduling, Labor scheduling*

1. Introduction:

Workforce management techniques have been studied in the literature for many years. The abundance of research is the result of numerous settings where this research is applicable. This paper provides a brief overview of existing literature relevant to each phase of the workforce management process in Figure 1. The main focus of each section of this paper will be the literature that deals specifically with the planning, scheduling, and allocation/ adjustment decisions studied in this research. The review will show that there are still many areas for opportunity to study workforce management. In addition, the assignment of heterogeneous employees to a set of shifts remains an attractive research stream, with limited attention in the literature. Lastly, there has been almost no research that integrates models across the decision phases of the workforce management process.

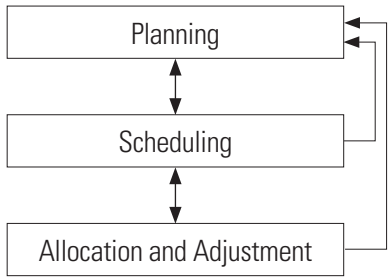

Figure 1 : Workforce Management Framework

The decisions that make up workforce management can be categorized as in Figure 1. This figure represents an adaptation of a three-phase workforce management framework seen in Campbell (1999) and Abernathy et al. (1973). There are several decisions made in each phase of the process and each is dependent on earlier phases. In addition, each of these decisions is based on forecasted demand for the services that the employees provide. The arrows in Figure 1 represent information flows. The planning and scheduling phases contain decisions made before the time of service, while the allocation and adjustment phase contains decisions made at the time of service.

In the planning phase, the manager makes decisions such as: how many employees to hire, what level of cross-training each should achieve, how many to dedicate to each unit of the company, and how many employees to schedule for each shift over the planning horizon. The number of employees needed for each shift is referred to as the *employee requirements*.

In the scheduling phase, the manager develops a schedule which shows when each employee works over the planning horizon. The scheduling model developed in this research accommodates employees that are heterogeneous in terms of skill, availability, and preference while minimizing schedule cost and undesirable shifts. As will be discussed later, some recent research identifies a tradeoff analysis between the cost and undesirable shifts objectives of the tour assignment model.

The allocation and adjustment phase deals with real-time schedule adjustment in order to accommodate actual demand. Allocation and adjustment can be accomplished by assigning cross-trained employees to particular units and transferring employees from one unit to another when necessary.

2. Planning Literature

2.1 Determining the Workforce Size

The size of the workforce (i.e., the number of employees on the payroll) must be determined based on anticipated demand. This decision is based on having enough manpower to cover the expected employee requirements for each shift over the planning horizon. Other scheduling policies may place limitations on the number and/or composition of the shifts each employee is allowed to work. Several researchers have studied this problem and presented algorithms that determine the optimal size of the workforce under various scheduling policies (Burns and Carter 1985, Burns and Koop 1987, Dijkstra et al., 1994, Hung 1994, Ikem and Reisman 1990, Koop 1988).

2.2 Determining Employee Requirements

Approaches to generating requirements have dominated most research dealing with the planning phase of the workforce management process. The approach used is dependent on the individual characteristics and objectives of the company. Service-based and economic-based approaches are most common in the literature. Previous literature is classified by their approach in Table 1. Service-based approaches seek to minimize the employee requirements subject to some minimum service level. Queueing and discrete-event simulation methods are most common for this type of approach. Those that involve queueing commonly use one of Erlang's models, e.g. M/M/c/∞ delay model or M/M/N/N loss model. Call centers have been a favorite area for this research (Agnihhothri and Taylor 1991; Gaballa and Pearce 1979; Hueter and Swart 1998; Segal 1974; Sze 1984). Thompson (1993) addresses multi-period impacts of service to develop employee requirements. Easton and Rossin (1996) allow for variable service levels by using a stochastic goal program to determine requirements. More complicated service systems for which analytical results are too difficult to obtain are typically simulated. For instance, Mason et al. (1998) simulated passenger behavior for two distinct groups, one for departing flights and one for arriving flights, which were served by the same staff. These service based approaches are limited because customer service in a hospital is based not so much on waiting time but rather on quality of service. Service based studies that focus on recent legislation regarding nurse to patient ratios and overtime have recently appeared in the literature (Wright, et al. (2006).

Economic-based models for determining requirements also appear in the literature. This approach generates employee requirements based on calculated opportunity

costs associated with differences between capacity and demand. Costs for understaffing and overstaffing must be readily available for this type of model. Mabert (1979) used economic criteria in the context of check encoding operations. These same criteria are used in a call center environment in Andrews and Parsons (1989, 1993) and Quinn et al. (1991). Thompson (1995) used a net present value (NPV) approach to determine the marginal benefit of adding an additional worker to the requirements.

Approach	Reference
Service-based	Agnihhothri and Taylor (1991)
	Gaballa and Pearce (1979)
	Easton and Rossin (1996)
	Heuter and Swart (1998)
	Mason et al., (1998)
	Segal (1974)
	Sze (1984)
	Thompson (1993, 1997a)
	Wright et al. (2006)
Economic-based	Andrews and Parsons (1989, 1993)
	Mabert (1979)
	Quinn et al. (1991)
	Thompson (1995)

Table 1 Classification of Employee Requirements Literature

3. Scheduling Literature

3.1 Shift/Tour Scheduling

Employee requirements, as determined during the planning phase, are typically used as inputs for the development of the schedule. Schedule development involves creating a set of shifts (tours) for the workforce while complying with various scheduling policies that may exist. The decision variables in the tour scheduling problem indicate how many workers to schedule for each period. Therefore, the tour scheduling problem assumes that labor resources are in infinite supply, which differs from the tour assignment problem discussed in the next section. The earliest formulation of the tour scheduling problem can be seen in Dantzig (1954). This seminal work involved a set covering formulation that satisfied the employee requirements for each shift at the lowest cost. Keith (1979) presented a model which allowed but penalized deviations from the target employee requirements. The models presented in these two works provide the basis for most scheduling research in the literature. A subset of this literature can be seen in Table 2 categorized by the type of formulation. Minimization of the wage cost of the schedule is the predominant performance measure for tour scheduling research. In addition, some authors include a specific consideration for employee preferences (Miller et al., 1976, Warner 1976). Because of the large scale of most tour scheduling problems, heuristic methods have been most frequent. Heuristics range from local search (Henderson and Berry 1976, Keith 1979, Krajewski et al., 1980, Showalter and Mabert 1988, Easton and Rossin 1991a), working subset (Mabert and Watts 1982, Bechtold and Brusco 1994, 1995, Easton and Rossin 1991b), and construction/improvement (Bechtold and Showalter 1987, Buffa et al., 1976). A review of several tour scheduling methodologies can be seen in Bechtold et al. (1991).

Type of Formulation*	Reference
Set Covering (Dantzig 1954)	Henderson and Berry (1976,1977)
	Bechtold and Showalter (1987)
	Easton and Rossin (1991a, 1991b)
	Dantzig (1954)
	Mason, Ryan and Panton (1998)
Penalty functions for deviations from target staffing level (Keith 1979)	Bailey (1985)
	Buffa, Cosgrove and Luce (1976)
	Keith (1979)
	Krajewski, Ritzman and McKenzie (1980)
	Mabert (1979)
	Mabert and Watts (1982)
	Thompson (1990, 1995)
	Warner and Prawda (1972)

Table 2 Classification of Shift/Tour Scheduling Literature

* References are categorized by the formulation that is most similar

3.2 Shift/Tour Assignment

The tour assignment problem is an area of the labor scheduling research that has not been given as much attention. In a labor-constrained environment, the workforce is fixed and each individual must be assigned a set of shifts for the given scheduling horizon. The particular setting in which the tour assignment problem is implemented may include homogeneous (identical) or non-homogeneous employees (non-identical). When employees can be categorized into groups with the same characteristics, a separate assignment problem can be easily solved for each group. This was the case with Ritzman et al. (1976) who assigned postal workers to shifts. They considered different skill levels, but all employees within each skill group were interchangeable. When employees have differences, i.e., are not completely interchangeable, the assignment problem is more difficult to solve. Heterogeneous tour assignment has been given limited attention in the literature.

Developing tour assignments for a heterogeneous workforce requires special consideration for each of its employees. Heterogeneous employees can be unique in terms of skill level, availability, shift preferences, et cetera. Only a few papers that consider heterogeneous employees appear in the literature. Loucks and Jacobs (1991) presented a construction/improvement heuristic to assign workers to tasks within a fast food environment. Love and Hoey (1990) also studied a fast food scheduling system. They presented two network subproblems of an integer goal programming formulation, one that determines employee requirements and one that assigns heterogeneous employees to shifts. Thompson (1997a) assigned telephone operators to shifts based on seniority and preference using a goal programming formulation. Thompson (1990) studied employees that had limited availability. Past research dealing with tour assignment is summarized in Table 3. The first three columns indicate the inclusion of schedule cost, the use of heterogeneous employees, and employee preferences. The last column represents research that integrates more than one phase of the workforce management process. Wright et al. (2006) and Wright and Bretthauer (2009) considered wage cost, heterogeneous employees, employee preference, and also integrated decisions across multiple phases of the workforce management process.

Reference	Cost Objective	Heterogeneous Employees	Employee Preference	Integrate Multiple Phases
Ritzman, et al. (1976)	*			
Malhorta and Ritzman (1994)				
Loucks and Jacobs (1991)	*	*		
Thompson (1990)				
Thompson (1997a)	*	*	*	
Love and Hoey (1990)				
Wright, et al. (2006)	*	*	*	*
Wright and Bretthauer (2009)				

Table 3 Classification of Tour Assignment Literature

Another characteristic that can make employees unique is their level of training outside of their normal department or station. Cross-training, as it is referred to, introduces flexibility into the scheduling environment. Cross-training literature will be reviewed in the following section.

4. Allocation and Adjustment Literature

4.1 Allocation of Cross-Trained Workers

Cross-training is a tactic that managers have used to increase the amount of scheduling flexibility. When workers are trained in multiple areas, it increases the number of options that a manager has to create the schedule. Several researchers have explored the use of cross-training in various settings. A common result in most studies showed that marginal benefits associated with cross-training can be high initially, but diminishing returns sets in relatively quickly.

Brusco and Johns (1998) evaluated several cross-training policies in the context of workers in a paper mill. Campbell (1999) studied various cross-training policies for use in a multi-department service environment.

Workers were assigned to departments at the beginning of a shift. Campbell and Diaby (2002) developed a heuristic for allocating cross-trained staff with non-linear departmental objective functions. Brusco et al. (1998) examined the impact of cross-training on the size of the workforce. In a multi-location environment, Brusco & Showalter (1993) presented several staffing models which allowed cross-trained workers to be transferred to other locations for which they are trained. Pinker and Shumsky (2000) caution that efficiencies gained by the use of cross-trained staff may be offset by decreases in service quality. They incorporate learning, length of employment, and cross-trained servers in their system and show that cross-trained employees may not achieve sufficient experience to provide acceptable levels of customer service. They concluded that some mixture of cross-trained and specialized workers is best. Hopp and Van Oyen (2004) discuss cross-training in the context of coordination. Finally, the use of cross-training in the context of a nurse float pool also appears in the literature. Hershey et al. (1974) evaluated fixed staffing policies versus variable staffing policies that included the use of a cross-trained nurse float pool. Trivedi and Warner (1976) used patient acuity levels at the beginning of a shift to determine departmental needs.

4.2 Real-Time Schedule Adjustment

The Real-Time Work Schedule Adjustment (RTWSA) problem was introduced by Hur et al. (2002). Very little work concerning RTWSA has appeared in the literature. The relevant decision is to modify the planned schedule in real time when the initially scheduled service capacity becomes asynchronous with forecasted demand. Modifications may be required as a result of worker absenteeism, tardiness, or unforeseen variability in customer demand. Vaughan (1995, 1996) suggested the use of on-call employees to alleviate understaffing. These on-call employees were paid a much smaller wage unless they were called to work. Berman and Larson (1994) advocated the use of temporary employees to help cover understaffing. These employees are called only when needed but are guaranteed a minimum number of shifts each month. On-call and temporary employees are short term responses to differences in forecasted and actual demand. Easton and Goodale (2002) studied the importance of planning in advance for turnover and absenteeism. Their method suggested an increase in employee requirements to create additional buffer capacity. Each of these papers presented methods that involved planning in advance for real time adjustment of the schedule. Easton and Goodale (2005) focused on service recovery when absenteeism is encountered. Thompson (1999) suggested more sophisticated methods of monitoring demand and the use of many "action times" (starting or ending time of shifts and breaks) to better prepare for real-time adjustment. Hur et al. (2002) explored a variety of options that could be exercised in real time in the event of both understaffing and overstaffing. These included modification of shift start or end times, cancellation or addition of shifts, reassignment after initial work station assignments, and changes to employee break schedules.

5. Nursing Specific Literature

The nurse scheduling problem has been a favorite area that has been addressed by several authors over the past 30 years. Nurse scheduling, among other service environments, presents a special case of the scheduling problem because of the need for workers on a 24-hour basis. In addition, demand must not be backlogged and there must be a high level of customer service. Nursing is also facing a crisis worldwide (Buerhaus et al. 2008). Table 4 shows past research dealing with nursing. Each article is categorized by the phase of the workforce management process it concerns. Much like the general scheduling literature, the nurse scheduling literature is also dominated by the use of homogenous employees. Early nurse scheduling research explored fixed (Stimson and Stimson 1972) and variable (Hershey, et al. 1974) staffing policies. Fixed staffing only considered full time employees that worked the same time each day. Variable staffing allowed for part-time employees. Kao and Tung (1981) assessed the need for permanent staff, overtime pay, and temporary personnel. Warner and Prawda (1972) presented a mixed-integer programming model that determines the number of each skill class to be scheduled for each unit and shift. Bordoloi and Weatherby (1999) studied the implications of staff skill mix. Easton et al.

(1992) evaluated several nurse scheduling policies used at eight medical and surgical units to reduce turnover. Huarng (1999) used employee preference as a criterion in a binary goal-programming model to determine work tours for nurses. Other academic research dealing with nurse planning (Brusco et al., 1993; Brusco and Showalter 1993; Kao and Queryanne 1985; Needleman et al., 2002; Siferd and Benton 1992; Venkataramanan and Brusco 1996), scheduling (Warner and Prawda 1972; Ozkarahan and Bailey 1988; Downsland 1998; Jaumard et al., 1998; Miller et al., 1976; Warner 1976) and allocation/adjustment (Trivedi and Warner 1976; Hershey et al., 1974) can be seen in Table 4.

In addition to the literature found in academic journals, numerous articles have appeared in practitioner-focused journals. Many of these articles discuss current and troubling issues regarding nurse staffing and scheduling (Aiken et al., 2001, 2002, Graham 1995, Hung 1991, Lanser 2001, Lovern 2002, Marchionno 1987, Schaffner & Ludwig-Beymer 2003, Staff Writer 2002, Tieman 2001a, 2001b, 2002a, 2002b, Jones 2005, 2007). For example, in a series of articles, Tieman discusses developments on the legislature's intervention in nurse staffing issues by instituting mandatory nurse to patient ratios. In fact, 28 state governments plan to consider nurse to patient ratios in the 2004 legislative session. These actions motivate: (1) an evaluation of how the nurse to patient ratios impact scheduling cost and the desirability of the schedule and (2) new methods for determining employee requirements based on controlling the amount of work assigned to each employee.

6. Integrative Literature

There have been a few studies in the literature that claim integrative approaches to planning and scheduling. Venkataraman and Brusco (1996) present an iterative procedure that alternates between planning and scheduling modules until a suitable solution to both problems is found. Easton et al. (1992) also discuss both a staffing and a scheduling model but do not solve them simultaneously. Thompson (1997b) develops two service level approaches for the planning problem and then solves the scheduling problem. Abernathy et al. (1976) present a three-stage model for the nurse-staffing process. Love and Hoey (1990) treat both problems, but do so separately. Each of the authors discuss and provide insights into two problems in the same paper, however, they still solves each phase independently. Although these researchers indicate integrative or simultaneous approaches, they do not meet the level of integration provided by Wright et al. (2006) and Wright & Bretthauer (2009) where the integrative model has the ability to solve both problems simultaneously with decision variables for each phase.

Example of an Integrative Model

This section presents an example of an integrative model that is a scaled down formulation of the model found in Wright et al. (2006). The model coordinates across two problems that are typically treated independently:

Planning	Scheduling	Allocation and Adjustment
Brusco et al. (1993)	Huarng (1999)	Trivedi and Warner (1976)
Brusco and Showalter (1993)	Easton et al. (1992)	Hershey et al. (1974)
Bordoloi and Weatherby (1999)	Warner and Prawda (1972)	Wright and Bretthauer (2009)
Kao and Queryanne (1985)	Ozkarahan and Bailey (1988)	
Needleman et al. (2002)	Downsland (1998)	
Siferd and Benton (1992)	Jaumard et al. (1998)	
Stimson and Stimson (1972)	Miller et al. (1976)	
Venkataramanan and Brusco (1996)	Warner (1976)	
Wright, et al. (2006)	Wright, et al. (2006)	
Wright and Mahar (2009)	Wright and Bretthauer (2009)	
	Wright and Mahar (2009)	

Table 4 Classification of Nursing Specific Literature

planning and scheduling. This integrative model determines how many employees are needed to work on each shift at the same time creates the schedule. The benefits of this integrative model are that it can substantially reduce scheduling cost. The particular model was constructed for a nursing environment and is formulated as a non-linear, bi-criteria integer programming problem.

