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Measuring Market Risk – An Application of Value-at-risk to Select Government Bonds in India

G. P. Samanta, Prithwis Jana, Angshuman Hait and Vivek Kumar*

Value-at-Risk (VaR) is widely used as a tool for measuring the market risk of asset portfolios. Banks, who adopt 'internal model approach' (IMA) of the Basel Accord, require to quantify market risk through its own VaR model and minimum required capital for the quantified risk would be determined by a rule prescribed by the concerned regulator. A challenging task before banks and risk managers, therefore, has been the selection of appropriate risk model from a wide and heterogeneous set of potential alternatives. In practice, selection of risk model for a portfolio has to be decided empirically. This paper makes an empirical attempt to select suitable VaR model for government security market in India. Our empirical results show that returns on these bonds do not follow normal distribution – the distributions possess fat-tails and at times, are skewed. The observed non-normality of the return distributions, particularly fat-tails, adds great difficulty in estimation of VaR. The paper focuses more on demonstrating the steps involved in such a task with the help of select bonds. We have evaluated a number of competing models/methods for estimating VaR numbers for selected government bonds. We tried to address non-normality of returns suitably while estimating VaR, using a number of non-normal VaR models, such as, historical simulation, RiskMetric, hyperbolic distribution fit, method based on tail-index. The accuracy of VaR estimates obtained from these VaR models are also assessed under several frameworks.

JEL Classification : C13, G10

Keywords : Value-at-Risk, Transformations to Symmetry and Normality, Tail-Index

1. Introduction

The market risk amendment of 1988 Basel Accord in 1996, the advent of New Basel Accord (Basel II) in 2004, and subsequent revisions in the accord have brought about sea changes in risk

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management framework adopted at banks globally in recent years. Regulators across the world today follow banking supervision systems broadly similar to the framework articulated in these documents. A key feature of this framework is the risk capital – the minimum amount of capital a bank requires to keep for its exposure to risk. It is argued that the risk capital acts as a cushion against losses, protecting depositors' interest and increasing the resilience of the banking system in the event of crisis. Risk capital also makes the banks take risk on their own fund, thereby induces them to invest in prudent assets and curb their tendency to take excessive risk, which reduces the chances of bank runs greatly. So, the risk-based capital regulation has emerged as a tool to maintain stability of banking sector. Eventually, not only the banks but an increasing number of other financial institutions and firms are also aligning their risk management framework in the similar line.

Two important changes are notable in the supervisory framework in recent years. First, determination of minimum required capital is now made more risk-sensitive (also more scientific) than earlier. Second, there has been an expansion in coverage of risk events in banks' portfolio. In contrast to traditional focus solely on credit risk (BIS, 1988), the regulatory framework has gradually covered two more important risk categories, viz., market risk (BIS, 1996a, 1996b) and operational risk (BIS, 2004).

The Basel Accords and associated amendments/revisions provide broad guidelines to determine the level of minimum required capital a bank should maintain for all three types of financial risks mentioned above. Under each risk category there have been a number of alternative approaches – starting from simple/basic to advanced in increasing level of sophistication. Also a distinction between basic and more advanced approach is that later emphasizes more on actual quantification of risk.

In the case of 'market risk' the advanced approach is known as 'internal model approach' (IMA), wherein risk capital is determined based on the new risk measure, called value-at-risk (VaR). Higher the value of VaR, higher the level of market risk, thereby; larger the level

of minimum required capital for market risk. Banks, who adopt IMA, subject to regulators' approval, would quantify market risk through its own VaR model and minimum required capital for the quantified risk would be determined by a rule prescribed by the concerned regulator.

The concept of VaR was first introduced in the regulatory domain in 1996 (BIS, 1996) in the context of measuring market risk. However, post-1996 literature has given ample demonstration that the same concept is also applicable to much wider class of risk categories, including credit and operational risks. Today, VaR is considered as a unified risk measure and a new benchmark for risk management. Interestingly, not only the regulators and banks but many private sector groups also have widely endorsed statistical-based risk management systems, such as, VaR.

As stated above, modern risk management practices at banks demand for proper assessment of risk and VaR concept is an influential tool for the purpose. The success of capital requirement regulation lies on determination of appropriate level of minimum required risk capital, which in turns depends on accuracy of quantified risk. There has been a plethora of approaches in measuring VaR from data, each having some merits over others but suffering from some inherent limitations. Also, each approach covers a number of alternative techniques which are sometimes quite heterogeneous. A challenging task before banks and risk managers, therefore, has been the selection of appropriate risk model from a wide and heterogeneous set of potential alternatives. Ironically, theory does not help much in direct identification of the best suitable risk model for a portfolio.

In practice, selection of risk model for a portfolio has to be based on empirical findings. Against this backdrop, this paper makes an empirical attempt to select VaR model for government security market in India. The paper focuses more on demonstrating the steps involved in such a task with the help of select bonds. In reality, actual portfolio differs (say, in terms of composition) across investors/ banks and the strategy demonstrated here can be easily replicated for any specific portfolio. The rest of the paper is organized as follows.

Section 2 presents the VaR concept and discusses some related issues. Section 3 summarises a number of techniques to estimate VaR using historical returns for a portfolio and Section 4 discusses criteria to evaluate alternative VaR models. Empirical results for select bonds are presented in Section 5. Finally, Section 6 presents the concluding remarks of the paper.

Section II

Value-at-Risk – The Concept, Usage and Relevant Issues

2.1 Defining Value-at-Risk

The VaR is a number indicating the maximum amount of loss, with certain specified confidence level, a financial position may incur due to some risk events/factors, say, market swings (market risk) during a given future time horizon (holding period). If the value of a portfolio today is W, one can always argue that the entire value may be wiped out at some crisis phase so the maximum possible loss would be the today's portfolio value itself. However, VaR does not refer to this trivial upper bound of the loss. The VaR concept is defined in a probabilistic framework, making it possible to determine a non-trivial upper bound (lower than trivial level) for loss at a specified probability. Denoting L to represent loss of the portfolio over a specified time horizon, the VaR for the portfolio, say V*, associated with a given probability, say p, $0 < p < 1$, is given by Prob[Loss > V*] = p, or equivalently, Prob[Loss < V*] = (1-p), where Prob[.] represents the probability measure. Usually, the terms 'VaR for probability p' refer to the definitional identity Prob[Loss > V*] = p, and the terms 'VaR for 100*(1-p) per cent confidence level' are used to refer to the identity Prob[Loss < V*] = (1-p).

The VaR can be defined in terms of a threshold for change in value of the portfolio also. In order to illustrate this point, let W_t denotes the total value of underlying assets corresponding to a financial position at time instance t, and the change in value of the position from time t to t+h is $\Delta W_t(h) = (W_{t+h} - W_t)$. At time point t, W_{t+h} is not known, so $\Delta W_t(k)$ is also unknown and can be considered a random variable. So, the value-at-risk V* would satisfy the identity Prob[$\Delta W_t(h)$

< -V*] = p, or equivalently, as earlier, the identity can be expressed as Prob[$\Delta W_t(h) > -V^*] = (1-p)$.

It is important to note that any VaR number has two parameters, viz., holding period (i.e. time horizon) and probability/confidence level. For a given portfolio, VaR number changes with these two parameters - while VaR decreases (increases) with the rise (fall) of probability level[1], it changes in the same direction with changes in holding period.

2.2 Short and Long Financial Positions, and VaR

The holder of a short financial position suffers a loss when the prices of underlying assets rise, and concentrates on upper-tail of the distribution while calculating her VaR (Tsay, 2002, pp. 258). Similarly, the holder of a long financial position would model the lower-tail of return distribution as a negative return on underlying assets makes her suffer a loss.