Sets

N = the set of all nurses
N_{kj} = the set of nurses of type k available for shift j
K = the set of all nurse types
S = the set of shifts
T = the set of weeks in the scheduling horizon
SA^i = the set of shifts that nurse i is available to work
S^{it} = the set of shifts that nurse i is available to work in week t

Subscripts

i : nurse i k: nurse type k
j : shift j
t : week t

Decision Variables

x_{ij} = 1 if nurse i works shift j at regular time wages, 0 otherwise.
y_{ij} = 1 if nurse i works shift j at overtime wages, 0 otherwise.
b_{jk} = the number of nurses of type k required for shift j

Parameters

w = the number of weeks in the scheduling horizon
c_{ij} = regular time wages if nurse i works shift j
d_{ij} = overtime wages if nurse i works shift j
$\overline{n_i}$ = maximum number of shifts each week for nurse i
$\underline{n_i}$ = minimum number of shifts each week for nurse i
$\overline{l_i}$ = upper limit on the number of overtime shifts assigned to nurse i
R_k = the number of patients per nurse type k as determined by the nurse-to-patient ratio
λ_j = mean patient arrival rate during shift j
μ_j = mean unit service rate during shift j
$P_h(\lambda_j, \mu_j)$ = probability of h occupied beds during shift j
u_k = upper limit on the single shift service level for nurse type k
v_k = upper limit on the average service level for nurse type k over the planning horizon
s = number of beds (servers) on a unit
M = a large number

$$\text{Min} \quad \sum_{i\in N}\sum_{j\in SA^i} c_{ij}x_{ij} + \sum_{i\in N}\sum_{j\in SA^i} d_{ij}y_{ij} \tag{1}$$

$$\text{st} \sum_{i\in N^{kj}} x_{ij} + \sum_{i\in N^{kj}} y_{ij} \geq b_{jk},\ j \in S,\ k \in K \tag{2}$$

$$\sum_{h=R_k\cdot b_{jk}+1}^{s} P_h(\lambda_j, \mu_j) \leq u_k,\ j \in S, k \in K \tag{3}$$

$$\left(\sum_{j\in S}\sum_{h=R_k\cdot b_{jk}+1}^{s} P_h(\lambda_j, \mu_j)\right) / |S| \leq v_k, k \in K \tag{4}$$

$$\underline{n_i} \leq \sum_{j\in S^{it}} x_{ij} \leq \overline{n_i},\ \ i \in N, t \in T \tag{5}$$

$$\sum_{j\in SA^i} y_{ij} \leq l_i, i \in N \tag{6}$$

$$(x_{ij} + y_{ij}) + (x_{i(j+1)} + y_{i(j+1)}) + (x_{i(j+2)} + y_{i(j+2)}) \leq 1, i \in N, j \in SA^i \tag{7}$$

$$x_{ij} \in \{0,1\}, y_{ij} \in \{0,1\},\ \ i \in N, j \in SA^i \tag{8}$$

$$b_{jk} \geq 0 \text{ and integer}, j \in S, \text{ and } k \in K \tag{9}$$

where

$$P_h(\lambda_j, \mu_j) = \frac{(\lambda_j/\mu_j)^h / h!}{\sum_{g=0}^{s} (\lambda_j/\mu_j)^g / g!} \qquad i = 0, 1, \ldots, s \tag{10}$$

Having specific decision variables for both the planning and scheduling phases of the workforce management process accomplishes the integration in the above model. The planning decisions come from the b_{jks} in constraint (2) which are determined by constraints (3) and (4). The scheduling decisions are made with decision variables x_{ij} and y_{ij}. Objective (1) minimizes regular time and overtime wage costs for each nurse over the scheduling horizon. Constraint (2) enforces the requirements for each nurse type for each shift. These requirements are determined from constraints (3) and (4) which enforce service levels. Constraint (3) determines per shift service levels and (4) enforces average service levels over the entire planning horizon. Constraint (5) forces each nurse to be scheduled for a minimum and maximum number of shifts per week according to hospital policy. Constraint (6) sets limits to how much overtime can be scheduled for each nurse. Constraint (7) specifies that each nurse must not be scheduled within 24 hours before the previously assigned shift. Constraints (8)-(9) force integer, binary,

and non-negative conditions as appropriate. Expression (10) calculates the probability of any number of beds being occupied on a unit. It is used to enforce service quality in constraints (3) and (4) (see Wright et al. 2006 for more details). Any number of additional constraints could be added. For instance, a manager may want to limit the number of weekend shifts worked by nurses that do not want to work weekends. In addition, as was done in Wright et al. (2006), undesirable shifts may be reduced by adding an objective that minimizes undesirable shifts. This type of objective is important for employee satisfaction and morale.

7. Summary

Three areas of the literature stand out as needing further attention. First, integrative approaches to workforce management, as described above, have just begun to appear in the literature. Many researchers have noted the need for integrative workforce management but only one published paper (Wright et al. (2006)) exists. Because of the complexity of the three-phase staffing problem, integrative models are difficult. However, they are a necessity for the models to be consistent with all of the issues of a practicing manager. Campbell (1999) argues that integrative models that can handle both the scheduling and allocation/adjustment phases of the scheduling process would be particularly useful. Brusco and Johns (1998) describe an example of an "interesting and challenging extension" that is very similar to the integrative approaches developed in this research. Second, the earlier discussion indicates that the tour assignment problem has not been the focus of the workforce management literature, especially with respect to heterogeneous employees. Tour assignment models that also have treatment of employee preferences are particularly useful and attractive to managers. And third, there is a wealth of opportunity in the nurse scheduling area particularly in light of many new laws that pertain to staffing of nurses. Although we have not covered all literature in this review, we have certainly proposed some issues that need to be addressed that are lacking in the literature.

8. References

Abernathy, W. J., N. Baloff, J. C. Hershey, S. Wandel, "A Three-stage Manpower Planning and Scheduling Model – A Service Sector Example," Operations Research, 21(3), 1973, 693-711.

Agnihothri, S.R., & P.F. Taylor, "Staffing a Centralized Appointment Scheduling Department in Lourdes Hospital," Interfaces, 21(5), 1991, 1-11.

Aiken, L.A, Clarke, S.P., Sloane, D.M., Sochalski, J. A., Busse, R., Clarke, H., Giovannetti, P., Hunt, J., Rafferty, A.M., Shamian, J. 2001. Nurses' Reports On Hospital Care in Five Countries. Health Affairs, 20(3) 43-53.

Andrews, B., & H. Parsons, "L.L. Bean Chooses a Telephone Agent Scheduling System," Interfaces, 19(6), 1989, 1-9.

Andrews, B., & H. Parsons, "Establishing Telephone-Agent Staffing Levels through Economic Optimization," Interfaces, 23(2), 1993, 14-20.

Bailey, J., "Integrated Days Off and Shift Personnel Scheduling," Computers & Industrial Engineering, 9(4), 1985, 395-404.

Bechtold, S.E., "Implicit Optimal and Heuristic Labor Staffing in a Multiobjective Multilocation Environment," Decision Sciences, 19(2), 1988.

Bechtold, S.E. & M. J. Brusco, "Working Set Generation Methods for Labor Tour Scheduling," European Journal of Operational Research, 74(3), 1994, 540-551.

Bechtold, S.E. & Showalter, M. J., "A Methodology for Labor Scheduling in a Service Operating System," Decision Sciences, 18(1), 1987, 89-107.

Berman, O. and R.C. Larson, "Determining optimal pool size of a temporary call-in work force," European Journal Of Operational Research, 73(1), 1994, 55-64.

Bordoloi, S.K., & E.J. Weatherby, "Managerial Implications of Calculating Optimum Nurse Staffing in Medical Units," Health Care Management Review, 24(4), 1999, 35-44.

Brusco, M.J. & T.R. Johns, "Staffing a Multi-skilled Workforce with Varying Levels of Productivity: An Analysis of Cross-training Policies," Decision Sciences, 29(2), 1998, 499-515.

Brusco, M.J., T.R. Johns, and J.H. Reed, "Cross-Utilization of a Two-Skilled Workforce," International Journal of Operations & Production Management, 18(6), 1998.

Brusco, M.J. & M.J. Showalter, "Constrained Nurse Staffing Analysis," Omega, 21(2), 1993, 175-186.

Buffa, E.S., M.J. Cosgrove, & B.J. Luce, "An Integrated Work Shift Scheduling System," Decision Sciences, 7 (4), 1976, 620-630.

Burns, R.N., and M.W. Carter, "Workforce Size and Single Shift Schedules with Variable Demands, Management Science, 31(5), 1985, 599-607.

Burns, R.N., and G.J. Koop, "A Modular Approach to Optimal Multiple-Shift Manpower Scheduling, Management Science, 35(1), 1987, 100-110.

Campbell, G.M., "Cross-Utilization of Workers Whose Capabilities Differ," Management Science, 45(5) May 1999, 722-732.

Campbell, G.M., & M. Diaby, "Development and Evaluation of an Assignment Heuristic for Allocating Cross-Trained Workers," European Journal of Operational Research, 138, 2002, 9-20.

Dantzig, G.B., "A Comment on Edie's Traffic Delays at Toll Booths," Operations Research, 2(3), 1954, 339-341.

Dijkstra, M. C., L.G. Kron, M. Salomon, J.A.E.E. van Nunen, L.N. Van Wassenhove, "Planning the Size and Organization of KLM's Aircraft Maintenance Personnel," Interfaces, 24(6), 1994, 47-58.

Downsland, K.A., "Nurse Scheduling with Tabu Search and Strategic Oscillation," Eurpoean Journal of Operational Research, 106( ), 1998, 393-407.

Easton, F.F. & J.C. Goodale, "Labor Scheduling with Employee Turnover and Absenteeism," Working Paper, Syracuse University, 2002.

Easton, F.F. & D.F. Rossin, "Equivalent Alternative Solutions for the Tour Scheduling Problem," Decision Sciences, 22(5), 1991a, 985-1007.

Easton, F.F., D.F. Rossin, "Sufficient Working Subsets for the Tour Scheduling Problem," Management Science, 37(11), 1991b, 1441-1451.

Easton, F.F., D.F. Rossin, & W.S. Borders, "Analysis of Alternative Scheduling Policies for Hospital Nurses," Production and Operations Management, 1(2) Spring 1992, 159-174.

Easton, F.F. & D.F. Rossin, "A Stochastic Goal Program for Employee Scheduling," Decision Sciences, 27(3), 1996, 541-568,

Gaballa, A. & W. Pearce, "Telephone Sales Manpower Planning at Quantas," Interfaces, 9(3), 1979, 1-12.

Graham, M.V., "A Day-to-Day Decision Support Tool," Nursing Management, 26(3),1995, 48I-48L.

Henderson, W.B. & W. L. Berry, "Heuristic Methods for Telephone Operator Shift Scheduling: An Experimental Analysis," Management Science, 22(12), 1976, 1372-1380.

Hershey, J.C., W.J. Abernathy, & N. Baloff, "Comparison of Nurse Allocation Policies – A Monte Carlo Model," Decision Sciences, 5 (1), 1974, 58-72.

Hopp, W. J., & Van Oyen, M.P. (2004). "Agile workforce evaluation: A framework for cross-training and coordination," IIE Transactions 36, 919-940.

Huarng, F., "A Primary Shift Rotation Nurse Scheduling Using Zero-One Linear Goal Programming," Computers in Nursing, 17 (3), 1999, 135-144.

Hueter, J., and W. Swart, "An Integrated Labor-Management System for Taco Bell," Interfaces, 28(1), 1998, 75-91.

Hung, R., "A Cyclical Schedule of 10-Hour, Four-Day Workweeks," Nursing Management, 22(9), 1991,30-33.

Hung, R., "Multiple-Shift Workforce Scheduling Under the 3-4 Workweek With Different Weekday and Weekend Labor Requirements," Management Science, 40(2), 1994, 280-284.

Hur, D., V.A. Mabert, & K.M. Bretthauer, "Staff Adjustment Decisions: An Investigation and Evaluation," Working Paper, Indiana University, 2003.

Ikem, F.M., and A.M. Reisman, "An Approach to Planning for Physician Requirements in Developing Countries using Dynamic Programming," Management Science, 38(4), 1990, 607-618.

Jaumard, B., F. Semet, & T. Vovor, " A Generalized Linear Programming Model for Nurse Scheduling," European Journal of Operational Research, 107(1), 1998, 1-18.

Jones, C.B. (2005). "The costs of nursing turnover, part 2," Journal of Nursing Administration, 35(1), 41-49.

Jones, C.B. (2007). "Revisiting nurse turnover costs," Journal of Nursing Administration, 38(1), 11-18.

Kao, E.P.C., & M. Queyranne, "Budgeting Costs of Nursing in a Hospital," Management Science, 31 (5), 1985, 608-621.

Keith, E.G., "Operator Scheduling," AIIE Transactions, 1979, 11 (1), 37-41.

Kao, E.P.C., & G.G. Tung, "Aggregate Nursing Requirement Planning in a Public Health Care Delivery System," Socio-Economics Planning Science, 15, 1981, 119-127.

Koop, G.J., "Multiple Shift Workforce Lower Bounds," Management Science, 34(10), 1988, 1221-1230.

Krajewski, L.J., L.P. Ritzman, & P. McKenzie, "Shift Scheduling in Banking Opeations: A Case Application, Interfaces, 10(2), 1980, 1-8.

Lanser, E.G. 2001. "A Model Workplace: Creating an Effective Nursing Environment," Healthcare Executive, 16(4), 6-11.

Loucks, J.S. & F. R. Jacobs, "Tour Scheduling and Task Assignment of a Heterogeneous Work Force: A Heuristic Approach," Decision Sciences, 22, 1991, 719-738.

Love, R.R. & J.M. Hoey, "Management Science Improves Fast-Food Operations," Interfaces, 20(2), 1990, 21-29.

Lovern, E., "Rx for Nurses, Final version of staffing legislation in the works," Modern Healthcare, January 7, 2002, 10.

Mabert, V.A., "A Case Study of Encoder Shift Scheduling Under Uncertainty," Management Science, 25(7), 1979, 623-631.

Mabert, V.A. & C.A. Watts, "A Simulation Analysis of Tour-Shift Construction Procedures," Management Science, 28(5), 1982, 520-532.

Malhotra, M.K., & L.P. Ritzman, "Scheduling Flexibility in the Service Sector: A Postal Case Study," Production and Operations Management, 3(2), 1994, 100-117.

Marchionno, P. M., "Modified Cyclical Scheduling: A Practical Approach," Nursing Management, 18(10), 1987, 60-67.

Mason, A.J., D.M.Ryan and D. M. Panton, "Integrated Simulation, Heuristic and Optimisation Approaches to Staff Scheduling," Operations Research, 46(2), 1998, 161-175.

Miller, H.E., W.P. Pierskalla, and G.J. Rath, "Nurse Scheduling Using Mathematical Programming," Operations Research, 24(5), 1976, 857-870.

Needleman, J., P. Buerhaus, S. Mattke, M. Stewart & K. Zelevinsky, "Nurse-Staffing Levels and the Quality of Care in Hospitals," New England Journal of Medicine, 346(22), 2002, 1715-1722.

Ozkarahan, I. & J.E. Bailey, "Goal Programming Model Subsystem of a Flexible Nurse Scheduling Support System," IIE Transactions, 20(3), 1988, 306-316.

Pinker, E.J. & R.A. Shumsky, "The Efficiency-Quality Trade-off of Cross-Trained Workers," Manufacturing & Service Operations Management, 2 (1), 2000, 32-48.

Quinn, P., B. Andrews, & H. Parsons, "Allocating Telecommunications Resources at L.L. Bean, Inc.," Interfaces, 21(1), 1991, 75-91.

Ritzman, L., L. Krajewski, & M. Showalter, "The Disaggregation of Aggregate Manpower Plans," Management Science, 22(11), 1976, 1204-1214.

Segal, M., "The Operator-Scheduling Problem: A Network-Flow Approach," Operations Research, 32(4), 1974, 808-823.

Schaffner, J. W., & Ludwig-Beymer, P. (2003). Rx for the nursing shortage: A guidebook. Chicago, IL: Health Administration Press.

Showalter, M. J. & V. A. Mabert, "An Evaluation of a Full-/Part-time Tour Scheduling Methodology," International Journal of Operations and Production Management, 8(7), 1988, 54-71.

Siferd, S.P. and W.C. Benton, "Workforce Staffing and Scheduling: Hospital Nursing Specific Models," European Journal of Operational Research, 60(3), 1992, 233-246.

Staff Writer, "Nurses march on Washington over 'alarming' issue of overtime," Modern Healthcare, 32(19) May 13, 2002

Stimson, R.H., & D.H. Stimson, "Operations Research and the Staffing Problem," Hospital Administration, XVII (Winter 1972), 61-69.

Sze, D. Y., "A Queueing Model for Telephone Operator Staffing," Operations Research, 32(2), 1984, 229-249.

Thompson, G.M., "Shift Scheduling in Services When Employees Have Limited Availability: An L.P. Approach," Journal of Operations Management, 9(3), 1990, 352-370.

Thompson, G,M., "Accounting for the Multi-Period Impact of Service When Determining Employee Requirements for Labor Scheduling," Journal of Operations Management, 11(3), 1993, 269-287.

Thompson, G.M., "Labor Scheduling Using NPV Estimates of the Marginal Benefit of Additional Labor Capacity," Journal of Operations Management, 13(1), 1995.