2.3 Usage of VaR

Despite being a single number for a portfolio, VaR has several usages. First, VaR itself is a risk measure. Given probability level 'p' and holding period, larger VaR number would indicate greater risk in a portfolio. Thus, VaR has ability to rank portfolios in order of risk. The second, it gives a numerical maximal loss (probabilistic) for a portfolio. Unlike other common risk measures, this is an additional advantage in measuring risk through VaR concept. Third, VaR number is useful to determine the regulatory required capital for banks exposure to risk.

Apart from the general usages of VaR concept, it is also worthwhile to note a few points on its applicability to various risk categories. Though there has been criticism against it as being not a coherent risk measure and lacking some desirable properties (see for

instance, Artzner, et al., 1999), it is a widely accepted risk measure today. Though VaR was originally endorsed as a tool to measure market risk, it provides a unified framework to deal with other risks, such as, credit risk, operation risk. As seen in the definition, the essence of VaR is that it is a percentile of loss/return distribution for a portfolio. So long as one has data to approximate/fit the loss distribution, VaR being a characteristic of such distribution, can be estimated from the fitted distribution.

2.4 Choice of Probability Level and Holding Period

The choice of 'probability/confidence level' and 'holding period' would depend on the purpose of estimating the VaR measure. It is now a common practice, as also prescribed by the regulators, to compute VaR for probability level 0.01, i.e. 99% confidence level. In addition, researchers sometimes consider assessment of risk for select other probability levels, such as, for probability 0.05.

A useful guideline for deciding 'holding period', is the liquidation period – the time required to liquidate a portfolio[2]. An alternative view is that the holding period would represent the 'period over which the portfolio remains relatively stable'. Holding period may also relates to the time required to hedge the risk. Notably, a rise in holding period will increase the VaR number. One may also get same outcome by reducing probability level (i.e. increasing confidence level) adequately (instead of changing holding period). In practice, regulators maintain uniformity in fixing probability level at p=0.01 (equivalently, 99% confidence level). Thus, holding period has to be decided based on some of the consideration stated above. It may be noted that VaR for market risk may have much shorter holding period as compared to say VaR for credit risk. Basel Accords suggests 10-day holding period for market risk, though country regulators may prescribe higher holding period. In case of credit risk, duration of holding period is generally one-year.

2.5 VaR Expressed in Percentage and Other Forms

As seen, VaR is defined in terms of the change/loss in value of a portfolio. In practice, distribution of return (either percentage change or continuously-compounded/log-difference[3]) of the financial position may actually be modeled and thus, VaR may be estimated based on percentile of the underlying return distribution. Sometimes percentiles of return distribution are termed as 'relative VaR' (see for instance, Wong, et al., 2003). On this perception, the VaR for change in value may be termed as 'absolute/nominal VaR'.

Thus, the percentile ξ_p corresponding to left-tail probability p of distribution of k-period percentage change itself is the relative VaR (expressed in per cent) with specified parameters and corresponding (absolute) VaR would be $[(\xi_p/100)W_t]$. Alternatively, if ξ_p represents the p-percentile for log-return (in per cent), then (absolute) VaR can be expressed as $[\{\exp(\xi_p/100)-1\}W_t]$. In our paper, unless otherwise stated, we use the term VaR to indicate 'relative VaR' (expressed in per cent).

2.6 The *h-period* VaR from *1-period* VaR

Another point to be noted relates to the estimation of multi-period VaR (i.e. VaR corresponding to multi-period 'time horizon', say h-day). In practice, given probability level 'p', $0<p<1$, 1-period VaR are first directly computed using 1-period return (say, daily return), and then they are converted to multi-period VaR using some approximation rule under certain assumptions about the market/ portfolio. The widely used approximation relation between, say h-day VaR and 1-day VaR is given by

$$\text{VaR}(h,p) \approx \begin{cases} \sqrt[\alpha]{h}\ \text{VaR}(1,p) & \text{if VaR is estimated using tail-index } \alpha \\ \sqrt{h}\ \text{VaR}(1,p) & \text{otherwise} \end{cases} \quad \text{..... (1)}$$

where VaR(h,p) denotes a VaR with probability level 'p' and h-day holding period.

It is important to note that above relationship between h-period VaR and 1-period VaR is not correct in general conditions. However,

for simplicity, this has been widely used in practice and regulators across the world has also subscribed to such approximation. Indeed, as per the regulators' guidelines, banks adopting IMA for market risk require to compute 1-day VaR using daily returns and the validation of risk-model depends upon how accurately the models estimate 1-day VaR. However, minimum required capital is determined using multi-period VaR, say 10-day VaR numbers, which are generated from the 1-day VaR values.

Section III

Measurement of VaR – Select Techniques

The central to any VaR measurement exercise has been the estimation of suitable percentile of change in value or return of the portfolio. Following the earlier discussion, we focus here in estimating 1-period VaR (e.g., 1-day VaR using daily returns). Also, we shall be focusing only on estimating VaR directly from portfolio-level returns. As well known, a portfolio usually consists of several securities and financial instruments/assests, and returns on each component of the portfolio would follow certain probability distribution. Portfolio value is the weighted sum of all components, changes in which can be assessed by studying the multivariate probability distribution considering returns on all components of the portfolio. In our study, such a strategy has not been followed. Instead, our analysis, as quite common in the literature, relies on historical portfolio-level returns and VaR estimation essentially requires to study the underlying univariate distribution.

3.1 Estimating VaR Under Normality of Unconditional Return Distribution

The normality assumption to portfolio return distribution simplifies the task of VaR estimation greatly. A normal distribution is fully characterized by first two moments, viz., mean (μ) and standard

deviation (σ), and the percentile with left-tail probability p, $0<p<1$, is given by $z_p = [\ \mu + \tau_p\ \sigma\ ]$, where τ_p denotes the corresponding percentile for standard normal distribution. By definition, VaR for given probability p is the absolute value of z_p, denoted by $|z_p|$. Thus, if $\hat{\mu}_t$ and $\hat{\sigma}_t$ denote the estimate of μ and σ, respectively, based on a sample of portfolio returns upto time t, the estimated VaR (with probability p, $0<p<1$) for the next time point, i.e. time point (t+1), is given by

$$VaR_{t+1} = |\hat{\mu}_t + \tau_p \hat{\sigma}_t| \quad \text{..... (2)}$$

where the meaning of |.| remains same.

3.2 Non-Normality of Unconditional Return Distribution - Estimating VaR

The biggest practical problem of measuring VaR, however, is that the observed returns hardly follow normal distribution - the financial market returns are known to exhibit 'volatility clustering phenomena' and follow 'fat-tailed' (leptokurtic) distribution with possibly substantial asymmetry. The deviation from normality intensifies the complexity in modelling return distribution, hence estimation of required percentiles and VaR numbers.

A simple approach to handle non-normality has been to model return distribution non-parametrically, such as, employing the historical simulation approach. The non-parametric techniques do not assume any specific form of the return distribution and are quite robust over alternative distributional forms. Besides, these techniques are easy to understand and pose no difficulty to implement. But inherent limitations of a non-parametric approach is well known.

The conventional parametric approaches to deal with non-normality can be classified under four broad categories; (i) conditional heteroscedastic models - modeling conditional return distribution through RiskMetric approach, ARCH/GARCH or more advanced forms of such models; (ii) fitting suitable non-normal or mixture distribution for unconditional distribution; and (iii) application of

extreme value theory (EVT) - modeling either the distribution of extreme return or only the tails of return distribution.

3.2.1 Non-Parametric Approach - Historical Simulation

The non-parametric approach, such as, historical simulation (HS), possess some specific advantages over the normal method, as it is not model based, although it is a statistical measure of potential loss. The main benefit is that it can cope with all portfolios that are either linear or non-linear. The method does not assume any specific form of the distribution of price change/return. The method captures the characteristics of the price change distribution of the portfolio, as it estimates VaR based on the distribution actually observed. But one has to be careful in selecting past data. If the past data do not contain highly volatile periods, then HS method would not be able to capture the same. Hence, HS should be applied when one has very large data points to take into account all possible cyclical events. HS method takes a portfolio at a point of time and then revalues the same using the historical price series. Daily returns, calculated based on the price series, are then sorted in an ascending order and find out the required data point at desired percentiles. Linear interpolation can be used to estimate required percentile if it falls in between two data points.

Another variant of HS method is a hybrid approach put forward by Boudhoukh, et al. (1997), that takes into account the exponentially weighing approach in HS for estimating the percentiles of the return directly. As described by Boudhoukh et al. (1997, pp. 3), "the approach starts with ordering the returns over the observation period just like the HS approach. While the HS approach attributes equal weights to each observation in building the conditional empirical distribution, the hybrid approach attributes exponentially declining weights to historical returns". The process is simplified as follows:

- Calculate the return series of past price data of the security or the portfolio.
- Fix a value δ from the interval (0,1). Usually δ is fixed at =0.98.
- To each most recent k returns: R(t), R(t-1), …R(t-k+1) assign a

weight proportional to $1, \delta, \delta^2, \ldots, \delta^{k-1}$, respectively. In order to make total weights sum to 1, the weights for R(t), R(t-1), …..,R(t-k+1) would be $[(1-\delta)/(1-\delta^k)], [(1-\delta)/(1-\delta^k)]\,\delta, \ldots [(1-\delta)/(1-\delta^k)]\delta^{k-1}$, respectively[4].

- Sort the returns in ascending order.
- In order to obtain VaR of the portfolio for probability 'p', 0<p<1, start from the lowest return and keep accumulating the weights until 'p' is reached. The return corresponding with accumulated weight 'p' relates to VaR. Linear interpolation may be used, if necessary, to attain exact 'p' of the distribution.

3.2.2 Use of Conditional Heteroscedasticity Models

The 'volatility clustering phenomenon' implies that the conditional variance of return is not constant over time (i.e. heteroscedastic). This phenomenon is a potential source of observed fat-tail of unconditional return distributions. Interestingly, theory also proves that unconditional distribution of return will possess fat-tails even when returns follow normal distribution conditionally. These results give rise to the idea of modeling conditional heteroscedasticity of returns. Under normality of such conditional distributions, expression for VaR is $|\mu_t + \sigma_t \tau_p|$, where μ_t and σ_t are time-varying/ conditional mean and standard deviation of return, respectively; 'p'is the probability level attached with VaR number; τ_p is the tabulated value for standard normal distribution corresponding with the lower-tail probability 'p'.

Using historical returns on a portfolio, one can estimate conditional mean and standard deviation at different time points. Accordingly estimated VaR numbers would be

$$\text{VaR}_{t+1} = |\hat{\mu}_{t+1|t} + \tau_p \hat{\sigma}_{t+1|t}| \qquad \ldots\ldots(3)$$

where $\hat{\mu}_{t+1|t}$ and $\hat{\sigma}_{t+1|t}$, respectively, denote estimated conditional mean and variance for time point t+1 (using information upto time t)[5].

There exist several alternative models to estimate conditional mean and variance. The simplest form of conditional heteroscedastic model is the one like exponentially weighted moving average as used in RiskMetrics (J.P. Morgan/Reuters, 1996). This popular technique in effect models conditional variance as a weighted average of past variances and past returns, where exponential weighting scheme for past returns is used as follows;

$$\sigma^2_{t+1|t} = \lambda\sigma^2_{t|t-1} + (1-\lambda)\, r_t^2 = \lambda^t \sigma_0^2 + (1-\lambda)\sum_{k=0}^{t-1} \lambda^k \, r^2_{t-k} \qquad \text{....(4)}$$

where $\sigma^2_{t|t-1}$ and r_t denote conditional variance and return at time t, respectively; σ_0^2 denotes the variance at origin (i.e. time t=0); and the parameter λ, known as decay factor, satisfies $0 < \lambda < 1$.

For daily data, the value of the decay parameter in the RiskMetric approach is generally fixed at λ=0.94 (van den Goorberg and Vlaar, 1999). The accuracy in VaR estimates may also improve for alternative values for λ, such as, 0.96 or 0.98 (see for instance, Samanta and Nath, 2004).

More advanced models like ARCH, GARCH and so forth (Engle 1982; Bollerslev, 1986; Wong et al., 2003) can also be used for capturing conditional heteroscedasticity. Though conceptually appealing, the performance of the conditional heteroscedastic models in estimating VaR, however, is mixed. In a recent empirical study, Wong et al., (2003) found that the approaches, like, ARCH/GARCH, do not necessarily improve the quality of VaR estimates.

3.2.3 Fitting Non-Normal Distribution for Returns

Alternatively, one can simply fit the parametric form of a suitable non-normal distribution to the observed returns. The class of

distributional forms considered would be quite wide including, say, hyperbolic distribution, t-distribution, mixture of two or more normal distributions, Laplace distribution or so forth, (van den Goorbergh and Vlaar, 1999; Bauer 2000; Linden, 2001).

In our study we consider symmetric hyperbolic distribution as an alternative fat-tailed distribution for returns[6]. A d-dimensional random variable 'r' is said to follow a symmetric hyperbolic distribution if it has density function as below;

$$f(r;\zeta,\delta,\mu,\Delta)=\frac{\zeta^{d-1}}{(2\pi)^{d/2}\delta^{d}K_{1}(\zeta)}\frac{K_{1-d/2}\left(\zeta\sqrt{1+\frac{(r-\mu)}{\delta}\Delta^{-1}\frac{(r-\mu)^{T}}{\delta}}\right)}{\left(\zeta\sqrt{1+\frac{(r-\mu)}{\delta}\Delta^{-1}\frac{(r-\mu)^{T}}{\delta}}\right)^{d/2-1}} \quad \text{..... (5)}$$

where, K_{ν} is the modified Bessel function of the third kind, the parameters δ and Δ are for multivariate scales, μ for location and ζ mainly changes the tails.

For the presence of Bessel functions in above density function, closed form expression for maximum likelihood estimators are not possible. Bauer (2000) suggests an approach to have maximum likelihood estimators[7]. Once estimates of the parameters become available, one can estimate the required percentile of the distribution following numerical iteration method.

3.2.4 Methods under Extreme Value Theory – Use of Tail-Index

The fat tails of unconditional return distribution can also be handled through extreme value theory using, say, tail-index, which measures the amount of tail fatness. One can therefore, estimate the tail-index and measure VaR based on the underlying distribution. The basic premise of this idea stems from the result that the tails of every fat-tailed distribution converge to the tails of Pareto distribution. In a simple case, upper tail of such a distribution can be modeled as,

$$\text{Prob}[X > x] \approx C^{\alpha} |x|^{-\alpha} \text{ (i.e. Prob}[X \leq x] \approx 1 - C^{\alpha} |x|^{-\alpha}); \; x>C \quad \text{..... (6)}$$

Where, C is a threshold above which the Pareto law holds; |x| denotes the absolute value of x and the parameter α is the tail-index.

Similarly, lower tail of a fat-tailed distribution can be modeled as

$$\text{Prob}[X > x] \approx 1 - C^{\alpha} \; x^{-\alpha} \quad \text{(i.e. Prob}[X \leq x] \approx C^{\alpha} x^{-\alpha}); \quad x < C \quad \text{..... (7)}$$

Where, C is a threshold below which the Pareto law holds, and the parameter α, called as tail-index, measures the tail-fatness.

In practice, observations in upper tail of the return distribution are generally positive and those in lower tail are negative. The holder of a short financial position suffers a loss in the event of a rise in values of underlying assets and therefore, concentrates on upper-tail of the distribution (i.e. Eqn. 6) for calculating VaR (Tsay, 2002, pp. 258). Similarly, the holder of a long financial position would model the lower-tail of the underlying distribution (i.e. use Eqn. 7) as a fall in asset values makes her suffer a loss.