Thompson, G.M., "Assigning Telephone Operations to Shifts at New Brunswick Telephone Company," Interfaces, 27(4), 1997a.

Thompson, G.M., "Labor Staffing and Scheduling Models for Controlling Service Levels," Naval Research Logistics, 44, 1997b, 719-740.

Thompson, G,M., "Labor Scheduling: Part 4. Controlling Workforce Schedules in Real Time," Cornell Hotel and Restaurant Administration Quarterly, 40 (3), 1999, 85-96.

Tieman, J., "Standing by on nurse staffing," Modern Healthcare, Chicago Sep 3, 2001a

Tieman, J., "Counting Down," Modern Healthcare, Chicago Dec 24-31, 2001b

Tieman, J., "Absolute Minimum," Modern Healthcare, Chicago Jan 28, 2002a

Tieman, J., "But does it work? Measuring the effect of the staffing ratios could be tough," Modern Healthcare, Chicago Mar 4, 2002b

Trivedi, V.M. & D.M. Warner, "A Branch and Bound Algorithm for Optimum Allocations of Float Nurses," Management Science, 22(9), 1976, 972-981.

Vaughan, T., "Examination and Optimization of On-Call Labor Scheduling," Proceedings of the Decision Sciences Institute National Meeting, Decision Sciences Institute, 1995.

Vaughan, T., "Shift-Scheduling with On-Call Labor," Proceedings of the Decision Sciences Institute National Meeting, Decision Sciences Institute, 1996.

Venkataraman R., & M.J. Brusco, "An Integrated Analysis of Nurse Staffing and Scheduling Policies," Omega, 24(1), 1996, 57-71.

Warner, D.M., "Scheduling Nursing Personnel According to Nursing Preference: A Mathematical Programming Approach," Operations Research, 24(5), 1976, 842-856.

Warner, D.M., & J. Prawda, "A Mathematical Programming Model for Scheduling Nursing Personnel in a Hopital," Management Science, 19(4), 1972, 411-422.

Wright, P. D., Bretthauer, K.M., & Côté, M. (2006). "Reexamining the nurse scheduling problem: staffing ratios and nursing shortages," Decision Sciences, 37(1), 39-70.

Wright, P.D. & Mahar, S. (2009) "Centralized Nurse Scheduling to Simultaneously Improve Schedule Cost and Nurse Satisfaction," under review at Omega.

Wright, P.D., & Bretthauer, K.M. (2009) "Combating the Nursing Shortage Coordinated Decision Making and Workforce Flexibility," under review at Decision Sciences.

DHĀRANA
BHAVAN'S INTERNATIONAL JOURNAL OF BUSINESS
Vol:4, 1 (2010) 38-43 ISSN 0974-0082

Assessment of Reliability and Validity of Perceived Credibility of Corporate Blogs

Uday S. Tate[1], Elizabeth Alexander[2], Avinash Waikar[3] and Basanna. S. Patagundi[4]

Abstract

Recent years have experienced an exponential growth in the use of weblogs as a marketing tool. With this surge in blogs used as marketing tools, the question remains: how credible are blogs as a source of consumer information? How do consumers perceive the credibility of blogs from different sources when making purchase decisions and product evaluations? The primary objective of the present study is to assess validity and reliability of a set of Semantic Differential scales purported to measure perceived credibility of blogs posted by corporations. Confirmatory factor analysis via LISREL8.5 package was used to obtain appropriate statistics for convergent validity, Discriminant validity, and composite reliability. In general, the scales used to measure the two hypothesized factors (source credibility and content credibility) for each type of blog achieved a satisfactory level of construct validity.

Key words : Semantic Differential Scales. Discriminant Validity, Composite Reliability

1. Introduction

Weblogs, popularly known as "blogs," were introduced in late 90s. Initially, they were referred to as an array of links developed and maintained by individuals with Internet technology background. Steadily, blogs caught the attention of mainstream Internet visitors, resulting into a mass of journal and diary entries, political and religious issues, and reflection on one's lifestyle (Ng and Falkow, 2008). With its popularity increasing exponentially, the corporate world showed a keen interest in blogs to use them as a marketing tool, specifically for niche markets. For example, Business Week (www.businessweek.com; October 24, 2007) reported over 106 million blogs in the month of September, 2007, about 12 million more than the previous month. Blogs are defined as interactive websites or online journals. Essentially, a blog allows an individual to read online postings which are frequently updated. They also allow individuals to post their own comments or responses. Blogs contain text, media, images and data, all arranged in a chronological fashion. Some blogs also utilize links to other sites and advertising (Dearstyne 2005; Quible 2005).

[1] Marshall University-WV, USA, [2]Marshall University-WV, USA, [3] Southeastern Louisiana University-USA, [4]Bhavan-Marshall MBA Program, India

Blogs are now being utilized by corporations as an interactive, two-way communication channel with their customers. In other words, blogs posted by corporations can play a major role in the consumer decision process. Potential buyers may use corporate blogs as a source of information and decision aid. In the post-purchase stage, the blog can be used as a channel for either complaint or praise. Corporate blogs can also provide information of additional product benefits or answers to utilization questions. Of course, consumers may also choose to use other blog types for similar tasks. A blog maintained by an individual could be accessed for product information before and after purchase. It also acts as a feedback mechanism. Getting pulse of a customer is a major input in designing marketing strategy. Blogs enable organizations to reach out and feel the pulse of customers. Blogs of all types may provide motivation to seek additional product information.

Since blogs have become a widely used source of consumer information, it is imperative that one must investigate how credible are blogs perceived by consumers. A recent study by Envision Solutions and the Medical Blog Network (December, 2006) concluded that "only 23 percent of bloggers say that 81 percent to 100 percent of blogs are written by individuals they implicitly trust." After reviewing several studies on blogs, Johnson and Kaye (2004) concluded that while there is no dearth of research on credibility of traditional sources of consumer information, majority of the reviewed studies focused on the traditional media such as radio, television, and newspapers, but they did not find any study that focused on the issue of credibility of blogs as an information source for consumers. These authors have called for research to examine the credibility of blogs as source of information. However, before any such attempt is made, it is imperative that researchers focus on the psychometric properties (i.e. validity and reliability) of scales they use to measure source credibility with respect to blogs. The present study attempts to assess the construct validity (convergent validity, Discriminant validity, and reliability) of scales used to measure perceived credibility of blogs developed by corporations.

2. Research Questions and Methodology

Results of our study will allow for an initial understanding of the psychometric properties of the scales used to measure consumer perceptions with regard to source and content credibility of blogs developed by corporations. In addition, it will provide a foundation to further refine the existing scales.

In order to collect data for our study, a questionnaire based on a comprehensive literature review, a focus group session, and faculty input was used. The questionnaire included a series of scales measuring the respondent experience with blogs and their perceptions of blog's credibility as a source of information. Respondents' perceptions were measured on nine 5-point, Semantic Differential scales (for example: trustworthy-untrustworthy, honest-dishonest and so on). The present study used the measurement scales developed by Beltramini (1988). However, one of the original ten items was omitted due to its irrelevance to the topic under study.

The study used convenience sampling conducted by trained research assistants who distributed the questionnaire to student and non-student groups in a small city located in the western part of West Virginia, USA.

3. Survey Analysis

The survey resulted in 418 usable questionnaires. The sample consisted of 52 percent male and 48 percent female respondents with the average age of 27.6 years. The majority of the respondents were college students (56 percent). Of the total sample, 65 or 15% reported not having access to a computer at their residence, and 43 (9%) reported not using the Internet. When reporting blog experience 99 (23%) reported some level of experience with blogs and 169 (39%) reported knowledge of but no experience with a blog.

Respondents with at least some blog knowledge were asked to evaluate the credibility of information contained in a blog operated and owned by corporations. A previously developed scale was adjusted and utilized for this measure (Beltramini, 1988; Bruner and Hensel 1998). Nine items were rated on a 5-point Semantic Different

scale. The means and standard deviations of the scales for each type of blog are reported in Table 1.

Scale	Blogs by Corporations	
	Mean	Std Dev
Unbelievable-Believable	3.2	1.12
Trustworthy-untrustworthy	3.08	1.04
Not convincing-convincing	3.34	0.94
Unreasonable-reasonable	3.31	0.93
Credible-not credible	3.08	0.99
Honest-Dishonest	3.07	1
Unquestionable-questionable	2.91	0.93
Conclusive-inconclusive	3.14	0.97
Not authentic-authentic	3.26	0.98

Table 1 Means and Standard Deviations of Scales Measuring Credibility Perception

Note 1 : represents the negative anchor of the scale, whereas 5 reflect the positive anchor.

4. Validation Analysis

According to Trochim (2006), "construct validity refers to the degree to which inferences can legitimately be made from the operationalizations in one's study to the theoretical constructs on which those operationalizations were based." In other words, construct validity is the extent of agreement between a theoretical concept and its empirical evidence (in terms of specific measurement scales). Bagozzi (1980), James, Mulaik, and Brett (1982), Joreskog and Sorbom (1983), Fornell and Larcker (1981), and Netermeyer, Johnston, and Burton (1990) propose three basic criteria of construct validity, namely, convergent validity, Discriminant validity, and reliability. Specifically, convergent validity is defined as "the degree to which the operationalizations is similar to (converges on) other operationalizations that it theoretically should be similar to" (Trochim 2006). On the other hand, Discriminant validity is "the degree to which the operationalizations is not similar to (diverges from) other operationalizations that it theoretically should be not similar to" (Trochim 2006). Finally, in the present research reliability was defined in terms of internal consistency of the scales used to measure the hypothesized constructs (source credibility and content credibility). Trochim (2006) defines internal consistency in the results for different items (scales) for the same construct within the measure. The current research used the three criteria to establish the construct validity of the scales reported in Table 1 for each source.

To assess convergent validity, Discriminant validity, and internal consistency of the scales used to measure source and content credibility, the correlation matrix of the nine scales of perceived credibility with regard to blogs posted by corporations) was subjected to LISREL 8.5 version (Jorskog and Sorbom 2003). Due to space limitations, the correlation matrices are not displayed; interested readers or reviewers can obtain them from the contact author.

5. Validation Results and Discussion

The main purpose of the present study was to assess the construct validity of scales used to measure perceived credibility of blogs developed by corporations. The evidence of convergent validity can be assessed by examining the factor loading of the measures and their respective t-values extracted by LISREL. In general, a factor loading of 0.70 and above is a good indicator of convergent validity. Discriminant validity is the extent to which two factors (theoretical constructs) are independent from each other, measured in terms of their respective scales. Fornell and Larker (1981) suggest that Discriminant validity is evident when the squared value of the correlation between two factors is less than the variance extracted from each factor separately. Finally, composite reliability can be determined by assessing the internal consistency of the measures. The composite reliability of the measures of the two hypothesized factors was calculated using the formula provided by Fornell and Larker (1981, p. 45). An internal consistency of 0.70 is considered as satisfactory (Joreskog and Sorbom 1989).

To assess the convergent validity of the nine scales for each corporate blog, the following procedure was used. Three separate correlation matrices were subjected to LISREL 8.5. For each matrix, a null model (hypothesizing no factor structure) was first run. The next model was a

one-factor model where all nine items were hypothesized to represent one overall dimension (factor) only. Finally, a two-factor model was run. The two factors were initially determined by an exploratory factor analysis based on a hold-out sample of 80 from the original sample of 418. The two factors were labeled as: source credibility and content credibility. For the null, one-factor, and two-factor models, chi-square values, degrees of freedom and a select group of goodness of fit indices were obtained. The three models represented a nested sequence for comparison. This approach is recommended by Bentler and Bonnett (1980) and further expanded by James, Mulaik, and Brett (1982). The overall estimates of the three models are shown in Table 2 for blogs by corporations.

Model	$\Delta\chi^2$	df	NNFI	PNFI	AGFI	RMSR
Blogs by Corporations						
Null Model	1319.03	36	.00	.00	.18	.43
One-Factor Model	468.24	27	.54	.48	.41	.15
Correlated Two-Factor Model	123.88	26	.90	.65	.84	.05
Perfectly Correlated Two-Factor Model	178.21	27	.84	.65	.79	.51

Table 2 Nested Model Comparisons: Three Sources of Blogs
Note: df=degrees of freedom; NNFI=non-normed fit index; PNFI=parsimony fit index; AGFI=adjusted goodness of fit index; RMSR=root mean square residuals.

As can be seen in Table 2, the worst fit is for the null model followed by one-factor model. On the other hand, the best fit is for the correlated two-factor model, as evidence by non-normed fit index, (NNFI), parsimony normed fit index (PNFI), adjusted goodness of fit index (AGFI), and root mean square residuals (RMSR). According to Bentler and Bonnett (1982), a value of .90 and above for NNFI and AGFI indicates an "acceptable" fit for the model. From Table 2, one can see that NNFI for the three models satisfy the Bentler-Bonnett condition. However, the correlated two-factor model failed to achieve the .90 cut-off point for AGFI. PNFI is useful when comparing a series of nested models. In the present case, the PNFI index increased from zero for the null model to .65 for the correlated two-factor model. Finally, According to Medsker, Williams, and Holahan (1994), RMSR indicates the mean of the differences between of the theoretical covariance matrix and the observed covariance matrix. According to Joreskog and Sorbom (1989), the value of RMSR closer to zero indicates a better fit of the model. Table 2 shows that RMSR for corporate blogs decreases from .43 for the null model to .05 for the correlated two-factor model indicating an acceptable goodness-of-fit for the latter.

It is not sufficient to assess the model fit in order to determine the psychometric properties of the scales used to measure theoretical constructs. For that one needs to examine and evaluate convergent validity, Discriminant validity and internal consistency of the measures. Again, we used the LISREL approach to determine the psychometric properties of the scales used in the present study. Specifically, standardized factor loadings, their respective t-values, extracted variance for each factor, and composite reliability were obtained based on the covariance matrixes for each type of blog. Tables 3 and 4 show LISREL indices to assess the construct validity and reliability of the measures.

Joreskog and Sorbom (1989) suggest that a factor loading of 0.70 and above is an acceptable value to assess the correlation between a measure and its theoretical construct (factor). As can be seen in Table 3, the factor loadings for each of the factors (source credibility and content credibility) are at or above 0.70, with an exception of the factor loading for the item labeled as "unquestionable." All of the factor loading were statistically significant at .01 level. The variance extracted index for each factor was 0.55 and 0.66, for a value of 0.50 or above is acceptable (Netermeyer, Johnston, and Burton 1990). Finally, a composite reliability of the measures of

Factor and Indicators	Standardized loading	Error variance	Variance extracted estimate	t-values[b]
Source Credibility[d]	---	.88[a]	.55	
Trust	.81	.34	.66	---c
Credibility	.90	.20	.81	16.00
Honest	.80	.36	.64	13.83
Unquestionable	.60	.64	.36	9.61
Conclusive	.75	.44	.56	12.63
Content Credibility[d]	---	.88[a]	.66	
Believable	.75	.43	.57	---c
Authentic	.88	.23	.77	13.51
Reasonable	.81	.34	.66	12.50
Convincing	.79	.38	.62	12.11

Table 3 Measurement Properties for Blogs by Corporations

Note: [a]denotes composite reliability using the formula by Fornell and Lacker (1981).

[b]t-values significant at p-level < .01.

[c]The indicator fixed to the value of 1 as a reference variable.

[d]The estimated correlation between the two factors = .52.

source credibility and content credibility is 0.88 and 0.88, respectively. As per Joreskog and Sorbom (1989), internal consistency of 0.70 and above is acceptable. Thus, the measures of the two factors have achieved a satisfactory level of convergent validity.

To assess the Discriminant validity of the measures of the two factors was assessed by comparing the squared value of the correlation between the two factors with their respective variance extracted. As stated earlier, this squared value should be less than the value of variance extracted for each of the two factors.

As can be seen in Table 4, the squared correlation value (0.27) between the two factors for each type of blog was less than the variance extracted for each factor separately, implying that the two factors have achieved an acceptable level of Discriminant validity. Another test for Discriminant validity was performed by comparing two models (correlated two-factor models versus perfectly correlated two-factor models). Table 2 shows that NNFI, PNFI, AGFI, and RMSR show poor fit for the perfectly correlated two-factor models, implying that the two factors, source credibility and content credibility have achieved Discriminant validity.

LISREL Statistics	Factors of Credibility	
	Source Credibility	Content Credibility
Variance Extracted	.55	.66
Squared Correlation Between two factors	0.27	
Composite reliability	.88	.88

Table 4 Evidence of Discriminant Validity of the Two Factors: Corporate Blogs

Finally, the composite reliability (internal consistency) of the measures of the two hypothesized factors is shown in Table 4. In each case, the composite reliabilities of the measures of the two hypothesized factors were high, ranging from 0.88.

6. Conclusions

It is imperative that researchers must evaluate the construct validity and reliability of the scales used to measures theoretical constructs before any predictive or explanatory conclusion can be drawn in their study. Specifically, researchers must address the following

questions: (1) how consumer use blogs as a source of information, (2) what specific information do they use in arriving at their purchase decisions, and (3) when do they use such information, first we must assess how credible do consumers perceive blogs as sources of information. The primary focus of the present study was to assess the convergent validity, Discriminant validity, and composite reliability of the scales used to measure two factors of credibility of blogs, namely, source credibility and content credibility. For this purpose we used a rigorous methodology known as structural equations methodology to obtain appropriate statistics to assess the construct validity. The preliminary results indicated that the scales have achieved satisfactory level of construct validity.

Future research effort should examine the underlying causes and consequences of the factors of perceived credibility with regard to blogs used by corporations. Such an effort can be helpful in developing blogs and their contents that can be perceived as credible by consumers. In addition, researchers need to examine the use of blogs as a source of information by consumers under various buying situations and its role in the entire value chain. Finally, a segmentation study can be performed to identify groups among blogs users and to develop their demographic and psychographic profiles. Such research effort can be useful in targeting blogs to specific groups of interest.

As with any research design, there are several caveats in the present study. One, the sample was a convenient sample. Two, the study was a cross-sectional and not longitudinal. Three, the limited sample size did not allow to take a hold-out sample for the purpose of cross validation of the results. Four, the present research used only one method (Semantic Differential Scales) to measure the credibility constructs. Hence there is a possibility of methods bias in the results. Ideally, one must use a multi-trait, multi-method approach to assess construct validity (Bagozzi 1980). Due to these caveats, the results of the present study cannot be generalized to other populations.

7. References

Bagozzi, R. P. Causal modeling in marketing. New York, NY: Wiley. (1980).

Baker, S. The inside story on company blogs. Accessed March 6, 2006, [available at http://www. businessweek.com].

Beltramini, R. F. Perceived believability of warning label information presented in cigarette advertising. Journal of Advertising, 17 (1): (1988). 26-32.

Bentler, P. M. & Bonnett, D. C. Significant tests and goodness fit in the analysis of covariance structures. Psychological Bulletin, 80: (1980). 588-606.

Blood, R. "Weblogs: A history and perspective", Rebecca's Pocket. 07 September 2000. Accessed on August 30, 2006 at www. rebeccablood.net/essays/weblog_history.html.

Bruner, G. C. & Hensel, P. J. Marketing Scales Handbook: A compilation of Multi-Item Measures, Vol. II. Chicago, IL: American Marketing Association. (1998).

BusinessWeek, May 2, 2006.

Dearstyne, B. W. Blogs: the new information revolution?. The Information Management Journal, September/October: (2005). 38-44.

DeFelice, A. A new narketing medium. Customer Relationship Management, December: (2006). 32-35.

Fornell, C. & Lacker, D. F. Evaluating structural equation models with observed variables and measurement errors. Journal of Marketing Research, 18: (1981). 39-50.

James, L. R., Mulaik, S. A., & Brett, J. Causal analysis: Models, assumptions, and data. Beverly Hills, CA: (1982). Sage.

Johnson, T. J. & Kaye, B. K. Wag the blog: How reliance on traditional media and the internet influence credibility perceptions of weblogs among blog users. J&MC Quarterly, (81 (3): (2004). 622-642.

Joreskog, R. G. & Sorbom, D. LISREL: Analysis of linear structural relations by the method of maximum likelihood (Version VII). Chicago: National Education Resources. (1983, 1989).

Medsker, G. J., Williams, L. J., & Holahan, P. J. A review of current practices for evaluating causal models in organizational behavior and human resources management research. Journal of Management, 20 (2): (1994). 439-464.

Ng, Debra & Falkow, Sally. Blogs – the new marketing strategy. http://www.melissadata.com/enews/marketingadvisor/ articles/0704/2.htm

Netermeyer, R. G., Johnston, M. W., & Burton, S. Analysis of role conflict and role ambiguity in a structural equations framework. Journal of Applied Psychology, 75 (2): (1990).148-157.

Quible, Z. K Blogs and written business communication courses: A perfect union. Journal of Education for Business, July/August: (2005). 327-332.

"Taking the Pulse of the Healthcare Blogsphere: A global online survey of healthcare bloggers," Envison Solutions and the Medical Blog Network, December, 2006: at http://www. envisionsolutionsnow.com/pdf/Studies/Healthcare_Blogger_ Survey_Report_doc.pdf

DHĀRANA
BHAVAN'S INTERNATIONAL JOURNAL OF BUSINESS
Vol:4, 1 (2010) 44-60 ISSN 0974-0082

SYNOPSIS

Segmenting and Profiling Wellness Clients based on Lifestyle and Behavior

Satya Suresh
Acharya Institute of Technology, Bangalore

Abstract

This is the first attempt in India to study the wellness sector whose turnover was estimated at Rs.1,00,000 million (approximately $2.5 billion US) by the Confederation of Indian Industry(CII). To get insights to customer's needs and wants, wellness clients are segmented based on their lifestyle and behavior.

The intention of any service provider would be to retain clients and to improve loyalty towards the wellness service centers. This study examines the factors evolving from lifestyle, behavior and inspects its effect on loyalty towards wellness services.

Lifestyle is understood through sub dimensions of Activities, Interests and Opinions chosen from focused group interview. Behavior is studied in terms of the 'Attitude towards Wellness Services', 'Expected Benefits from the Wellness Services' and 'User Occasion'.

The study is based on the empirical data collected from 310 clients from five wellness centers in Bangalore, India. Conceptual model for Activity, Interest and Opinion vis-a-vis loyalty, Lifestyle dimensions and its effects on Loyalty and Behavior factors' effects on Loyalty were tested. Analysis revealed that three of the four 'Activity' factors, three of the four 'Interest' factors and two of the four 'Opinion' factors, five of the ten 'lifestyle' factors and five of the seven 'behavior' factors had positive effect on Loyalty.

Four lifestyle segments evolved from this study and they are: 1. Work enthusiasts and family oriented 2. Commoners, 3. Net-workers and 4. Hard core strivers. The four behavior segments are 1. Heredity Ailment Prevention and Change in Current Lifestyle Seekers, 2. Occupational Ailment Prevention Seekers, 3.Skeptics & Anti-Ageing Prevention Seekers and 4. Stress Release Seekers.

Branded service packages were evolved for each of these lifestyle and behavior segments with professional inputs which is a pioneering effort in the emerging Indian wellness sector.

Key words : Wellness, Segment, Lifestyle, Behavior.

1. Introduction

The potential of wellness industry can be attributed to the changes that have happened in the society over a period of time. Nasreen Taher (2005) states "Wellness, at one point of time was considered to be a state of mind. Today however, it is an industry. Lifestyle awareness aimed at managing mental and physical health has moved from ashram to five-star clinic".

On the other hand, Sreenath (2005) has analysed how Indians can leverage their cultural heritage to the success of Wellness Sector. He points out that Yoga is a $ 27 billion dollar industry in USA, with 18 million American practitioners and over 98 per cent of the teachers Non-Indians. "Clearly the economic potential here could be as big as India's software exports, especially if yoga were included in India's proposed initiative to export health services".

In another case it is clearly evident how the Multinational companies have understood the economic potential of the Ancient Indian Knowledge. "Ayurveda is a $ 2 billion per year industry and a part of the high growth international market for plant medicines. The popular consumer brand, Aveda, was started by an American devotee of Indian guru to bring Ayurveda to the West. The company was later sold to "Estee Lauder" (Malhotra, 2003). Hence it is time to acknowledge our cultural resources and package them into super speciality wellness services.

Kotler and Gertner (2002) discuss positioning of a country on a right platform to obtain a marketing edge. "Even when a country does not consciously manage its name as a brand, people still have images of countries that can be activated by simply voicing the name. Country images are likely to influence peoples decisions related to purchasing, investing, changing, residence and traveling" (Kotler and Gertner, 2002). The travelers to India seek experiential, experimental, or existential meaning to their travel, so positioning India on a wellness platform would prove effective.

The health and wellness segment and the incentive travel segment, though two market segments with lower volumes at present, had been recommended by The World Tourism Organization for the Pacific Asia Travel Agents (PATA) WTO Strategy (2001).

Naseer Taher (2005) brings out the range of products and services that can be catered by the Wellness Industry. "The by-product of the wellness industry is wellness music, created to improve relaxation, inner peace and positive thinking. Add to this Reiki, Holistic healing, the Art of Living, Aroma Therapy and Herbal Spas, and you have still just touched the tip of the iceberg that is the "Wellness industry in India" (Nasreen Taher, 2005).

It is clear that the concept of Wellness is holistic and like total quality management concept, there is no point beyond which progression cannot be made. Hence, any human residing in any corner of the world adopting any life style has a scope to improve and cherish from the Indian Wellness concept.

1.1 Wellness and Health

It is important to understand health and wellness sector as they are misunderstood as one and the same. Mueller and Kaufmann (2001) aimed to make a clear distinction between wellness and cure, from the health policy angle. The authors' states a line should be drawn between wellness, which includes comprehensive service packages consisting of physical fitness, beauty care, healthy nutrition/diet, relaxation/meditation, mental activity/education, and illness prevention. Though there is an overlapping of service requirements in health sector and wellness sector the differentiation come in who seeks the services, a healthy person seeks wellness services for upkeep and maintenance. On the demand side, the authors assumed solely "healthy" people, their prime aim being prevention, pursue wellness. While wellness guests can claim services which are very similar to those used by "normal cure guests," wellness guests ask for those services with the motive of preserving or promoting their health, which contrasts with the cure guests.

1.2 Wellness Sector: Opportunities and Challanges

The opportunities of wellness sector are immense as the macro-level environmental changes in structure of families and health care gives wellness an impetus. First to analyze the Indian families in the metros, the joint family system has changed to nuclear families generations ago. But in the last decade the dispersion

in with the nuclear family has become a phenomenal factor. Opening up of the Indian economy has given fertile opportunities for scientists, computer professionals, teaching professionals to seek jobs in other parts of the globe. Even small entrepreneurs have immense opportunities to expand their vistas to other countries. The outcome of this is frequent travel across continents, or migration to other continents, or settlement in places away from the family. Hence old age persons in the family are left on their own with not much of assistance. In the European countries this situation is dealt with organized old age homes and community living. But in India the psychological factor plays a big role and enrolment in old age homes are for those who have been neglected rather than for those who are willing to live independently. In such situations maintaining health and preventing ailment is crucial. Prevention and postponement of ailments is safe and adhering wellness lifestyle is a natural choice than to fall ill and ail.

Asha Krishna kumar (2004) has also observed the demographics of Indian population and has gone to the extent of saying that health to all will be the challenge of the 21st century. "With the population of elderly people rising, their health care has become a matter of concern especially since the family support system is crumbling and there is no comprehensive geriatric care system. If achieving longevity was the triumph of the 20th century, care of the elderly will be the challenge of the 21st century."

The article by Satya Ventakesh (2008) points out that the role of families as a social safety net for the elderly is fast eroding; the poor among the elderly have become the most vulnerable sections of society in India. The government has taken cognizance of this and passed 'The Maintenance and Welfare of Parents and Senior Citizens Bill 2006'.

The second important factor is the trauma involved in hospitalization and recouping with the mounting of medical expenditures. Medical treatments have become so expensive that taking a few corrective measures in certain key principles of life would be really worth the while. Khomba Singh (2008) points out that the escalating cost of raw materials has pushed Indian drug makers to a corner as the prices of bulk drugs imported from China have increased by 20-100 per cent in the last six months.

Satya Narayanan (2008) has pointed out that over 80 per cent of health care expenditure is borne by patients in India. The cost of health care varied between 73 per cent and could go up to 78 per cent among the ten per cent most diseased household.

Hence, providing affordable health care is a complex issue with a vast number of players like the government, drug manufacturers, ineffective drugs, evolution of new strains of viruses causing disease, research undertaken at the labs, laws and intellectual property acts that guide them, cost and economics for the manufacturer, insurance companies, hospital management, expertise of the doctors, available education and technology, the civic society to broadly name a few. In the given context, prevention of diseases and nurturing wellness is a natural choice. It is in the individual's capacity to watch and maintain wellness lifestyle, which is more direct and simple.

The third important factor advocating wellness is the changing nature of job and corporate responsibility in maintianing healthy employees. Wellness is not just prevention of diseases at old ages but also maintenance of quality life at youth. The following insights from various quarters would reiterate this point:

India times Health (2008) has observed the advent of the multi-national corporation (MNC), work culture characterized by increased work pressure and an increasing need for performance in the workplace has led to increased stress. This lifestyle increases the chances of developing heart disease by 10-15 times. Gentleman (2005) stated that India is facing an obesity crisis among its newly wealthy middle-class, alluding to IT (Information Technology) professionals. The average age a person may suffer from heart attack has gone down to 30 from 40. Nanjappa (2007) observed that 1,246 divorce cases pertaining to those in the IT sector were filed in 2006 at the matrimonial courts in Bangalore, India alone. Financial freedom, lack of time at home, erratic working hours, work pressure, financial security and stress are also seen as the main reason for this fiasco. At this juncture, it is vital to know how the educated affluent, new generation

from India manages their personal lifestyles for wellness.

Some of the views on corporate wellness initiatives are: An increasing number of companies, both large and small, are instituting programs that encourage their employees to engage in healthier lifestyle Rotenberk (2007). A survey of 450 major US employers conducted by Hewitt Associates, a global human resource-consulting firm, confirmed that incentive-based health programs are on the rise. There was a 10 per cent increase in 2006 over 2005. However, getting individuals committed to wellness was never part of the equation. Providing incentives helped promote commitment towards wellness Ventresca (2007).

It is pointed out that health educators is the profession of the coming years, The Bureau of Labor Statistics (BLS), a division of the U.S. Department of Labor, projects employment of health educators to grow faster than the average for all occupations through 2014. Teaching people about healthy living is less expensive than treating sick patients. Health educators promote wellness and healthy lifestyle covering a wide range of health related topics Teixeira (2007). Hence change in the nature of family structure, the changes in demographics of population at large and the demand from high-pressure jobs with the corporate responsibility to maintain employees' health promotes concept of wellness rather than cure.

The challenges wellness sector would face is also vast. Wellness is an emerging sector and it can be seen as an extension of health industry as wellness helps in prevention of ailments. It can also be seen as an extension of beauty and fitness or from a holistic point of view since the concept is multidimensional where it provides peace of mind to relaxation, social acceptance to intellectual and emotional stability. The scope is too vast and no single provider has got the basket of services to render full range that wellness stands for. Service providers range from multinational five star hotels who offer wellness as product augment to their existing business clients to small make shifts huts- especially in Kerala, who can offer massages and herbal therapies. The religious and spiritual organization also has programs which promise overall harmony. "Wellness programs exist in many forms, some programs merely consist of employee assistance programs, while others demand a mandatory fitness level, neither of which develops a holistic view of related health factors" (Rosanna L Church, 2001). Hence, the sector itself needs a focus. If the sector is let loose, to garner strategic support and draw a clear road map to achieve sustainable growth is difficult.

1.3 Literature Review

After analysing the potential, opportunities and challenges of wellness sector the next step was to understand through the literature how this sector can be streamlined and what strategic marketing plans can be operationalized to enhace the scope of this sector from the service providers' point of view. Literature review was done to understand the following aspects:

- The importance of segmentation as a strategic marketing tool in implementing marketing programs in an organization.
- The statistical tools used in various studies to segment the markets and the various nuances involved which includes cluster formation, cluster interpretation, cluster validation and so on.
- Lifestyle segmentation.
- Studies based solely on AIO model to segment lifestyle across a variety of service sectors
- The segmentation based on behavior

Some of the highlights of the literature review are

- Segmentation is a powerful strategic tool in marketing and provides scope for strategic planning at the service provider's level. Frank, R.E., Massy, W.F. and Wind, Y. (1978), Frank, R.E, (1972), Piercy, N (2002), Dibb, Simkin (1997), Bowen (1998).
- The nuances of statistical procedures in using factor, cluster and discriminant analysis is very important as the crux is in the interpretations of the researcher. Each study gave more clarity thus providing the researcher a platform to leverage the experiences of other researchers in this study. Chen, Hsu (1999), Jurowski, Reich (2000), Arimons, Elfessi (2001), Dolnicar, Leisch (2003), Dolnicar, (2004).

- With in lifestyles there are varieties of models the most popular being VALS and AIO. Since the AIO variables offers good scope by lending itself to the topic being explored AIO model was used to construct questionnaire to understand lifestyle of wellness clients. Lazer (1963), William D Wells, Douglas J Tigert (1971), Joseph T Plummer (1972), Orsey Kucukemiroglu (1999), Grunert, Brunso, Bisp (1999), Kaynak, Kara (2000), Gonzalez, Bello (2000), Lawson,Todd,Boshoff, (2001), Wai, Chang, Moon, To, Hsia, (2004).
- Behavioral studies focused on attitude, expectation and user occasion showed that it is a very useful way to segment wellness clients. Gomez, Arranz, Cillan (2006), Pedersen, Nysveen (2001), Alfasi, Sargeant (2000), Machaver, Morgner (2001), Johns, Gyimothy, (2002), Yuksel, Yuksel, (2002), Sirakaya, Uysal, Yoshioka (2003), Sarigollu, Huang (2005).

After the literature review it was evident that a) though segmentation is an effective tool to evolve robust marketing strategies it has not been attempted in the wellness sector, b) It was also evident that Lifestyle and Behavioral bases are two platforms from which wellness clients can be segmented to achieve insights into consumers types c) It was observed that all studies on segmentation stopped with providing some insights as to what each of the segments would need from the service provider. This study aims to go beyond the other studies and evolve service packages for the identified segments, thus setting a trend where managerial recommendations by academicians are taken one step closer to operationalizing the implementation in the wellness sector.