From Eqns.(6) and (7), it is clear that the estimation of VaR is crucially dependent on the estimation of tail-index α. There are several methods of estimating tail-index, such as, (i) Hill's (1975) estimator and (ii) the estimator under ordinary least square (OLS) framework suggested by van den Goorbergh and Vlaar (1999). In this study, only the widely used Hill's estimator of tail-index is considered.

Section IV

Selecting VaR Model – Evaluation Criteria

The accuracy of VaR estimates obtained from a VaR model can be assessed under several frameworks, such as, (i) regulators' backtesting (henceforth simply called as backtesting); (ii) Kupiec's test; (iii) loss-function based evaluation criteria. Under each framework, there would be several techniques and what follows is the summary of some of the widely used techniques.

4.1 Backtesting

As recommended by Basel Committee, central banks do not specify any VaR model to the banks. Rather under the advanced 'internal model approach', banks are allowed to adopt their own VaR model. There is an interesting issue here. As known, VaR is being used for determining minimum required capital – larger the value of VaR, larger is the capital charge. Since larger capital charge may affect profitability adversely, banks have an incentive to adopt a model that produces lower VaR estimate. In order to eliminate such inherent inertia of banks, Basel Committee has set out certain requirements on VaR models used by banks to ensure their reliability (Basel Committee, 1996a,b) as follows;

(i) 1-day and 10-day VaRs must be estimated based on the daily data of at least one year

(ii) Capital charge is equal to three times the 60-day moving average of 1% 10-day VaRs, or 1% 10-day VaR on the current day, which ever is higher. The multiplying factor (here 3) is known as 'capital multiplier'.

Further, Basel Committee (1996b) provides following Backtesting criteria for an internal VaR model (see van den Goorbergh and Vlaar, 1999; Wong et al., 2003, among others)

(i) One-day VaRs are compared with actual one-day trading outcomes.

(ii) One-day VaRs are required to be correct on 99% of backtesting days. There should be at least 250 days (around one year) for backtesting.

(iii) A VaR model fails in Backtesting when it provides 5% or more incorrect VaRs.

If a bank provides a VaR model that fails in backtesting, it will have its capital multiplier adjusted upward, thus increasing the amount of capital charges. For carrying out the Backtesting of a VaR model, realized day-to-day returns of the portfolio are compared to the VaR of

the portfolio. The number of days, when actual portfolio loss is higher than VaR estimate, provides an idea about the accuracy of the VaR model. For a good 99% VaR model, this number would approximately be equal to the 1 per cent (i.e. 100 times of VaR probability) of back-testing days. If the number of VaR violations or failures (i.e. number of days when observed loss exceeds VaR estimate) is too high, a penalty is imposed by raising the multiplying factor (which is at least 3), resulting in an extra capital charge. The penalty directives provided by the Basel Committee for 250 back-testing trading days is as follows; multiplying factor remains at minimum (i.e. 3) for number of violations up to 4, increases to 3.4 for 5 violations, 3.5 for 6 violations, 3.65 for violations 7, 3.75 for violations 8, 3.85 for violations 9, and reaches at 4.00 for violations above 9 in which case the bank is likely to be obliged to revise its internal model for risk management (van den Goorbergh and Vlaar, 1999).

4.2 Statistical Tests of VaR Accuracy

The accuracy of a VaR model can also be assessed statistically by applying Kupiec's (1995) test (see, for example, van den Goorbergh and Vlaar, 1999 for an application of the technique). The idea behind this test is that frequency of VaR- violation should be statistically consistent with the probability level for which VaR is estimated. Kupiec (1995) proposed to use a likelihood ratio statistics for testing the said hypothesis.

If z denotes the number of times the portfolio loss is worse than the VaR estimate in the sample (of size T, say) then z follows a Binomial distribution with parameters (T, p), where p is the probability level of VaR. Ideally, more the z/T closes to p, more accurate the estimated VaR is. Thus the null hypothesis $z/T = p$ may be tested against the alternative hypothesis $z/T \neq p$. The likelihood ratio (LR) statistic for testing the null hypothesis against the alternative hypothesis is

$$LR = 2\left[\log\left(\left(\frac{z}{T}\right)^{z}\left(1-\frac{z}{T}\right)^{T-z}\right)-\log\left(p^{z}(1-p)^{T-z}\right)\right] \qquad \text{..... (8)}$$

Under the null hypothesis, LR-statistic follows a χ^2-distribution with 1-degree of freedom.

The VaR estimates are also interval forecasts, which thus, can be evaluated conditionally or unconditionally. While the conditional evaluation considers information available at each time point, the unconditional assessment is made without reference to it. The test proposed by Kupiec provides only an unconditional assessment as it simply counts violations over the entire backtesting period (Lopez, 1998). In the presence of time-varying volatility, the conditional accuracy of VaR estimates assumes importance. Any interval forecast ignoring such volatility dynamics may have correct unconditional coverage but at any given time, may have incorrect conditional coverage. In such cases, the Kupiec's test has limited use as it may classify inaccurate VaR as acceptably accurate.

A three-step testing procedure developed by Christoffersen (1998) involves a test for correct unconditional coverage (as Kupiec's test), a test for 'independence', and a test for correct 'conditional coverage' (Christoffersen, 1998; Berkowitz and O'Brien, 2002; Sarma, et al., 2003). All these tests use Likelihood-Ratio (LR) statistics.

4.3 Evaluating VaR Models Using Penalty/Loss-Function

Tests mentioned above assess the frequency of VaR violations, either conditionally or unconditionally, during the backtesting trading days. These tests, however, do not look at the severity/magnitude of additional loss (i.e. loss in excess of estimated VaR) at the time of VaR violations. However, a portfolio manager may prefer the case of more frequent but little additional loss than the case of less frequent but huge additional loss. The underlying VaR model in the former case may fail in backtesting but still the total amount of loss (after adjusting for penalty on multiplying factor, if any) during the backtesting trading days may be less than that in later case. So long as this condition persists with a VaR model, a portfolio manager, particularly non-banks who are not required to comply with any regulatory requirement, may prefer to accept the VaR model even

if it fails in backtesting. This means that the objective function of a portfolio manager is not necessarily be the same as that provided by the backtesting. Each manager may set his own objective function and try to optimize that while managing market risk. But, loss-functions of individual portfolio managers are not available in public domain and thus, it would be impossible to select a VaR model appropriate for all managers. However, discussion on a systematic VaR selection framework by considering a few specific forms of loss-function would provide insight into the issue so as to help individual manager to select a VaR model on the basis of his own loss-function. On this perception, it would be interesting to illustrate the VaR selection framework with the help of some specific forms of loss-function.

The idea of using loss-function for selecting VaR model, perhaps, is proposed first by Lopez (1998). He shows that the binomial distribution-based test is actually minimizing a typical loss-function – gives score 1 for a VaR violation and a score 0 otherwise. In other words, the implied loss-function in backtesting would be an indicator function I_t which assumes a value 1 at time t if the loss at t exceeds corresponding VaR estimate and assumes a value zero otherwise. However, it is hard to imagine an economic agent who has such a utility function: one which is neutral to all times with no VaR violation and abruptly shifts to score of 1 in the slightest failure and penalizes all failures equally (Sarma, et al., 2003). Lopez (1998) also considers a more generalised loss-function which can incorporate the regulatory concerns expressed in the multiplying factor and thus is analogous to the adjustment schedule for the multiplying factor for determining required capital. But, he himself observed that, like the simple binomial distribution-based loss-function, this loss-function is also based on only the number of violations in backtesting observations – with paying no attention to another concern, the magnitudes of loss at the time of failures. In order to handle this situation, Lopez (1998) also proposes a different loss-function addressing the magnitude of violation as follows;

$$L_t = \begin{cases} 1 + (Loss_t - VaR_{t|t-1})^2 & if\ Loss_t > VaR_{t|t-1} \\ 0 & otherwise \end{cases} \qquad \textbf{..... (9)}$$

where L_t denotes a score at time t, $Loss_t$ is the magnitude/amount of loss at time t and $VaR_{t|t-1}$ is the estimated value-at-risk made for time t made at time (t-1).