1.4 Problem Statement

Wellness sector is an emerging sector in India. The concept is catching up world over as this sector focuses on maintenance of health rather than cure. If the wellness sector is planned well, this sector can become another IT sector in terms of generating goodwill and tourist interest in India. By systematically segmenting the market, various client groups with specific needs and wants will emerge and packages can be tailor-made for each of these identified segments. Segmenting requires an understanding of client's lifestyles and behavior patterns, to name a few. Wellness providers should assess client's needs and suggest appropriate treatments based on lifestyle, behavior and demographic characteristics. Achieving Customer loyalty is the key to any business enterprise. Wellness sector should identify which lifestyle and behavioral aspect leads to loyalty. Clarity in this aspect would lead to effective integrated marketing communications. Identifying these as the focus for research, current study will answer the following questions:

1. What is the lifestyle of wellness clients studied through AIO (Activity, Interest, and Opinion) model?
2. What are the behavior patterns of wellness clients studied through Attitudes towards Wellness Services, Expected Benefits and User Occasion?
3. Is there positive effect of a) underlying AIO factors, b) Behavioral factors c) Lifestyle factors studied by combining AIO on Loyalty?
4. Can wellness clients be segmented based on their lifestyle? and
5. Can wellness clients be segmented based on their behavior?

1.5 Objectives of Study

1. To explore the factors underlying Activities studied in terms of Work and Entertainment and find out its effects on Loyalty towards wellness services;
2. To find out the factors underlying Interest studied in terms of Achievement and Food and examine the effects on Loyalty towards wellness services;
3. To know the underlying factors of Opinion studied through Culture and Opinion on Self and appraise its effects on Loyalty towards wellness services;
4. To elicit lifestyle factors combining Activities, Interests, Opinions and explore its effects on Loyalty towards wellness services;
5. To extract Behavioral factors and find out its effects on Loyalty towards wellness services; and
6. To segment wellness clients based on their Lifestyle and Behavior

1.6 Conceptual Models And Hypotheses Of The Study

Recently non-financial measures of company performances like branding, customer satisfaction and Loyalty has been taken seriously. Smith Rodney, E., Wright William, F. (2004) has pointed out that recent research in Accounting advocates non-financial measures of company performances, such as customer satisfaction and Loyalty as useful indicators of firm performance. There are many conceptual models developed to test the impact of various aspects like customer expectation, satisfaction and its effects on Loyalty. Some of the empirical studies that attempted to build models around Loyalty are as follows:

Smith Rodney, E., Wright William, F.(2004) in their study provide an integrated causal model of company performance in Personal Computer Industry that tests links between Product Value, Business Process Performance, Customer Loyalty and Financial outcomes. Nic S Terblanche (2006) has created a model realizing that customer retention has become a major concern for many businesses. Measures such as satisfaction, loyalty have been operationalized with the purpose of enhancing customer retention. For this purpose the authors have tested the American Customer Satisfaction Index Model, which links Customer Satisfaction, Customer Expectations, Perceived Quality and Loyalty. Mollenkopf, D., Rabinovich, E., Laseter, T.N, Boyer, K.K. (2007) have created a structural equation model in the field of Internet retailing. Service quality, Supply Chain Management, Customer Satisfaction and Loyalty is interlinked to develop a model and a set of hypotheses relating ten latent variables in the service returns offering.

Customers have a variety of choice while selecting services. The basic criterion for selection of a particular service depends on one's lifestyle. Lifestyle profiles are so varied that understanding a specific lifestyle pertaining to a particular sector is vital to create tailor made service blueprints. Many companies use lifestyle as a starting point to package their services for the end consumers. While studying the recreation market Gilbert F and Warren W (1995) stated, "Recent studies have shown that by adding more diverse lifestyle information, recreational professional are able to tailor make their programs better to the needs and demands of their consumers". A study by Richard L Divine and Lawrence Lepisto (2005) aimed to gain better understanding of the healthy lifestyle consumer by examining demographic, personal value and psychographic antecedents. Results indicated that people who maintain a healthy lifestyle tend to be female, older, more educated, place less importance on the value of "excitement", have a greater tendency to plan ahead and tend to experience less role overload & products/services more convenient to time-pressured consumers. Based on these studies, conceptual model was created and hypotheses that articulate a framework of Lifestyle and Behavior factors on Wellness Client's Loyalty were tested.

The hypotheses set to test the conceptual model are as follows:

Hypothesis 1:
There is no effect of Activity factors on Loyalty towards wellness services.

Hypothesis 2:
There is no effect of Interest factors on Loyalty towards wellness services.

Hypothesis 3:
There is no effect of Opinion factors on Loyalty towards wellness services.

Hypothesis 4:
There is no effect of Lifestyle factors combining AIO on Loyalty towards wellness services.

Hypothesis 5:
There is no effect of Behavioral factors on Loyalty towards wellness services.

2. METHODOLOGY

2.1 Focus Group

For the current study AIO model was used to understand the life styles of wellness clients. From the various variables enlisted under Activities, Interests and Opinions a selected few, which has direct relevance to wellness was identified. For this purpose two focus group interviews were conducted. The first group consisted of 6 members who had visited wellness center after

completion of project from an IT firm and they were asked to identify two main aspects in Activities, Interests and Opinions which directly relates to state of wellness. The second focus group consisted of five members, two spouses, who had visited the wellness center to spend their weekend and an executive who had visited the center for weight reduction. After the two focused group interviews 'Work' and 'Entertainment' were the two variables from "Activities", 'Food' and 'Achievements' were identified as the two most important variables from "Interests" and 'Opinion on themselves' and 'Culture' were the two most important variables from "Opinions". Based on these dimensions the instrument was built.

2.2 Instrument Construction for Segmenting and Profiling Wellness Clients

The instrument had four parts the first one was geographic information. This part questioned about the nationality of the respondent and the questions were set to nominal scale multiple-choice type. The second part of the instrument had questions relating to demographics. Questions were asked on Age, Sex and Educational qualification, Nature of job and Duration of travel undertaken in work. The third part of the instrument was prepared to understand the lifestyle of wellness clients. Lifestyle in this study is understood through Activities studied through Work and Entertainment, Interest studied through Achievements and Food, and Opinion studied through Culture and Opinion on self. All these questions were in interval scale and set to 5-point likert's type. The plan to understand Behavioral aspect of the wellness clients was through Attitude, User Occasion and Expected Benefits. This was fourth part of the questionnaire. Loyalty was studied through cognitive, connative, behavioral and action loyalty.

2.3 Pilot Testing

After the preparation of the instrument, a pilot study was conducted with 60 wellness clients from one wellness center. Through this pilot study modifications and corrections were made in the construction of sentences and certain questions, which were repetitive.

2.4 Defining Population for the Study

The next aspect of the study is defining the population to be studied. For this study, the population is defined in terms of Element, Units, Extent, Time. For this study Element: All clients who are registered in Unit: the wellness centers like Golden Palm, Ayur Gram, Jindal Extent: In Bangalore Time: March 2006 and December 2006. The framework used for this study is the "register- data base" maintained by the wellness centers for the guests, where their identity and other details are recorded. The units of study are the centers of wellness. The elements are the clients in the centers who are registered for wellness programs. The procedure followed is the census method since all elements in the unit are studied in prescribed time frame set by the researcher.

2.5 Collection Of Data

The actual study was based on the empirical evidence gathered from 310 clients of the wellness centers. Data were collected from five wellness centers in Bangalore, India. In all, front office staff distributed 500 questionnaires during March 2006 and December 2006 to their clients. This time frame was chosen to iron out the peak and the non-peak occupancy. Questionnaires were given to clients during their "leisure" hour so as to not disrupt their daily routine of yoga, meditation, spa treatment, walking, and other activities, as advised by the wellness centers. Researchers collected completed questionnaires from the front office staff at the end of the week. A 64 per cent response rate was achieved (320 questionnaires). Of questionnaires returned, 310 were deemed usable for further analysis.

2.6 Statistical Tools used for the Analysis of Data

Data was analyzed using SPSS 15 version. Statistical tools employed at every stage are explained and then results are reported. Descriptive statistics was used to get the demographic results and the level of agreement with each variable. Item analysis was used to enhance the Croanbach's alpha value. Factor analysis was applied to derive the underlying factors of A-I-O, Lifestyle and Behavior of wellness clients. Regression was applied to find out the effect of various factors of A-I-O, Lifestyle and Behavior on Loyalty. Cluster analysis was used to segment the wellness clients and finally discriminant analysis was used to validate the clusters.

3.0 Summary of Findings and Discussions

Descriptive statistics is used to understand the demographic profile and the level of agreement with

each of the variable. A bird's eye view of the demographic profile of the wellness clients is as follows:

3.1 Demographic Profile

1. The demographic profile of the wellness clients reveals that Indian clients constitute more than 80 per cent of the clientele. This gives ample scope to market the services amongst targeted foreign Nations.
2. There is good proportion of Male and Female (65:35) clientele and family programs can be promoted to encourage good participation from both genders.
3. 86 per cent of the clients are within 40 years of age. Based on this fact the service providers can provide certain facilities like Television and Internet. These facilities are not available in certain centers as they feel that the effect of the services is well pronounced and more effective in the absence of such distractions, but these are necessities for the professionals of today.
4. As far as educational qualification in concerned, about 90 per cent of the wellness clients have procured Bachelor's degree or above. This educational qualification can be leveraged through innovative, cost-effective and personalized communication packages for them.
5. Nature of work of the wellness clients reveals that 58.4 per cent of the clients are technicians and service providers. Since Bangalore is the Silicon Valley of India, the population of study is skewed towards employment in Information Technology sectors.
6. Day of travel in the month reveals that about 60 percent of the wellness clients travel for about 6 to 15 days a month. Over the years, frequency in travel brings about a variety of ailments and this can be addressed effectively at the centers.

3.2 Overview of Lifestyle Aspects of Wellness Clients: Activities Studied Through (1) Work (2) Entertainment

There were ten variables to elicit information on work and work related aspects of the wellness clients. Another ten variables were meant to understand the entertainment habits of wellness clients. The study revealed that the wellness clients disagreed with nine statements in total and five of them related to work.

The mean score revealed that the wellness clients agreed two statements namely 'My work gives me satisfaction', and 'I balance work and entertainment to avoid stress'. This reveals that work gives the wellness clients both satisfaction and stress. Stress is dealt with by balancing it with entertainment. There are so many methods of stress release and quality entertainment is a good stress buster.

The mean scores also revealed that the wellness clients neither agreed nor disagreed to nine statements under activities studied in terms of work and entertainment. The work related statements, which received neutral response, included 'My work is of primary importance to me in life', 'My work is stressful', 'My work is my true identity' and My work involves a lot of travel'. The entertainment related statements which received neutral responses include ' My favorite entertainment is to watch movies', 'My favorite entertainment is to go out with friends','My favorite entertainment is to travel with family', 'My favorite entertainment is to meet with friends', 'I eat out and entertain myself'. As far as the work related statements are concerned the wellness clients are neutral to view point that work is their true identity and it involves a lot of stress. These signifies that wellness clients have other facets to exhibit themselves and are aware of methods to deal with the stress created through work. As far as entertainment is concerned, wellness clients are neutral about movies, going out with friends & traveling with family.

The statements disagreed by the wellness clients on work includes 'I have no option so I work', 'Work takes away all my active time', 'My job has nothing to do with my actual personality', 'I combine work and entertainment', 'I want to do other things than to work'. It is very clear from these findings that work is the prime motivator.Wellness clients identify themselves through their work. As far as entertainment is concerned wellness clients have disagreed to the following statements and they are: 'I have no time to entertain',

'Shopping is my favorite entertainment', 'Business meetings are my entertainment', 'Watching TV is my favorite entertainment'. The findings reveal that the wellness clients make time for their entertainment; it is also evident that shopping and watching TV are not the favorite entertainment. When corporate companies are doing everything to conduct their meetings in exotic places and make corporate meetings a vacation touch, wellness clients do not consider business meetings as their entertainment.

There were 20 items in the instrument to get information on activities and on checking the reliability score it was observed that the Cronbach's alpha was low (.2450), to enhance the reliability value item analysis was performed and the alpha value appreciated to .8000 after elimination of items with negative inter item correlation & also to get information on Activities studies through work and entertainment.

3.3 Factors Evolved from Activities Studied Through (1) Work (2) Entertainment

To address the objective set for the study results of factor analysis of each of the Activity, Interest and Opinion variable was derived. Factor analysis was done using Principle Component Method using varimax rotation, Kaiser-Meyer-Olkin (KMO test) was performed to test sampling adequacy. Bartlett test of Sphercity was also done. It was found that the results were good to justify the use of factor analysis. 13 'Activity' items studied through Work and Entertainment were reduced to four factors and they are: *Work as true identity* (Crobhach's alpha value of .8638), *Entertainment Focused* (.7700), *Over Worked* (.7605), *Food as Entertainment* (.7600). In all 76.243 per cent of the variance is explained through these four factors.

3.4 Overview Of Lifestyle Aspects Of Wellness Clients Interest Studied Through (1) Achievement (2) Food

There were ten statements to elicit information on achievements from the wellness clients. Another ten statements were framed to get opinions of wellness clients on their food and food related habits. Of the twenty statements there were two statements in achievements that the wellness clients have agreed as per the mean score and they are 'My achievements are everything to me in life and I have positive frame of mind to achieve my goals'. The one statement in food, which is agreed by the wellness clients, reads as 'I am cautious and avoid excessive liquor intake'. It is evident that the wellness clients are achievement oriented and positive in their frame of mind and are aware of the ill effects of liquor to personal health and are cautious to avoid it.

The mean scores revealed that the wellness clients had neutral opinion on two achievement statements and seven food statements. They have neither agreed nor disagreed to 'I set huge targets for myself to achieve', and 'I constantly strengthen my inner self to achieve my goals'. The neutral score on huge targets could be attributed to the fact what is huge for ones' capacity need not be huge for another. The statements on food that have neutral scores includes ' I eat to stay fit', 'I eat to enjoy myself', 'My eating habits are healthy', 'I want to bring about change in my food habits', 'I know my diet is not balanced and healthy', 'Non vegetarian food is a must for me', 'I eat what is available for me'. In keeping with the concept of credence quality it could be true that people are unable to assess if their food habits are healthy or not as they are not experts in the science of dietary.

It was observed from the study that there were six statements from achievements that got mean score of about 2 indicating that these statements were disagreed by the clients. The statements which were disagreed include 'Obstacles make me de-motivated, I set no goals and takes life as it comes, I fail to reward myself for my achievements, My achievements are negligible compared to others, If I am not successful I blame myself, I lack perseverance and focus to achieve my goals'. There were two statements from Food, which was disagreed, and they are: ' I eat at irregular time, Fried food is my weakness'. It can be construed that wellness clients are regular eaters & are beyond the weakness of fried food. As far as achievements they have disagreed to all the negative statements projecting positive attitude to achievements in life. The Cronbach's alpha of Interest dimension was .2890 and after the item analysis 11

variables are retained and the Cronbach's alpha of these 11 items was .7790.

3.5 Factors Evolved From Interest Studied Through (1) Achievement (2) Food

Factor analysis of these 11 items resulted in four Interest factors and they are: *Indisciplines Foodies and Change in Food Habit Seekers* (Cronbach's alpha value of .8520), *Non- Focused Individuals and Low Self-esteem* (.9085), Positive Achiever (.5978), *Weak Willed and Self- deniers* (.7487). In all 82.16 per cent of the variance is explained by these four factors.

3.6 Overview of Lifestyle Aspects of Wellness Clients Opinion Studied Through (1) Culture (2) Opinion of Self

Viewpoints on culture are understood through seven statements. The mean scores revealed that the wellness clients have disagreed to two statements, neither agreed nor disagreed to four statements and has agreed to one statement. The statement they have agreed to read, as 'I feel rich and proud of my culture' which shows their affinity to culture. The four statements that received neutral response were 'I follow my heart more than my culture, I feel comfortable with people who speak the same language, My dietary habits are typically ethnic, I have strong hold on cultural values'. This exhibits that the wellness clients are not too clear about their cultural practices, this could be due to the fact that they are required to behave differently at different occasions and hence they are unable to take a stand. It was also observed that two variables namely ' I am apprehensive of adopting other cultures' and 'Being ethnic gives my special identity', were disagreed by the wellness clients, this shows that wellness clients are open to adapt to other cultures and they are not highly ethnocentric.

There were thirteen statements to elicit information of self. Mean score values revealed that one statement was strongly disagreed, four statements were disagreed, six statements were neither agreed nor disagreed and one statement was strongly agreed by the wellness clients. The lone statement that was strongly disagreed reads, as 'I am a complex individual'. This shows that the wellness clients are not in lack of clarity in assessing themselves. The lone statement that was strongly agreed reads as ' I update myself constantly'. This is not surprising considering the educational qualification and technology savvy profile of the wellness clients. The statements which was neither agreed nor disagreed by wellness clients include ' I am friendly and social', 'I want things my way', 'I am self contented', 'I am independent and believe in self-help', 'I am cautious and planned', 'I fall upon my family and friends for help', and 'I strive for progressive improvement'. It is not to very easy to classify ourselves categorically on certain issues as we tend to behave differently at different circumstances. For example, a person can be self contented in terms of his assets and belongings but has a burning desire to do something to society. This could be the reason why the wellness clients have attributed neutral score to some of the self-assessment questions. The twenty items of opinions studied in terms of Culture and Opinion on self were reduced to 15 items after an item analysis, which improved the alpha value from .6477 to .7652.

3.7 Factors Evolved from Opinion Studied Through (1) Culture (2) Opinion On Self

As many as 15 items were reduced to four factors and they are: *Cultural Buffs and Reserved Individuals* (Cronbach's alpha value of .9015), *Ethnocentric and Complex Individuals* (.8629), *Language Buffs and Average Individuals* (.3763) and *Self-deniers and Cautious Individuals* (.4464). In all the above four factors explained 76.52 per cent of total variance. 12 factors emerged from Activities, Interests and Opinions. Four factors are from Activities studied in terms of Work and Entertainment; four factors from Interests studied in terms of Achievements and Food, and four factors from Opinions studied in terms of Culture and Opinion on self.

3.8 Overview Of Behavior Aspects of Wellness Clients Studied Through Attitude Towards Wellness Services, Expected Benefits and User Occasion

This section has twenty-nine statements in all. While ten statements are framed to understand the attitude towards wellness services nineteen statements are framed to understand the expected benefits and experienced services from the wellness centers. Of the ten statements

to measure attitude towards wellness services, five statements were disagreed and the remaining five were neither agreed nor disagreed by the wellness clients. Five statements on attitude have mean score indicating neither agreed nor disagreed and they are 'Wellness gives physical fitness to me, Wellness is altering practices in lifestyle, Wellness is something to think about when fitness is failing, I am not too familiar with the concept of wellness, Wellness relieves me of stress'. The wellness clients are unable to specifically single out the benefits that they derive from the wellness services and that could be the reason for the neutral stand. The five statements to which the wellness clients disagreed to includes 'Wellness offers nothing in concrete terms, Wellness is boring exercises, Wellness offers spiritual harmony, Wellness is pampering messages and spa treatments, and Wellness is restrictions in all areas of life. It is seen that the negative statements are disagreed by the clients indicating that the attitude is positive and spirituality through wellness is also something that is not agreed by the clients.

There were nineteen sentences to elicit information on expected benefits and service experience at the center. There were two statements 'I seek holistic perspective of health through wellness programs' and 'Benefits are not immediate it needs enduring adherence to wellness principles' that was agreed by the wellness clients. The good indication is that wellness is equated with holistic platform and it is also tied to long term and enduring life practices. This way the expectations are very genuine and realistic.

There were eight statements whose mean scores exhibited that they were disagreed by the wellness clients and they are: ' I seek wellness for prevention of heredity related ailments', 'I seek wellness to identify with some ideology in life', 'I seek wellness to prevent ageing', 'There is so much to learn from the wellness concepts', 'My experience at the centers were not very satisfactory', 'The benefits I seek were far more than what I received', 'Benefits are long lasting', 'The experiential benefits are very momentary'.

3.9 Factors Evolved from Behavior of Wellness Clients

Factor analysis was performed on the 26 variables chosen after item analysis to derive behavioral factors. Results showed seven behavioral factors evolved and they are: *Anti-Ageing Prevention Seekers and Strong Reviewers* (Cronbach's alpha .901), *Ideology/ Spirituality Seekers* (.402), *Occupational Ailment Prevention Seekers* (.828), *Heredity Ailment Prevention Seekers* (.825), *Antagonists* (.761), *Stress Release Seekers* (.771), *Change in Current Lifestyle Habit Seekers* (.666). Since factor two does not have the recommended Cronbach's alpha value it is not considered for cluster analysis. In all the seven factors explained 83.861 per cent of the total variance.

3.10 Over View of Loyalty Aspect of Wellness Clients

There are in total nine loyalty statements Cognitive loyalty is measured through the statements 'Service providers offer excellent customer relations' and 'Service providers are empowered', the first statement is agreed by the wellness clients as the mean score is 4.14 and the second statement is neither agreed nor disagreed. Affective loyalty is measured by 'I am reluctant to try out anything new and I am comfortable in a place already known to me'. Mean scores for these statements show that the first statement is disagreed and the second statement is neither agreed nor disagreed. Both the conative loyalty statements namely that is 'I have identified the program best suited for me and will adhere to it regularly' and 'I am used to the service provider and will want the same services always' are neither agreed nor disagreed by the wellness clients. Finally the action loyalty statements 'I am a regular wellness customer, and 'I am trying out various wellness programs and will choose the one which fits my lifestyle' are neither agreed nor disagreed by the wellness clients and the statement 'I travel to places exploring specialty services in wellness' is disagreed.

3.11 Conceptual Models and Testing of Hypotheses

In order to find out a) the effect of the different factors underlying Activities, Interests, and Opinions on Loyalty, b) Lifestyle factors evolved out of combining Activities, Interests and Opinion on Loyalty c) Behavioral factors and Loyalty, multiple regression method was employed. Factor scores of respective factors of Activities, Interests, Opinions, Lifestyle factors evolved out of combining the

three dimensions of Activities, Interests, and Opinions and Behavior factors were regressed with customer Loyalty.

Hypothesis 1:
There is no effect of Activity factors on Loyalty towards wellness services.

The regression model and results between factors underlying Activities and wellness client's loyalty is presented as:

Loyalty = $\alpha + \beta 1\ AF1 + \beta 2\ AF2 + \beta 3\ AF3 + \beta 4\ AF4$.

The regression results indicate, (Adj R^2 = 0.399) 39.90 per cent of variation in loyalty of wellness clients is demonstrated and explained the activity based constructs. Of the four factors evolved from Activities Entertainment Focused ($\beta 2$ = 0.322, p = 0.000), Over Worked ($\beta 3$ = 0.332, p = 0.000) Food as Entertainment ($\beta 4$= 0. 344, p = 0.000) positively influence the loyalty. However, the Factor 1: Work as true identity ($\beta 1$= -0.274, p = 0.000) negatively influences the loyalty. Since work does not tire them out, and they derive satisfaction and identity through their work this factor is not loyal to wellness services, as they do not need external stimuli to empower them. Hence there is positive effect of factor two, three and four on loyalty. However, factor one has negative influence on loyalty towards wellness services.

Hypothesis 2:
There is no effect of Interest factors on Loyalty towards wellness services.

The regression model and results between factors underlying Interest and wellness clients loyalty is presented as:

Loyalty= $\alpha + \beta 1\ IF1 + \beta 2\ IF2 + \beta 3\ IF3 + \beta 4\ IF4$

The regression results indicate (Adj R^2=0.384) 38.4 per cent of variation in loyalty of wellness client is demonstrated and explained the interest based constructs. Of the four factors, *Indisciplined Foodies and Change in Food Habit Seekers* ($\beta 1$= 0.067, p = 0.000), *Non-Focused Individuals and Low Self Esteem* ($\beta 2$= 0.201, p = 0.000), *Positive Achievers* ($\beta 3$= 0.501, p = 0.000) have positively influenced loyalty of wellness clients. However factor four that is *Weak willed and Self-Deniers* ($\beta 4$ =-0.310, p = 0.000) negatively influences loyalty. It is to be noted that obstacles make these clients de-motivated and they are also self deniers in the sense they do not acknowledge their success these are not characteristics of seekers of wellness who are progressive and wants to improve themselves constantly hence it is only natural that the weak willed and self deniers negatively influence loyalty of wellness services. Hence factor one, two and three have positive effect on Loyalty and factor four has negatively influences loyalty towards wellness services.

Hypothesis 3:
There is no effect of Opinion factors on Loyalty towards wellness services.

The dependent variable that is the wellness client loyalty is regressed with the underlying factors of "Opinion". The regression equation is:

Loyalty = $\alpha + \beta 1\ OF1 + \beta 2\ OF2 + \beta 3\ OF3 + \beta 4\ OF4$

The regression results indicate, (Adj R^2 = 0.109) 10.9 per cent of variation in loyalty of wellness clients is demonstrated and explained the Opinion based factors. Four factors were regressed with loyalty. It was observed that *Cultural Buffs and Reserved Individuals* ($\beta 1$=0.254, p = 0.000), and *Language Buffs and Average Individuals* ($\beta 3$=0.139, p = 0.010) have positively influenced the loyalty of the wellness clients. However factor two and four namely *Ethnocentric and Complex Individuals* ($\beta 2$= -0.190, p = 0.000) and *Self-Deniers and Cautious Individuals* ($\beta 4$= -0.030, p = 0.503) negatively influences the loyalty. It is to be noted that the ethnocentric and complex individuals are apprehensive about adapting to some new practices and self deniers and cautious individuals may not accept the services because of the very nature of being cautious and not open to new emerging ideas. Hence, factors one and three have positive effect on loyalty towards wellness services and factor two and four negatively influences loyalty.

Hypothesis 4:
There is no effect of Lifestyle factors combining AIO on Loyalty towards wellness services.

The next stage of analysis aimed at viewing the lifestyle factors of the wellness clients. 39 lifestyle items with an alpha value of (.7808), was put to factor analysis and 10

lifestyle factors had emerged from this analysis. The ten-lifestyle factors are: 1. *Work Enthusiasts* (.5916), 2. *Low Self-esteem and Cultural Buffs* (.8813), 3. *Ethnocentric and Complex Individuals* (.4109), 4. *Average Individuals and Language Buffs* (.5810), 5. *Indisciplined Foodies and Change in Food Habit Seekers* (.8520), 6. *Hardcore Strivers* (.8001), 7. *Net-workers* (.7478), 8. *Cautious Individuals and Family Oriented* (.6399), 9. *Weak Willed and Self-Denier* (.7487), and the last factor 10. *Striving for Progressive Improvement* is a factor with a lone variable. The regression model and results between factors underlying Lifestyle and wellness clients loyalty is presented as

Loyalty= α+ β1 LSF1 + β 2 LSF2 + β3 LSF3 + β4 LSF4+β5 LSF5 + β 6 LSF6 + β7 LSF7 + β8 LSF8+ β9 LSF9 + β10 LSF10

Ten lifestyle factors were regressed with loyalty. The regression results indicate, (Adj R2 =0.841) 84.1 per cent of variation in loyalty of wellness clients is demonstrated and explained the lifestyle-based factors. Of the ten factors factor two that is *Low Self-Esteem and Cultural Buffs* (β2 = 0.192, p = 0.000), factor four *Average Individuals and Language Buffs* (β4 = 0.371, p = 0.000), factor five *Indisciplined Foodies and Change in Food Habit Seekers* (β5 = 0.153, p = 0.000), factor six *Hard core striver* (β6 = 0.490, p = 0.000) and *Net worker* (β7 = 0.174, p =0.000), have positively influenced the loyalty of the wellness clients. Although five of the factors are positive the remaining five factors influences loyalty negatively and they are: *Work Enthusiasts* (β1 = -0.306, p = 0.000), *Ethnocentric and Complex Individuals* (β3 = -0.249, p = 0.000) factor eight *Cautious Individuals and Family Oriented* (β8 = 0.037, p = 0.106) factor 9 *Weak Willed and Self-Denier* (β9 = -0.464, p = 0.000), and the last factor that is factor ten S*triving for Progressive Improvement* (β10 = -0.078, p = 0.000). It is interesting to know that 'Work as true identity' the first factor under Activity did not effect positively to Loyalty and after combining the AIO dimensions the factor one under lifestyle with similar variables combined namely 'Work Enthusiasts' negatively influences Loyalty. As mentioned the reason could be that as these are clients who are already empowered by their work they do not need an external stimuli like the wellness centers to motivate them.

Ethnocentric and complex individuals did not influence loyalty positively. This could be due to highly ethnocentric views and non-acceptance of other practices. Cautious individuals are probably like the laggards and would want to try wellness services after getting an endorsement from innovators. Weak willed and Self-Deniers were the fourth factor under Interest Dimension of lifestyle and in the combined lifestyle factor analysis the ninth factor has evolved with almost the same items and this factor has not influenced loyalty. Because they are weak willed and their perseverance is not strong they do not seek wellness for life enhancement. The last factor is with a lone item 'I strive for progressive improvement' and that has negative influence on loyalty. Progressive improvement is attributed to other aspects of life enhancement and they could be potential clients when they realize the positive holistic wellness services. So it is observed that of ten lifestyle factors five factors positively influence loyalty. Hence factors two, four, five, six and seven have positive effect on loyalty towards wellness services, while factors one, three, eight, nine, and ten have negative effect towards loyalty.

Hypothesis 5:

There is no effect of Behavioral factors on Loyalty towards wellness services.

The regression model and results between factors underlying Behavior and wellness Clients loyalty is presented as

Loyalty= α+ β1 BF1 + β 2BF2 + β3 BF3 + β4 BF4 + β 5 BF5 + β36 BF6 + β7 BF7

Effect of behavioral factors on loyalty was found out using multiple regression method. Factor scores seven behavioral factors were regressed with customer loyalty. The Behavioral vis-a-vis Loyalty model and the results are as follows:

The regression results indicate, 90 per cent (Adj R2=0.900) of variation in loyalty of wellness client is demonstrated and explained the behavior based construct. Of the seven, five have positively influenced the Loyalty of wellness Clients. The results are as follows: *Anti-Ageing*

Prevention Seekers and Strong Reviewers (β1 = 0.630, p = .000) *Occupational Ailment Prevention seekers* (β3 = 0.505, p = .000), *Antagonists* (β5 = 0 .064, p = .000) *Stress Release Seeker* (β6 = 0.345, p = .000) *Change in Current Lifestyle Habit Seekers* (β7 = 0.356, p = .000). However, *Ideology/Spirituality Seekers* (β2 = 0.015, p = .414) and *Heredity Ailment Prevention Seekers* (β4 = 0.035, p = .050). Hence there is positive effect of factor one, three, five, six and seven and negative effect of factor two and four towards loyalty.

4.0 SEGMENTATION

4.1 Segmenting Wellness Clients Based on Lifestyle

The next stage of analysis aimed at grouping wellness clients into segments. Life style factors based on all the three sub variables namely Activities, Interests and Opinions were elicited. Of the ten factors, factor 3 that is 'ethnocentric and complex individuals' was eliminated for further analysis as its alpha value is below the recommended threshold (0.5). Nine factor scores of lifestyle were put to cluster analysis. First, a hierarchical technique was used to establish the number of clusters, profile the cluster centers, and identify any obvious outliners. Non-hierarchical method was used to select the seed points according to some practical, objectives, or theoretical basis. Using both the methods can gain the benefit of each. One of the hierarchical types is the agglomeration schedule, which can help us to identify large differences in the coefficient. A large difference in the coefficient values between any two rows indicates a solution pertaining to the number of clusters, which the lower row represents. It was observed from the agglomeration schedule that the jump in the coefficient values between the cluster 3 and 4 is the greatest, nevertheless the researcher ran 3,4,5 cluster solutions and keenly observing the values of distances between factors and the interpretations of cluster formation, 4 cluster solution was considered the best. It was also seen that the level of significance through ANOVA indicates that the 9 factors are significantly different across the four clusters. Hence the most parsimonious solution for lifestyle of wellness clients was a four-cluster solution. Nine factors were significantly different across four life style clusters and they are: Cluster 1. Work enthusiasts and family oriented contains 29.67 per cent that is 92 wellness clients Cluster 2. Commoners: this cluster has 14 members and consists of 4.15 per cent of the wellness clients. Cluster 3. Net-workers consist of 162 wellness clients and constitute 52.25 per cent and Cluster 4. Hard core strivers consists of 42 members that is 13.54 per cent of the wellness clients.

Validating Lifestyle Segments

Discriminant analysis was done to evaluate the accuracy of the segment classification completed by using cluster analysis. Over all 100 per cent of the original cases were classified correctly for lifestyle clusters. According to pooled within group correlations, "I am apprehensive of adopting other cultures" contributed to 8.6 per cent of function 1 structure; "My achievements are negligible compared to others" contributed to 16.2 per cent of function 2 structure, and "I balance work and entertainment to avoid stress" contributed to 17.3 per cent of function 3 structure.

4.2 Segmenting Wellness Clients Based on Behavior

As per the cluster analysis for the behavioral segmentation 26 behavioral items evolved 7 factors. Factor 2 with low Cronbach's alpha (.402) is not considered for cluster analysis. 6 factor scales were used to run the cluster analysis for segmenting the wellness clients based on behavior. ANOVA output revealed that all factors were significant across four clusters. To help identify large relative increases in the cluster homogeneity, percent change in the clustering coefficient for 10 to 2 clusters was calculated. Four-cluster solution was the most appropriate considering the distance between the clusters, clarity with which the interpretation can be made. The four behavioral clusters are: Cluster 1: Heredity Ailment Prevention Seekers and Change in Current Lifestyle seekers with 64 wellness clients constituting 20.64 per cent. Cluster 2: Occupational Ailment Prevention with 23 clients and 7.41 per cent Cluster 3: Skeptics and Anti-Ageing Prevention Seekers consisting of 61.29 per cent of wellness clients with 190 members 4: Stress Release Seekers with 33 members constituting 10.64 per cent of wellness clients.

Validating Behavioral Segments

Over all 99.7 per cent of the original cases were classified correctly for Behavioral clusters. Group centroids of four clusters were sufficiently discriminated by the three functions. According to pooled within group correlations, "*My experiential benefits were more than the expected benefits*" contributed to 16.6 per cent of function 1 structure; "*Wellness is boring exercises*" contributed to 28.4 per cent of function 2 structure, and "*I seek wellness to prevent occupation related ailment*" contributed to 31.0 per cent of function 3 structure.

Since both the lifestyle clusters and the behavioral clusters are validated the next objective of the research is addressed which is to evolve service packages to each of the identified segments. Packaging services to suit consumer preference and target expectations, results in evolving new products and services, this can be branded with specific product features.

5. Developing Service Packages

Packaging and programming perform five key roles in hospitality marketing. They are as follows: 1. Smoothing patterns of business, 2. Improving profitability, 3. Assisting in use of segmented marketing strategies, 4. Complementing other product/services- mix elements, 5. Bringing together other related hospitality and travel organizations.