The overall score (i.e. value of the loss-function) is the summation of all scores (L_t) over all back testing days. A VaR model which gives minimum overall score is preferred over other competing models.

In the spirit of Lopez (1998), Sarma et al. (2003) consider two loss-functions, viz., regulatory loss function and the firm's loss function, which assign scores on t-th backtesting day as follows;

Regulatory Loss Function

$$L_t = \begin{cases} (Loss_t - VaR_{t|t-1})^2 & if\ Loss_t > VaR_{t|t-1} \\ 0 & otherwise \end{cases} \quad \text{..... (10)}$$

Firm's Loss Function

$$L_t = \begin{cases} (Loss_t - VaR_{t|t-1})^2 & if\ Loss_t > VaR_{t|t-1} \\ \alpha\, VaR_{t|t-1} & otherwise \end{cases} \quad \text{..... (11)}$$

where α represents the opportunity cost of capital and meaning of other symbols and variables are as above.

Section V

Empirical Results

5.1 Data

Data availability in government securities to carry out value-at-risk analysis is quite difficult. This is simply because the government securities market is still not vibrant, deep and liquid enough. Securities keep on changing their tradability making it difficult to get time series trade data on a particular security for more than, say, three years. One can easily verify that though there are more than ninety outstanding government securities, less than ten securities are traded for good volume or number of trade. Among these, of course, all are not regularly traded. We could get data for three years from

August 2005 to July 2008. Effective working days during this three year period was 747 days while the most regularly traded security, 8.07% GS 2017, during this period was traded for 685 days followed by 7.37% GS 2014 for 608 days. Even after having a Primary Dealers system in place, who are specifically treated as market maker, representative quotes or data on that in several government securities are not available. In such a scenario, the analysis was kept limited to the trade data of above mentioned two securities. In case any of these securities is not traded in a particular day, the price has been taken from what is disseminated by Fixed Income Money Market and Derivatives Association of India (FIMMDA) on a daily basis.

5.2 Return Series

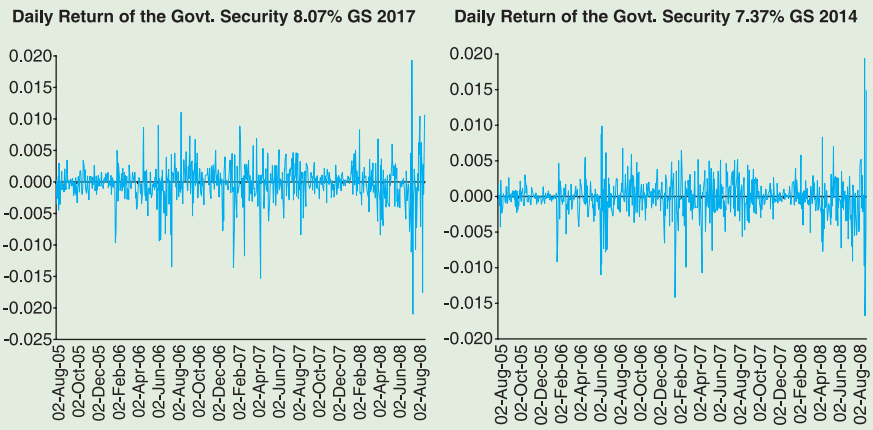
For each chosen bond, we consider the continuously compounded daily returns computed as follows;

$$R_t = \log_e(P_t) - \log_e(P_{t-1}) \quad \text{..... (12)}$$

Where P_t and R_t denote the price/value and return in t-th day.

Using the price data for 747 days, we have returns on each bond for 746 days. The daily returns, plotted in Chart 1, clearly

Chart 1: Observed Returns



exhibits volatility clustering indicating the fat-tails of unconditional distribution of returns. Observed probability distribution for each return series also appears to be non-normal (Chart 2).

In order to formally examine whether returns follow normal distribution, we employed Jarque-Bera (1987) and two other related Chi-Square tests. The Jarque-Bera (1987)[8] test statistics is given by $Q = n[(b_1)^2/6 + (b_2)^2/24]$, where b_1 and b_2 are sample estimates of measure of skewness β_1 and excess-kurtosis β_2, respectively and n is the number of observation used to derive the said estimates. Under the hypothesis of normality of return distribution, Q is asymptotically a χ^2 variable with 2 degrees of freedom. Also, under normality, each of b_1 and b_2 is asymptotically normally distributed with mean zero and respective variances 6/n and 24/n implying that each of $[n (b_1)^2/6]$ and $[n (b_2)^2/24]$ is asymptotically χ^2 variable with 1 degree of freedom. The test statistics stated above are used to examine normality.

Results of normality tests are presented in Table 1. As can be seen from this table, the Jarque-Bera test statistics is significant at

Chart 2: Observed Return Distribution and Corresponding Normal Fit

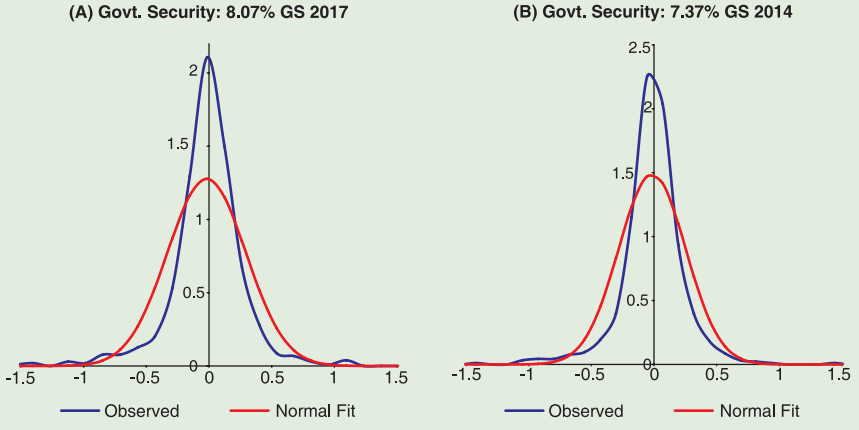


Table 1: Testing Normality of Returns

Govt. Bond	Measure of Skewness	χ^2_1 for Skewness	Excess Kurtosis	χ^2_1 for Excess Kurtosis	Jarque-Bera Statistics
8.07% GS 2017	-0.74	68.55* (0.0000)	8.15	2066.82* (0.0000)	2135.37* (0.0000)
7.37% GS 2014	-0.15	2.71 (0.0991)	9.16	2609.94* (0.0000)	2612.66* (0.0000)

Note: Figures within ( ) indicate significance level (i.e. p-value) of corresponding statistics; '*' indicates significant at 1% level of significance.

1% level of significance indicating that none of the return series could be considered to be normally distributed. The Chi-square tests for skewness or excess-kurtosis alone also support the finding. Results on these tests suggest that the underlying return distributions have significant excess-kurtosis indicating presence of fat-tails in the distributions and are skewed, though the degree of asymmetry in the case of the bond 7.37% GS 2014 appears to be mild[9].

5.3 VaR Estimates from Alternative Techniques

The identified non-normality of the underlying return distributions poses a great difficulty in estimating value-at-risk. As discussed earlier, there have been a plethora of techniques to handle non-normality but hardly any theory can directly identify the best VaR technique for a given portfolio. Thus selecting VaR model is a decision-making problem that has to be addressed empirically. Our strategy in this regard is that estimate VaR using a set of alternative techniques/models and evaluate each competing model based on suitable criteria.

In this study, 'normal method' is taken as the benchmark VaR estimation technique. The list of alternative approaches to handle non-normality includes (i) historical simulation – both simple and

hybrid; (ii) RiskMetric approach – using exponentially weighted sum of squares of past returns to capture the conditional heteroscedasticity in returns; (iii) symmetric hyperbolic distribution – a distribution having fat-tails; and (iv) tail-index based method – an approach under extreme value theory that measure tail fatness (through tail-index) and model tails of return distribution.