Packaging services to suit consumer preference and target expectations, results in evolving new products and services, this can be branded with specific product features. Harvard University's Ted Levitt, argues that new competition is not between what companies produce in their factories but between what they add to their factory output in the form of packaging, services, advertising, customer advice, financing, delivery arrangements, warehousing, and other things that people value.

This study is unique as it goes a step further than other studies and actually develops service packages for the various segments. Identifying segments, their needs and wants and then packaging new services, positioning it on holistic wellness platform, building brand equity and extending the brand equity to represent Indian Wellness sector is the road map for planned growth for the sector in India. The first step towards it is to segment the clients and form new wellness packages to cater to their needs and wants.

Through this research four clusters have been identified in life style and three clusters in Behavior. Wellness service packages were evolved for these clusters after interviewing twelve members from the five-wellness centers. Fitness experts, yoga master, dietitian, spa manager, marketing manager, naturopathy doctor, alternate therapy practitioners, were interviewed and packages were formulated. Package names are given in Sanskrit, which is the first attempt in the industry. The names of the packages indicate the effects and benefits that it would offer to the clients.

5.1 Developing Service Package for Lifestyle Segment

The service packages thus evolved with professional inputs were branded. This is the first effort of its kind in the wellness sector. The underlying theme for the lifestyle packages is "Turn a New Leaf". The following brands of service packages were evolved for the lifestyle segments.

Cluster 1: "Work Enthusiasts and Family Oriented"- Turn A New Leaf: *Anandha*"
Cluster 2: "Commoners"- Turn A New Leaf: *Prathignya*"
Cluster 3: "Net Workers"- Turn A New Leaf: *Sneha*"
Cluster 4: "Hard Core Strivers" - Turn A New Leaf: *Shanthi*".

5.2 Developing Service Package for Behavioral Segments

The theme for the behavioral packages is "Discover Happiness in Health". Four behavioral segments were formed and service packages evolved for them are as follows:

Cluster 1: "Heredity ailment prevention seekers and Change in current lifestyle seekers" "- Discover Happiness in Health: *Soukya*"
Cluster 2: "Occupational Ailment Prevention Seekers"- Discover Happiness in Health: *Arogya*"
Cluster 3: "Skeptics and Anti-Ageing Prevention seekers" Discover Happiness in Health: *Kalpana"*

Cluster 4: Stress Release Seekers Discover Happiness in Health: Buddha

5.3 Scope For Further Research

Wellness sector is in its nascent stages in India. The entire sector is open for more understanding. An in-depth study can be done on expectations and perception of clients on service quality and efficiency. From the service providers point of view benchmarking can be done to improve the existing standards to international standards. Building customer relations is another area, which can be studied and implemented in Wellness sector as wellness is adapting to certain key principles in varied life areas, which happens not instantaneously but over a period of time. To sustain client's interest out side the center and to motivate the client to maintain the key principles as a part of daily routine is a difficult task. Powerful customer relationship management can act as a major tool to maintain and keep up the wellness ethos out side the centers. "Wellness quotient" can be studied for various work groups; this can act as the basis on which training initiatives are planned for organizations.

5.4 Limitations Of The Study

This study was conducted in the city of Bangalore, India. Samples are not included from the other parts of India. Wellness as a concept and as an industry is not fully developed; it is still considered an extension of the beauty industry by some, health by others, fitness by a few, and even post-operative care by some. Especially in India, it is considered to be a part of spirituality wellbeing too. Hence, the industry is yet to shape up as a stand-alone entity. This is a strong limitation for a researcher who is seeking for well-positioned wellness centers for the purpose of study and data collection.

5.5 Conclusion

In all twelve factors were evolved from Activities, Interests, and Opinions of wellness clients. Of the twelve factors eight factors influence loyalty positively. Behavior of wellness clients studied in terms of Attitude towards wellness services, Expected benefits and User Occasion extracted seven behavioral factors. Four behavioral factors had positive effect on wellness loyalty. There were ten lifestyle factors evolved out of combining the AIO variables. Of these five factors had positively influenced loyalty. Ten lifestyle factors formed four wellness lifestyle clusters. Seven behavior factors formed into four wellness behavior clusters. Branded service packages were evolved for each of the identified lifestyle and behavior clusters which has never been attempted in the past.

6. References

Alfansi, L., Sargent, A. Market Segmentation in the Indonesian Banking Sector: The Relationship between Demographics and Desired Customer Benefits. The International Journal of Bank Marketing. Vol.8 (2), 2000. pp.64-74.

Ana, M. Gonzalez, Laurentino Bello. The Construct Lifestyle in Market Segmentation, The Behaviour of Tourist Consumers. European Journal of Marketing Vol.36 (1/2), 2000. pp.51-85.

Asha Krishna Kumar. 2004. The Old and The Ignored. Frontline, 21:19

Atila Yuksel, Fisun Yuksel. Market Segmentation based on Tourists' Dining Preferences. Journal of Hospitality & Tourism Research. Vol.26 (4), 2002. pp.315-331.

Blanca Garcia Gomez, Ana Gutierrez Arranz, Jesus Gutierrez Cillan. The Role of Loyalty programs in Behavioral and affective loyalty. Journal of Consumer Marketing. Vol.23 (7), 2006.

Claudia Jurowski, Allen Z Reich. An Explanation and Illustration of Cluster Analysis for Identifying Hospitality Market Segments. Journal of Hospitality & Tourism Research. Vol.24, 2000. pp.67-91.

Frank, R.E., Massey, W.F., Wind, Y. 1972 Market Segmentation. Englewood Cliffs: Prentice Hall.

Garry, T. Green, Kencordell, Carter, J. Betz, Chriatine Di Stefana. Construction and Validation of the National Survey on Recreation and Environments Lifestyle Scale. Journal of Leisure Research. Vol.38 (4), 2006. pp.513-535.

Gentleman. A. India's Newly Rich Battle with Obesity, The Observer. Available: www.guardian.co.uk/world 4, December 2005.

George Arimons and Adbulaziz Elfessi. Cluster Method for Categorical Data in Tourism Market Segmentation Research. Journal of Travel Research. Vol.39, 2001. pp.391-397.

Jack, A. Lesser, Marie Adele Hughes. The Generalizability of Psychographic Market Segment Across Geographic Locations. Journal of Marketing. Vol.50, 1986. pp.18-27.

John, T Bowen. Market Segmentation in Hospitality Research: No Longer a Sequential Process. International Journal of Contemporary Hospitality Management Vol.10 (7), 1998. pp. 289-296.

Joseph S Chen, Cathy H. C. Hsu. The Use of Logit Analysis to Enhance Market Segmentation Methodology. Journal of Hospitality and Tourism Research. Vol.23, 1999. pp.268-283.

Joseph, T. Plummer. Life Style Patterns and Commercial Bank Credit Card Usage. Journal of Marketing. Vol.35, 1971. pp.35-41.

Kanugovi, Sreenath. 2005. Brand India An Evaluation. Hyderabad: The ICFAI University Press.

Kaynak, E., Kara, A. Consumer's Perceptions of Foreign Products: An Analysis of Product Country Images and Ethnocentrism. European Journal of Marketing Vol.36 (7/8), 2002. pp.928-949.

Khomba Singh. Drug Companies Catch Cold as Raw Materials Costs Rise. The Economic times: 27, May 2008.

Machauer, A. and Morgner, S. Segmentation of Bank Customers by Expected Benefits and Attitudes. International journal of Bank Marketing. 19 (1), 2001. 6-11.

Malhotra, Rajiv. India in The American Mind in Brand India An Evaluation. Hyderabad: The ICFAI University Press, 2005.

Mollenkopf, D., Rabinovich, E., Laseter, T.N, Boyer, K.K. Managing Internet Product Returns: A Focus on Effective Service Management. Decision Science Journal. Vol.38 (2), 2007. pp.215-250.

Mueller.H, Kaufmann.E. Wellness: Tourism, Market Analysis of a Special Health Tourism Segment and Implications for the Hotel Industry. Journal of Vacation Marketing. Vol.7 (1), 2001. pp.7-15.

Nanjappa V. Bangalore: The Rising Divorce Rate in the IT Sector. Available: www.rediffcom/news. 2, August 2007.

Nick Johns and Szilvia Gyimothy. Market Segmentation and the Prediction of Tourist Behavior: The case of Bornholm, Denmark. Journal of Travel Research. Vol.40, 2003. pp.316-327.

Orsay Kucukemirogh. Market Segmentation by Using Consumer Lifestyle Dimensions and Ethnocentrism An empirical study. European Journal of Marketing Vol.33(5/6), 1999. pp.480-487.

Per, E. Pedersen, Herbjorn Nysveen. Shopbot Banking: An Exploratory Study of Customer Loyalty Effects. The International Journal of Bank Marketing vol.19 (4/5), 2001.

Philip Kotler, David Gertner. Country as Brand, Product, And Beyond: A Place Marketing, And Brand Management Perspective. Journal of Brand Management, Vol.9 (4/5), 2002. pp.249-262.

Piercy, N. Market-Led Strategic Change. Oxford: Butter Worth Heine Mann, 2002.

Rob Lawson, Sarah Todd, Christo Boshoff. Relations Between Consumer Sentiment Towards Marketing and Consumer Lifestyle. Australian Marketing Journal, Vol.9 (2), 2001. pp.7-22.

Rosanna L Church, Naomi Robertson. Policing. An International Journal of Police Strategies and Management, Vol.22 (3), 2001. pp.304-311.

Roten Berk. L. Wellness Programs Gains in Popularity, Take on New Approaches. Hospital and Health Networks, Vol.81 (8), 2007. 30.

Sally Dibb, Lyndon Simkin. A Program for Implementing Market Segmentation. Journal of Business & Industrial Marketing. Vol.12, 1997. pp.35-45.

Sara Dolnicar, Friedrich Leisch. Winter Tourist Segments in Austria: Identifying Stable Vacation Styles Using Bagged Clustering Techniques. Journal of Travel Research. Vol.41, 2003 pp.281-292.

Sara Dolnicar. Beyond Common Sense Segmentation: A Systematic of Segmentation Approaches in Tourism. Journal of Travel Research. Vol.42, 2004. pp.244-250.

Sarigollu, E., & Huang, R. Benefits Segmentation of Visitors to Latin America. Journal of Travel Research, Vol.43(3), 2005. pp.277-293.

Satya Narayana. Towards Equitable and Health Care: Drug Prices and Beyond. Indian Journal Medical Research. Vol.127, 2008. pp.301-304

Satya Venkatesh. Oldage Homes in India. Available: www.chillibreeze.com 15, May, 2008.

Sirakaya, E., Uysal, M., and Yoshioka, C.F. Segmenting the Japanese Tour Market to Turkey. Journal of Travel Research, Vol. 41(3), 2003. 293-304.

Smith Rodney, E., Wright William, F. Determinations of Customer Loyalty and Financial Performance. Journal of Management Accounting Research. Vol.16, 2004. pp.183-206.

Taher, Nasreen. India – The emerging brand. Hyderabad: The ICFAI University Press, 2005.

Teixeira, C. Health Educators: Working for Wellness. Occupational Outlook Quarterly Vol.51 (2), 2007. pp.32-36.

Terblanche Nic, S. The Relationship between Customer Satisfaction and Loyalty: An Application of American Customer Satisfaction Index in South African Fast Food Industry. Management Dynamics Vol.15 (2), 2006. pp.31-42.

Ventresca. Healthy Living, Healthy Incentives. Incentive Magazine 181 (9) 72. Available: www.trainingmag.com/msg 12, September, 2007.

W. Wai, J. Chang, K.L. Moon, C. To and P. Hsia. Effect of Hong Kong Consumers' Lifestyle on World Wide Web Shopping. Journal of the Textile Institute Vol. 95 (1-6), 2004. pp.51-58.

William, D.Wells, Douglas, J. Tigert. Activities, Interests and Opinion. Journal of Advertising Research Vol.11 (4), 1971. pp.27-35.

DHĀRANA
BHAVAN'S INTERNATIONAL JOURNAL OF BUSINESS
Vol:4, 1 (2010) 61-63 ISSN 0974-0082

Managerial Economics

Geetika,Piyali Ghosh & PurbaRoy Choudhury

First Reprint(2009),
Tata McGraw-Hill Publishing Company, 2008

Reviewer: N.S.Viswanath
Bhavan-Marshall Institute of Management, Bangalore

The Book under review claims to deal with a core subject of importance in business education. Economics cannot be taught as a subject of just 'firm relevance' or as a subject connected with business policy and governance. The treatment of the subject requires induction of the knowledge and of application to the business world. The students of business are not to be prepared as economists; they are however to be prepared as decision makers who would make firm level decisions based on endogenous and exogenous factors. The book under review has a special place in the realm of management education with special reference to Indian context. The book deserves appreciation for the conversational style of narration. The delivery of chapters is done logically and in a sequence. The book has several special features at the end of each chapter such as summary, key concepts, question, appendix and case study. The authors deserve a special praise for their painstaking efforts in crafting 'Reality Bites'. The real life situations which are reflected as detailed case studies, enable students to study the concepts through the reading of a case. The book has a value added concept to enable formal and lateral thinking by the introduction of ' think out of the box' and 'think of the box' narratives. The description given so far is sufficient to recommend the book for the students of MBA programme in India.

The book consists of six parts, that together include seventeen chapters ,which links up Micro and Macro economics. It also links up the firms with the economy. The book on the whole ends up with analysis of business cycles with a touch on vicissitudes of business.

The First chapter introduces basic concept of Microeconomics as applied to managerial situations. The assumptions, types, decision modes and principles of economics are covered in an elegant style. While covering principles of economics,the focus of the chapter is more on the demand side economics. The authors could consider adding a note on the supply side situations. This will enable a student to think about dealing with situation of abundance rather than just dealing with scarcity.

The second chapter deals with a brief back ground of 'the theory of firm'. The chapter should be read after reading the case on 'Dabur India Ltd…..'. The objectives of the firm coupled with theories of the firm will cover what is required for understanding objectives and goals of a firm. The organizational chart on page (pp 32) might be extended to firms in the III Sector such as NGOs, Co-operatives and so on. In the Indian context the III Sector is emerging at the micro level to provide goods and services. A Reality Bite on this would enrich Chapter 2.

The Part II of the book begins with demand and supply analysis. The highlight of the Chapter(3) is again the case wherein is scarcity of power across the country is highlighted. The economic agents are striving hard to meet with the consumer demand. An appropriate case followed by application of concept on demand and supply has made this chapter quite acceptable to the readers.

The Chapter 4 deals with consumer preference behavior and the choices. The basic theories connected with consumer have been enumerated well. A note on the assessment of consumer choice would enrich this chapter. The economists, of late, have been concerned with assessing 'consumer happiness' as against 'consumer satisfaction'. An additional note on assessing consumer happiness would help the reader to have sound knowledge of consumer behavior. This would surely help students to understand and capture irrational aspects of consumer behavior.

The concept of elasticity has been discussed with a special note on elasticity of supply. The concept of elasticity aids in making pricing decisions at the market level. A note on rewards and government policies has added value to this chapter.

Forecasting (Chapter 6) of any variable is as important as making an effective strategic action plan. The authors have given the practical attention to forecasting methods. The case in IT industry appears incomplete. This can be updated and the student can be given some more Questions(Posers) in forecasting which are discussed in the chapter.

The Part III of the book deals with production and cost theories. The basic concept of production function(Chapter7) with –one & two-variable inputs have been enumerated with masterly ease on the subject. This chapter gives details of different types of production functions. An explanation of the application there production function would help enrich student knowledge. Some practical cases of estimation of production functions at the firm level can be introduced(preferably one case each from the agricultural , industrial & services sectors).

The cost concepts(Chapter8) have been discussed by taking to account types, time and linkages. These are very essential for a beginner to apply them in real life situations. A detailed note on uncontrollable costs, with examples from business situations, is desirable. The highlight of the chapter is the introduction of the economy of scope and the relation between costs and learning curves. The authors deserve a special kudos for introducing the learning curve concept.

The Part IV of the book covers market nuances such as structure, type, uncertainty and application of game theory to market functioning. Any student of finance would love to read these chapters. The Chapter 9 begins with 'perfect competition'. The demand and supply concepts are linked to market equilibrium and profit. This makes this chapter unique in its description. This chapter begins with an idealistic and an optimistic note. The case on Indian Stock Market at the end of chapter succinctly summarizes the meaning of perfect competition.

Monopoly is discussed at great length(Chapter 10). The concept has unfolded different phases of monopoly and its implication on economic efficiency. The appendix at the end of the chapter gives a short view of the concept of "Monopoly Power."

The imperfectness (Chapter 11)in the market has been discussed with great relevance with prices and output. The situations under different types of profit give a comparative static picture of monopolistic competition. The Nirma story is a good example to make students feel of monopolistic competition. The case ends as a success story of an Indian company under an imperfect competition.

The concept of oligopoly (Chapter 12) has been theoretically presented well. The models of oligopoly as also a note on price leadership have been of help to students. The case of Indian cement industry may not appropriately represent the oligopoly situation. This case study may be re-written with an introduction of description on measures of oligopoly.

The Chapter 13 introduces the functions of a market under uncertainty in a game theoretic framework.

The concept of game theory, the Nash equilibrium , prisoners' dilemma and different types of games have been enumerated well. A simple introduction on market entry game is sufficient for a student to feel decision making under uncertainty.