As seen earlier, the hybrid/weighted form of historical simulation approach requires a parameter δ, $0 < \delta < 1$, which determines the weights of past returns while estimating volatility or VaR. As δ takes a fraction value, sometimes fixed at 0.98, the weight decays to with the increase in the remoteness of the past observation/return. We consider three alternative value of δ, viz., 0.94, 0.96 and 0.98.

For implementing RiskMetric approach also, there is a need to fix a value for the parameter λ. In original RiskMetric approach, value of this parameter was fixed at 0.94. In this study, however, three alternatives values for λ, viz., 0.94, 0.96 and 0.98 are considered.

Table 2 presents estimated 1-day VaRs, with probability level 0.01 (i.e. 99% confidence level), obtained by applying chosen

Table 2: Estimated VaR in the Last Day of the Database

VaR Technique	Security	
	8.07% GS 2017	**7.37% GS 2014**
Normal – Benchmark Model	0.83	0.70
Historical Simulation - Simple	1.11	0.90
Historical Simulation – Hybrid/Weighted		
$\lambda = 0.94$	2.08	1.66
$\lambda = 0.96$	2.08	1.66
$\lambda = 0.98$	2.08	1.66
Risk Metrics		
$\lambda = 0.94$	1.57	1.13
$\lambda = 0.96$	1.75	1.43
$\lambda = 0.98$	1.81	1.64
Hyperbolic Distribution	1.15	0.96
Tail Index	1.35	1.16

alternative techniques for the last day in our database. Noting that returns do not follow normal distribution, VaR number is likely to be underestimated by normal method. Our empirical results are consistent on this matter. As can be seen from Table 2, VaR estimates obtained from normal method are the lowest for selected bonds[10].

Among the non-normal alternatives, historical simulation (simple) and hyperbolic distribution produces the lowest VaR numbers. On the other hand, the RiskMetric and hybrid historical simulation methods produce the highest VaR estimates. The tail-index based method results into VaR estimates some where in between these two sets of estimates.

5.4 Evaluation of Competing VaR Models

Competing VaR models were evaluated in terms of their accuracy in estimating VaR over last 447 days in the database. For each VaR model, we followed following steps: First, estimate 1-day VaR with 99% confidence level (i.e. probability level 0.01) using the returns for first 300 days. This estimate is then compared with the loss on 301st day. In case loss exceeds VaR, we say that an instance of VaR-violation has occurred. Second, estimate VaR for 302nd day using returns for past 300 days (covering the period from 2nd to 301st days). This estimate is then compared with the loss in 302nd day in the database to see whether any VaR-violation occurred. Third, the process is repeated until all data points are exhausted. Finally, count the number/percentage of VaR violation over the period of 447 days. For a good VaR model, percentage of VaR violation should be equal to the theoretical value 1% (corresponding with probability level 0.01 of estimated VaR numbers). In Table 3, the number/percentage of VaR violation over last 447 days in the database is given separately for each of the competing VaR models.

As can be seen from Table 3, percentage of VaR violation for the benchmark model ‘normal method’ is above 3% - far above

Table 3: Number (Percentage) of VaR Violation*

VaR Technique	Security	
	8.07% GS 2017	**7.37% GS 2014**
Normal – Benchmark Model	15 (3.36)	14 (3.14)
Historical Simulation - Simple	10 (2.24)	9 (2.02)
Historical Simulation – Hybrid/Weighted		
$\lambda = 0.94$	9 (2.02)	9 (2.02)
$\lambda = 0.96$	11 (2.47)	12 (2.69)
$\lambda = 0.98$	12 (2.69)	15 (3.36)
Risk Metric		
$\lambda = 0.94$	14 (3.14)	16 (3.59)
$\lambda = 0.96$	12 (2.69)	16 (3.59)
$\lambda = 0.98$	15 (3.36)	16 (3.59)
Hyperbolic Distribution	7 (1.57)	6 (1.35)
Tail Index	5 (1.12)	3 (0.67)

Note: '*' Figures inside ( ) are percentage of VaR-Violation. For a good VaR model this figure should be ideally equal to 1%.

the theoretical 1% percentage value. This higher than expected frequency of VaR-violation is attributable to the underestimation of VaR numbers. The RiskMetric and hybrid historical simulation approaches also could not reduce this estimation bias and at times, the frequency of VaR-violation for RiskMetric even exceeds that of the benchmark model. On the other hand, the accuracy level of VaR estimates obtained from 'hyperbolic distribution' and 'tail-index' methods are much better. In fact, going by the closeness of observed frequency of VaR violation with the theoretical 1% level, the 'tail-index' method appears to be producing most accurate VaR numbers followed by the method using 'hyperbolic distribution'.

In order to see whether the frequency of VaR-violation associated with competing VaR models can be considered as equal to the theoretical 1% value, we employed the popular Kupiec's test. Relevant empirical results are presented in Table 4. As can be seen from this Table, the hypothesis that the frequency of VaR-violation is equal to the theoretical 1% value could not be accepted at 1% level of significance for the benchmark 'normal' method. The results show that the observed frequency is significantly higher than 1%, which indicates that the 'normal' method underestimates the VaR number. The Risk Metric approach also could not provide any improvement -

Table 4: Kupiec'c Tests – Observed Values of Chi-Square Statistics

VaR Technique	Security			
	8.07% GS 2017		7.37% GS 2014	
	Percentage of VaR-Violation	Observed Value of χ^2-statistics (p-value)	Percentage of VaR-Violation	Observed Value of χ^2-statistics (p-value)
Normal Method (Benchmark Model)	3.36	15.56*** (0.0004)	3.14	13.16*** (0.0014)
Historical Simulation – Simple	2.24	5.14 (0.0766*)	2.02	3.60 (0.1650)
Historical Simulation – Hybrid/Weighted				
λ = 0.94	2.02	3.60 (0.1650)	2.02	3.60 (0.1650)
λ = 0.96	2.47	6.88** (0.0321)	2.69	8.80** (0.0123)
λ= 0.98	2.69	8.80** (0.0123)	3.36	15.56*** (0.0004)
Risk Metric				
λ = 0.94	3.14	13.16*** (0.0014)	3.59	18.10*** (0.0001)
λ = 0.96	2.69	8.80** (0.0123)	3.59	18.10*** (0.0001)
λ = 0.98	3.36	15.56*** (0.0004)	3.59	18.10*** (0.0001)
Hyperbolic Distribution	1.57	1.25 (0.5365)	1.35	0.48 (0.7848)
Tail Index	1.12	0.06 (0.9687)	0.67	0.55 (0.7612)

Note: '***', '**' and '*' denote significant at 1%, 5% and 10% level of significance, respectively.

the frequency of VaR violation associated with this approach is also statistically higher than 1% value. Thus, like the 'normal' method, the Risk Metric approach also underestimates VaR numbers in our case. Interestingly, historical simulation method, in its appropriately chosen form, is able to keep VaR-violation within the statistically acceptable level. However, further improvement is noticeable in estimates of VaR numbers using 'hyperbolic distribution' or more so using tail-index method.

Table 5: Penalty/Loss-Function – Lopez's Loss-Function

VaR Technique	Security	
	8.07% GS 2017	**7.37% GS 2014**
Normal – Benchmark Model	19.90	16.60
Historical Simulation - Simple	13.40	10.50
Historical Simulation – Hybrid/Weighted		
$\lambda = 0.94$	10.70	10.20
$\lambda = 0.96$	12.90	13.30
$\lambda = 0.98$	14.10	16.40
Risk Metrics		
$\lambda = 0.94$	24.00	21.00
$\lambda = 0.96$	21.00	19.00
$\lambda = 0.98$	24.00	19.00
Hyperbolic Distribution	9.07	7.02
Tail Index	6.75	3.59

The evaluation criteria employed above uses only the frequency of VaR-violation. But the magnitude of VaR violation, defined as the amount of loss in excess of estimated VaR, is also important in evaluating a VaR model. Accordingly, we evaluated value of Lopez's (1998) loss-function (given by Eqn. 9) for each competing VaR models over the last 446 days in our database. Corresponding results are presented in Table 5. It is seen that the minimum values of loss-function are obtained for 'tail-index' method, followed by the 'hyperbolic distribution'. Historical simulation techniques also have lower loss-function value than the benchmark 'normal' method but once again the empirical results indicate that the Risk Metrics not necessarily improves the VaR estimates.

Section VI

Concluding Remarks

In this empirical paper we evaluated a number of competing models/methods for estimating VaR numbers for select Government bonds. Ideally one would like to estimate VaR as a measure of market risk for a much wider real portfolio held by any investor/institute. However, composition of and returns on such a portfolio is not readily available and there also exist certain data limitations. Under such a

situation, we chose two most liquid Government bonds during the period from August 2005 to July 2008 and constructed daily return series on the chosen two assets for the period. Though not aimed at analyzing market risk (value-at-risk) of any real bond portfolio, the study is useful in a sense that it demonstrates various relevant issues in details, which can be easily mimicked for any given portfolio.

If returns were normally distributed, estimation of VaR would be made simply by using first two moments of the distribution and the tabulated values of standard normal distribution. But the experience from empirical literature shows that the task is potentially difficult for the fact that the financial market returns seldom follow normal distribution. The returns in our database are identified to follow fat-tailed, also possibly skewed, distribution. This observed non-normality of returns has to be handled suitably while estimating VaR. Accordingly, we employed a number of non-normal VaR models, such as, historical simulation, RiskMetric, hyperbolic distribution fit, method based on tail-index. Our empirical results show that the VaR estimates based on the conventional 'normal' method are usually biased downward (lower than actual) and the popular Risk Metric approach could not improve this level of underestimation. Interestingly, historical simulation method (in its suitable chosen form) can estimate VaR numbers more accurately. However, most accurate VaR estimates are obtained from the tail-index method followed by the method based on hyperbolic distribution fit.

Notes

[1] This means VaR number increases (decreases) with the rise (fall) of confidence level.

[2] In the case of market risk, a related view is that 'holding period' may be determined from the '*time required to hedge'* the market risk.

[3] Note that $\Delta W_t(k)$ is the change in value of the assets in the financial position from time point t to (t+k) and the k-period simple return would be measured by $[100*\{\Delta W_t(k)/Wt\}]$. Alternatively, k-period continuously compounded return, known as log-return, is defined by $[100\{\log_e(W_{t+k}) - \log_e(W_t)\}]$. Through out the article, the base of logarithmic transformation is 'e' and therefore, anti-log

(i.e. the inverse of log-transformation) of a real number x is anti-log(x) = e^x; sometimes denoted by exp(x).

[4] It may be noted that the simple HS method corresponds to δ =1, where each of the past k returns is assigned a constant weight 1/k.

[5] Conventionally, $\mu_{t+1|t}$ is considered to be zero, though one can model the return process to have estimates of time-varying/conditional means.

[6] The symmetric hyperbolic distribution is a special case of generalized hyperbolic distribution which depends on six parameters. For a discussion of hyperbolic distribution, generalized and symmetric, one may see Bauer (2000).

[7] For more discussions on fitting symmetric hyperbolic distribution, one may see the papers referred by Bauer (2000), such as, Eberlein and Keller (1995).

[8] See, also, Gujarati (1995) for a discussion on the issues relating to Jarque-Bera (1987) test for normality.

[9] In this case the null hypothesis of zero skewness could be rejected only at 10% or higher level of significance.

[10] For the sake of brevity, we present VaR estimates only for one day. But we have noticed the similar pattern in other days in our database also.

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Determinants of Real Exchange Rate in India: An ARDL Approach

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This paper attempts to identify determinants of real exchange rate in India. Apart from providing theoretical background on possible determinants of real exchange rate, the paper tests their statistical significance using autoregressive distributed lag (ARDL) modelling approach. It finds that among the identified variables chosen *a priori* based on theoretical arguments as determinants of RER, productivity differential, external openness, terms of trade and net foreign assets turn out to be statistically significant. The signs of the short-run dynamic impact have been found consistent with long-run coefficients and error correction term is negative and statistically significant implying convergence to long-run equilibrium path. Since the fitted RER is found to be quite closer to the actual behavior exhibited by RER, the variables identified with certain lags could, therefore, serve as lead indicators of real exchange rate behaviour. On the basis of results, it may be noted that appreciation in RER should not always be seen as decline in international competitiveness of the traded sector as some of the factors contributing to the RER appreciation are attributed to higher growth reflecting improvement in competitiveness.

JEL Classification : E31, F31, C15.

Keywords : Real Exchange Rate, Economic Growth, Balassa-Samuelson hypothesis, Autoregressive Distributed Lag

Introduction

Real exchange rate (RER) is considered as barometer of the competitiveness of an economy for international trade. The higher real exchange rate *ceteris paribus* entails country's exports more expensive and imports relatively cheaper. Thus, affecting the prices of exports and imports, RER movements result in to variation in the allocation of internal production and consumption between traded and non-traded goods. RER assumes utmost importance in developing countries where non-tradable goods constitute a large segment of the goods market and only their prices are flexible as prices of traded

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goods are largely determined in world market. Therefore, the volatility in the prices of non-traded goods leads to misalignment of RER from its equilibrium level and supposedly, affects adversely the competitiveness and economic growth. In fact, recurrent and large misalignments are linked to lower growth rates and current account deficits in the long run and very frequently with currency and financial crisis. However, it has been debated for some times whether devaluations in RER are contractionary or expansionary. On the one hand, in the conventional textbook model, assuming the Marshall-Lerner condition holds, devaluations are supposed to increase competitiveness, increase production and exports of tradable goods, reduce imports, and thereby improve trade balance, GDP and employment. On the other hand, evidence from many countries reveals that currency appreciation results from accelerated economic development, whereas reverse is true in case of deceleration in economic development. Balassa-Samuelson hypothesis (1963), one of the most important hypotheses with respect to the equilibrium real exchange rate level, postulates that rapid economic growth is accompanied by real exchange rate appreciation because of differential productivity growth between tradable and non-tradable sectors. However, the analysis of the relationship between the level of economic development and real exchange rate, as was suggested by the seminal paper of Balassa-Samuelson, do not find much of the place in the history of research. Nevertheless, open economy macroeconomics has provided with a framework on equilibrium exchange rate level compatible with overall economic equilibrium, as well as policy instruments necessary to correct the possible misalignment.

The findings of various studies on the impact of real exchange rate on economic activities also differ distinctly. Aguirre and Calderon (2005) has found that large overvaluations and undervaluation in RER hurt growth, whereas small undervaluation can boost growth. On the other hand, Diaz-Alejandro (1963), Krugman and Taylor (1978), and Lizondo and Montiel (1989) have found that expansionary effect of real devaluations in tradable sector could be offset by contractionary impact in the non-tradable sector. Edwards (1989) investigated the

relationship between real exchange rate misalignment and economic performances and concludes that real exchange rate difference with regards to its equilibrium level has a negative effect. Cotti *et al* (1990) confirms that for some Latin American countries real exchange rate instability has handicapped exportation growth, whereas Asian exportation growth has been for the most part accounted for by real exchange rate stability. According to Sekkat and Varoudakis (1998), the chronic misalignments of real exchange rate are a major factor of the weak economic performances of developing countries. Ghura and Grennes (1993) show on a panel of African countries that real exchange rate misalignment negatively affected economic growth, exports, investment and saving.