The Part V of the book discusses domains of pricing – product and input. The product pricing(Chapter14) has been introduced to the reader with a clear focus on application. The linking up of pricing with the organizational objectives, competition, product life cycle and with relevance to operations of business cycle is done with great mastery. The subject chapter in multi product pricing, however, requires some more examples to be documented. The note on Ramsey (not Ramsay) pricing is a case in point. The chapter on input pricing(Chapter15) covers wage, rent, interest in the perspective of economic theory. This chapter is useful to the students in making decisions on pricing of inventories. The chapter, however, poses a question on how pricing methods can be evolved under business situations. Some clarity is necessary on pricing of inputs. An integrated case may help explain these concepts better.

The Part VI of the book concentrates on introduction of macro economics. The concepts such as National Income, money supply and inflation and business cycle have been covered. The chapter(16) on National Income is written with rigour. The authors have not lost sight of application of these concepts. The difficulty in the estimation of national income and its limitations have been described well. The authors aim to convince the reader as to how National Income statistics can be used and what limitations surround national income estimates.

The chapter(17) on Money Supply and Inflation is described in the same rigour & style as that of national income. The demand for & supply of money and types of inflation and its causes and how the economic agents have to deal with demand market under inflation have been dealt well . The measures to be taken in controlling inflation have been described in an appropriate manner. The highlight of the chapter is the Appendix – Money Supply Measures in India.

The chapter(18) on business cycles aims to convince the reader on the effect of cycles on growth and on business at the firm level. The case in IT industry appears relevant. The case,however, fails to describe the operation of business cycle and its effect on the sector and on the firms. A second write up on IT industry growth is desirable. Having reviewed this pleasant book, it is essential to highlight some essential additions which may make the book more comprehensive. The 'Reality Bite' may be supplemented by a little longer 'Reality Snacks'. The reality snacks are already, however, represented by many cases at the end of each chapter.

An addition of integrated case at the end of each part of the book may prove more useful to the students and the practitioners of business. This end of the part cases can be termed as 'Reality Food' – essentially weaving integrated cases from India.

It is suggested that a note on Okun's Law and Philip's Curve can be given at the end of chapter 16. Another chapter in IS-LM analysis & concept of general equilibrium can be introduced. The book suffers from Bibliography and Webliography, although References & Indexes are given at the end. A detailed list of books on managerial economics can be given as Bibliography. The Webliography should be given at the end of the book with date and time of retrieval . The reviewer has had the pleasure of reading the book. He has appreciated the efforts the authors in writing a book on Managerial Economics in the Indian context. The authors and the publisher deserve special thanks from the scholars, students and the general readers.

DHĀRANA
BHAVAN'S INTERNATIONAL JOURNAL OF BUSINESS
Vol:4, 1 (2010) 64-66 ISSN 0974-0082

Marketing Management

Global Perspective Indian Context

V.S. RAMASWAMY & S. NAMAKUMARI
4th Edition, MacMillan Publications, 2009

Reviewer: N.S.Viswanath
Bhavan-Marshall Institute of Management, Bangalore

The present book under review is the 4th edition of the book published in 2009. The book has had 29 reprints since it was first published in 1990. The present book has the fortune of a foreword by Prof.Theodore Levitt. The foreword proved a front runner for the seminal book written by Dr.V.S.Ramaswamy and Ms.S.Namakumari. The present review is based on several readings by the reviewer since March'09. The book has consistently grown in its size since the first edition. At present, the book consists of 43 chapters covered in nine parts. The average size of each chapter is 18.6 pages. The minimum size of a chapter being 9 (36th chapter) the maximum being 37 (37th chapter). The book has added 12 new chapters covering parts 1,2,3,4 and 6. These are all numerical descriptions about the composition of the book. The reality lies in the special features of the book for the users (Teachers, Decision Makers & Students of Marketing).

The presentation of the book has been divided into nine parts. The new perspective in marketing as a process of value creation has been discussed along with the fundamentals in part 1. The basics of value in terms of benefits in creation of total customer value has been described exceptionally well by the examples of Air Deccan and Virginia Atlantic. The value, types, value delivery and the paradigm shift have been presented with academic logic.

Marketing has been discussed as a domain of environment and as a function influenced by domestic and global environment in part 2. The tools such as Michael Porter's five forces model, SWOT analysis, Strategic Business Unit (SBU), the power balance, institutional frame work and a shift of the economy – both domestic / global – to knowledge economy have been enumerated well. The demographics of the domestic and global environment are presented with facts. The psychographics of domestic as well as global consumers could have become a domain of part 2. i.e., the nature of consumers as individuals, groups, country and as a civilization are to be presented to make the reader feel about the way a consumer changes in his / her behavior as an individual and as a member of civilization encompassing different layers such as group, society, country and so on.

The linking of marketing function with strategic tools have been discussed in part 3. Relevant themes have been selected which are covered in seven chapters. Part 3 emphasizes the importance of strategy as a tool in planning, marketing and for deriving competitive advantage. The case of Reliance textiles has been written with ease. The case of Reliance textiles could have been added as an addendum supporting chapters 9 to 14.The chapter 15 is in the form of presentation of a case of "ONLY VIMAL'.

The part 4 concentrates on Consumer Behaviour Analysis and consumer markets. The nature of Indian consumers, their changing profiles, the way they need be segmented and targeted for value orientation, the relationship

between the product and the consumer have been presented.

The 20th chapter which represents the case of Indian Car Market could have been part of Addendum at the end of text book. This will facilitate a reader and the teacher to understand the process of segmentation and targeting by appropriately experiencing the change profiles of consumers. The reviewer felt that a note on customer happiness should have been added in addition to assessing customer satisfaction,loyalty and trust. Product management with a special focus on differentiation, positioning and branding have been presented through 'The case of Scissors'. The chapter 24 may be added as another addendum to make readers learn on product and its management. Introducing new products is a good supplement for the cluster of chapters in part 5.

Distribution, Logistics and Supply Chain Management have been grouped together as part 6 by supplementing two cases – The Case of Asian Paints and The Case of Titan Watches. The concepts of channel management, logistics and supply chain management have been described in a simple and effective language. The two cases of Asian Paints and Titan Watches ought be added as a part of addendum. The chapter 33 on Direct Online Marketing is an odd chapter in part 6. This can be added as a chapter in part 9 under special fields in marketing.

Pricing and promotion are the themes dealt with in part 7. The chapter on pricing as a function of capturing value has been discussed impeccably well. The reviewer felt the need for examples in comparing several pricing methods under different situations.An example on media planning could be added to make reader feel about the utility of a media plan. Part 7 is rich with discussion on promotion functions.

Marketing effort management is the domain of part 8. The chapter 39 under this part covers marketing research, demand and forecasting and marketing control. The chapter on marketing control concentrates on controlling efforts for realizing value. In fact the sub themes in this chapter deal more with benefits, cost and credit management. The analytical tools for marketing management efforts have been presented with clarity.

In part 9, the concentration is on special themes in marketing functions. Services marketing as a chapter have been elucidated well in the absence of a detailed case. The situation in academics dictates a need for detailed and complete case. The chapter on rural marketing helps the reader forsee the potentiality, coverage and size of rural marketing in India. This picturesque note is sufficient enough to get a feel of changing India and the possible market opportunities that are likely to be realized.

The authors deserve a special applause for a student friendly format in framing the book. The twelve new chapters have enriched the value of the book for its contribution to the updated understanding of Principles of Marketing and Marketing Practices. The Principles of Marketing have been enumerated in terms of concepts and perspectives. The addition of a new chapter has been substantiated by concomitant changes in the theme. As an example, any one would enjoy reading the changes in the marketing environment in India. A thorough understanding of the changes in maketing environment in India is described distinctively which numbers in the form of exhibits would speak of. The strategic approach to a marketing problems in terms of orientation have been explained by specific cases in the Indian (ITCs e-choupal) as well as the western contexts (L'Oreal). The authors, all through have Indian context as the back drop, navigate easily to enumeration of narratives in the global context.

The reviewer would like to refer to chapter 17 which narrates the personality of the Indian consumer. The different facets of an aggregate Indian consumer have been highlighted by general features in size, composition, and by poverty levels (BOP / BPL). This chapter has more information than any book we have so far on Indian consumers. (The exception being 'We are like that only' of Rama Bijapurkar.) The reviewer intends to dwell upon the chapter on Customer Relationship Management (CRM). The CRM concept is aimed at customerising customised consumers. This CRM speaks of value by size and by establishing relationship between a customer and the organization. The design and operation of a CRM programme is the highlight of this chapter.

Segmentation and targeting is a theme we normally dwell upon under STP model. The various facets of segmentation, utility and the value to be derived from each segment, evaluation of each segment and holding on and the initiative to hold on the segments of consumers have been discussed with great command. The purpose of segmentation has been succintly brought out.

The new chapter on Global Marketing Environment makes erudition of the global marketing scenario based on trade blocks, power tilt in economics, the crises, and the emerging trade blocks. This particular chapter requires further elaboration on the role of WTO, the changes in the technical environment (special reference to communication technology) and on the rise of Asian Tigers – China, Japan and India. The reviewer felt more thrust has been given to the economics of nations rather than on trade patterns of nations. A short note on nuances of culture on global marketing environment would further enrich this chapter.

Products and Brand fundamentals have been nicely configured in part 5. While the object of the authors was to introduce products and its management, they start with and mix it with branding. The distinctions between product variants, levels, offering, mixes and product life and length have been described in a lucid style. The clarity within which discussion has been made by taking HUL product and that of Coca cola deserves a special mention. The product differentiation and branding subject themes have been done with academic elegance.

As a domain of discussing management themes the authors have cited the case of scissors. This case reference has wide ramification in understanding product, brand and management. The authors have given emphasis to retailing by adding three separate chapters (28,31&32) in part 6. While formal retailing has been discussed from manufacturers' perspective in chapter 28, Retailing for a consumer has a full exercise described in chapters 31 & 32 respectively. Two success stories of Pantaloons & Subhiksha have been taken as representative success stories. Success stories such as Reliance Fresh and Forum could have been added. These two retail success stories, however, may be added in the 5th edition of the book.

Marketing as a discipline have been dealt with in several ways. The producer, wholesaler, retailer, the institution and the consumer have been discussed in greater detail for a large product base. The emerging needs of the consumer and the way these are to be met by marketing functions have been described in chapter 39. The use of MIS has been brought out elegantly.

The example of the themes such as methods, scaling techniques and dimensions appeared scanty for the reviewer. The Marketing Research as a tool through syndicated Research agencies could have been expanded.

The reviewer noted that some value addition can be made in chapter 5. The role of consumer through internet, internet marketing and the characteristics of netizens and netsumers (Consumer through internet) can be added. The chapters 5,6&7 can be restructured by adding on governance and marketing. The paradigm shift in consumer and the emerging scenario of consumers in India, Asia, Europe, US, Australia can be a useful addition. In part 2, marketing planning and strategy may be added to highlight at the macro level trade, commerce and business.

In part 4 it is desirable to add a chapter on changing impulses of consumers and marketing management. The part 5 may include a separate chapter on new product development in between Chapter 24 and 25. A sub section or a chapter can be added in logistics and supply chain management with special emphasis on e-business enterprise. The changing Advertising Management appeared too fundamental. This chapter can be expanded by a detailed note on media planning.

The reviewer felt that recaptioning of parts 3,4,5,6,7,8&9 is essential. They could be renamed Planning & Strategy, structure of consumers, Product & Brand Management, Logistics & Retailing, Value Discovery, Probe for Marketing & New Domains in Marketing respectively.

After several readings, the reviewer felt that this book is very appropriate for a Foundation course in marketing with special applications on Principles and Practices. Any student of core marketing would derive rich dividends by reading this book. First reading of this book would make a student, teacher and/or a marketing practioner hold on in their respective personal libraries.

The authors are to be congratulated for their excellent efforts in bringing out the volume.This book will add knowledge and would change the attitude of any person on marketing who reads this book.

INSTRUCTIONS FOR AUTHORS

Dharana – Bhavan's International Journal of Business welcomes original articles on research into theory and practice of Business and Management. Publication will depend on relevance and clarity. Articles of speculative nature and of wide ramification will also be considered. An article should not be more than 5000 words. The article should have proper reference to key articles in the chosen topic area of the author(s).

REFEREEING: Research contributions received will be subjected to review by two or more referees on a 'double blind' system, whereby the name(s) of contributor(s) will be kept concealed from that of the referees and vice versa. Acceptance of an article is dependent on meeting the standards set by the journal. Revision whenever necessary should be done by the author(s) before publication.

PAPER PROCESSING FEES: A processing fee of Rs.500 ($ 50 for contributors from abroad) is charged for normal processing. In case the processing time is to be reduced to one month then the fee amount is Rs.1000 ($ 100 for contributors from abroad).

COPYRIGHT AND PUBLICATION: Submission of any article implies that it has not and will not be published in any form/language in any other journal. The author(s) shall assign copyright to the publisher for sanctioning reprints, photocopies and reprinting complete issues/volumes at a later period. Traditional rights of the author(s) would not, however, be jeopardized by assigning copyrights to the publisher, i.e., the author(s) has (have) the right, to reuse, veto publication of third party and obtain (or seek permission) for quoting in any other journal. Submission of an article shall be accompanied by a written declaration that the article is an original contribution and has not been submitted elsewhere for publication.

PREPARATION OF MANUSCRIPT: The article should be written in clear and concise English. The typeset should be in double-line spacing on single sided A4 size paper with a one-inch margin on all sides of each page. Pages should be numbered sequentially.

References, tables, exhibits and legends for figures should be printed on separate pages. One hard copy and one soft copy (on a CD) in MS Word format, should be submitted. The e-version of the article will be used for refereeing, reviewing, and for authors' editing & final revision.

REFERENCES

All references should be indexed using arabic numerals and referred in the manuscript by the corresponding numbers. Examples follow.

A Journal Publication: Glazer Rashi, Joel H. Steckel and Russel S. Winer, "Locally Rational Decision Making: The Distracting effort of information on Managerial performance", Management sciences, 38, February 1992, 212-226.

A Conference Publication: S.F. Roehrig, Path analysis and probabilistic networks: analogous concepts, in: Jay F. Nunamaker, R.H. Sprague (Eds.), Proceedings of the 26th Hawaiian International Conference on System Sciences, Vol. III, IEEE Computer Society Press, Los Alamitos, CA, 1993, pp. 523–532.

A Monograph: Harawini G. Swavy I, "Mergers and acquisitions in the US Banking Industry: Evidence from the capital markets", North-Holland, Amsterdam, 1990.

An article in an edited book: Mac Avoy and E. Roberts, "Establishing Superior Performance through Competitive Analysis", in Strategic Planning and Management Hand book, William R. King and David I. Chelland (eds.), Van Nostrand, New York, 1987.

A Book: A. Zeithaml Valarie, A. Parasuraman and Leonard L. Berry, "Delivering Quality Services: Balancing customer perception and expectations", Tree Press, New York, 1990.

Webliography: http://www.elsevier.com/trackarticle; Date of retrieval: 21 October 2007.

ARRANGEMENT OF ARTICLES

The article should be arranged in the following order:

1. Title, Author(s), Affiliations, Postal and e-mail addresses.
2. A 100 word abstract briefing the purpose, scope and conclusions, along with keywords and phrases.
3. Sequential arrangement of the text with proper headings.
4. Acknowledgement(s), if any.
5. References (including Webliography).
6. Illustrations on a separate sheet without text.

Title, Name(s) of Author(s), and the abstract should be centered. Rest of the text, along with section headings, subsection headings and formula(s) should be left justified. Headings should be sequentially numbered using the Decimal Numbering scheme. Keywords and phrases should be in italics.

The first page of the manuscript should contain:

i Title,

ii Name(s) of the author(s) and institutional affiliation(s),

iii Abstract of about 100 words,

iv Keywords and phrases,

v A footnote containing the corresponding author's name, address, e-mail address, telephone and fax number, if any.

Acknowledgement(s), if any, of resource person(s) and/or of grants received may be mentioned as a foot note.

Footnotes may be used, wherever necessary to a minimum, and they should be double spaced.

Formula(s) should be numbered on the right hand margin. Derivation details of Formula(s) may be provided on separate sheets.

DHĀRANA

BHAVAN'S INTERNATIONAL JOURNAL OF BUSINESS
Vol:4, 1 (2010) ISSN 0974-0082

SUBSCRIPTION

(For One Year Only)

Name of Subscribing Individual/Institution: .....

Address: .....

..... **PIN/ZIP:** .....

Please accept the enclosed Cheque (Local only) / Demand Draft (No. .....)

dated ..... drawn on ..... Bank, favouring **BVB-Marshall MBA Programme.**

Circle appropriately

INDIVIDUAL
- **a. Print Version :** Rs. 600/- (or $50) per year for two issues
- **b. CD Version** : Rs. 400/- (or $35) per year for two issues.

INSTITUTION
- **a. Print Version** : Rs. 1,200/- (or $100) per year for two issues
- **b. CD Version** : Rs. 600/- (or $50) per year for two issues.

ALUMNUS (with Registration Number and Year of Graduation)
- **a. Print Version** : Rs. 500/- (or $40) per year for two issues
- **b. CD Version :** Rs. 350/- (or $30) per year for two issues.

Date: Signature:

Mail the completed form along with Cheque/Draft to:
Subscription Desk, Dharana - Bhavan's International Journal of Business
#43, Race Course Road, Bangalore 560 001, India
Ph: 080-2237 0445, 0446 Fax: 080-2237 0447

BOOK-POST