Even though, it is not very clear whether net impact of RER devaluations is positive or negative in an economy, several emerging market and developing economies have resisted devaluation in the last many years partly because of concerns that such policy would be contractionary. This view arises from the experience of countries such as Mexico, where real depreciations (increase) of the Peso have consistently been associated with declines in output, while real appreciations (decrease) have been linked to expansion (Villavicencio and Bara, 2006). Furthermore, real exchange rate stability and alignments have assumed critical importance in policy formulations particularly in EMEs to improve economic performance during recent years. Real exchange rate misalignment affects economic activity in developing countries mainly due to their dependence on imported capital goods and specialization in commodity exports. Evidence from developing countries is often quoted to support the view that the link between RER misalignment and economic performance is strong.

Given the fact that RER movements and economic growth have got some association positive or negative, the determinants of RER becomes more relevant from policy perspective. In fact, a number of researchers have also pointed out the importance of understanding the main determinants of real exchange rate (Edwards, 1989; Elbadawi and Soto, 1997; Ebadawi, 1994; and Ghura and Grennes, 1993).

Furthermore, this is well established that in most of the cases, especially in emerging market and developing economies, RER does not strictly converge to purchasing power parity (PPP) and even if it does in some cases in the long-run, the rate of convergence remains very slow resulting from underlying macroeconomic fundamentals. This implies that impulse response of RER to movements in macroeconomic fundamentals is very pronounced.

Therefore, the objective of this paper is to identify theoretically the determinants of RER and empirically investigate the link between RER and select determinants in case of India. The structure of the remainder of the paper is as follows. The theoretical framework and macroeconomic variables as determinants of RER has been given in section II, while Section III dwells upon the RER evolution in India. Section IV provides details on sources of data and research methodology. Empirical results have been discussed in section V. The concluding observations have been furnished in section VI.

Section II
Theoretical Framework and Determinants

Theoretical framework

In order to specify the nature of the relation to be tested through econometrics techniques, the Balassa-Samuelson hypothesis has been taken as minimal theoretical framework for real exchange rate determination. For this purpose, a small open economy is considered, which is composed of a set of homogeneous firms. The representative firm produces two goods: a tradable commodity for the world market and a non-tradable one for domestic demand. The tradable goods production is presumed to require both capital and labour, while non-tradable goods production uses only labour. The competition is supposed to be perfect and it ensures that production factors are paid at their marginal productivity and at the same time, labour factor mobility ensures equal pay. Whereas labour supply is supposed to be constant and all variables are expressed in terms of tradable goods.

In this study, an extension of the benchmark model is used where the equilibrium real exchange rate is a path upon which an economy maintains both internal and external balances. The equilibrium real exchange rate depends not only on productivities but also on some other real variables. This model used in the present study is basically developed by Montiel (cited by Mkenda 2001). Real exchange rate is defined as the relative price of traded and non-traded goods. That is:

$$RER = q = \frac{PT}{PN} \tag{1}$$

Where, PT is the world price for traded goods and PN is the price of non-traded ones. This definition is called internal real exchange rate and is appropriate for developing countries where exports are predominately primary products and law of one price holds. The law of one price entails that price of traded goods is equivalent across the countries in common currency. Edwards (1989) mentions that this definition provides a consistent index of the country's tradable sector competitiveness and also influences resources allocation as an increase in q would cause a shift of resources away from the traded to the non traded sector. As per definition (1), the dynamics of the internal relative price of non tradable goods drives the movements in RER as law of one prices holds in case of traded goods and their prices amount equivalent to world prices, especially in emerging market and developing economies.

The definition of real exchange rate could be generalized and written in log form as follows.

$$logq = loge + logp - logp^{*} \tag{2}$$

Where, p and p* are respectively the national and foreign price indices, and assuming that log p and log p* can be split into traded and non traded prices as below.

$$logp = (1 - \alpha)logpT + \alpha logpN \tag{3}$$

$$logp^{*} = (1 - \alpha)logp^{*}T + \alpha\ logp^{*}N \tag{4}$$

So, substituting (3) and (4), definition (2) could be rewritten as:

$$logq = \log e + (\log pT - logp^{*}T) + \propto$$
$$(\log pN - \log pT) - (\log p^{*}N - \log p^{*}T) \quad (5)$$

Under the hypothesis that the law of one price is valid for traded goods and foreign prices of traded and non traded goods, (log *p*N* – log *p*T*), are given, the first term in equation (5) vanishes and real exchange rate varies only with the domestic relative price of non traded goods. After establishing the validity of prices of non traded goods as the driver of real exchange rate, next step would be to find out the macroeconomic variables, which causes variations in prices of non traded goods. These macroeconomic variables could be identified as determinants of real exchange rate.

Considering the RER framework detailed in equations (1 to 5), wherein it has been derived that RER is primarily the function of prices of non traded goods and the equilibrium RER is determined by a set of macroeconomic variables (fundaments), the same can be estimated using suitable econometric techniques. For estimation, the relationship between equilibrium RER and fundaments could be defined in the following single equation:

$$q_t = \beta' X_t + \varepsilon_t \quad (6)$$

Where X_t are the macroeconomic fundamentals, β the vector of long run coefficients and ε_t an error term. Clark and MacDonalds (1999) suggests that sustainable or permanent component of fundamentals can be used to construct the equilibrium RER path. Thus, the equilibrium RER path can be obtained estimating equation (6) as under:

$$\bar{q}t = \widehat{\beta}' X_t^p \quad (7)$$

Where the vector $\widehat{\beta}$ contains efficient estimators of β and X_t^p is the permanent component of the fundamental variables, which can be computed decomposing time series with usual techniques (Hodrick-

Prescott filter, Beveridge-Nelson decomposition or Gonzalo-Granger methodology).

After estimating equation (7), the misalignments in RER, d_t^d can be computed as deviations of observed RER, q_t, from its equilibrium level, that is:

$$q_t^t = q_t - \widehat{\beta}' X_t^p \tag{8}$$

RER stability and its correct alignment are known to be necessary conditions - though not sufficient - for economic development (Williamson, 1997). Considering this argument, numerous studies have been undertaken for estimations of equilibrium real exchange rates in developing countries during the eighties and early nineties. These studies on real exchange rate try to find the determinants of RER and then estimate its long run level. Indeed, once this has been done, one can determine the necessary adjustments to reach equilibrium. Moreover, equilibrium real exchange rate determinants identification enables to forecast its evolution and then to choose the appropriate measures to remedy possible differences and to determine the necessary adjustments with regards to economic policy purposes.

Determinants

The equilibrium real exchange rate is defined as the relative price of non-traded to traded goods compatible with simultaneous attainment of the internal and external equilibrium (Edwards, 1989). Internal equilibrium entails clearing of non traded goods and labour markets; while in case of external equilibrium the intertemporal budget constraint is applicable i.e. the economy is intertemporal solvent. Edwards and Savastano (1999) mention that the equilibrium real exchange rate is driven by a set of foreign and domestic real variables called fundamentals in the long run. In theoretical models, the equilibrium real exchange rate is generally linked to government spending, productivity differential (the Balassa-Samuelson effect), terms of trade, external openness of the economy, foreign capital inflows, and net foreign assets, among other variables. According to

Edwards (1989), both real and nominal variables affect equilibrium real exchange rate, where as it respond only to fundamentals in the long run. In view of above, the real exchange rate movements may be endogenously generated by variations in fundamentals and hence, not necessarily means disequilibrium situations.

The studies by Ghura and Grennes (1993), Aron *et al* (1997), Cotti *et al* (1990) and Elbadawi and Soto (1997) find that real exchange rate determinants are mainly the terms of trade, the openness degree of the economy, imports and capital flows.

We have considered the determinants of RER in India on the basis of extant theoretical literature and numerous empirical studies undertaken in respect of other countries having somewhat similar economic structure. The Edwards model (1988), a theoretical framework for equilibrium RER used in various empirical studies on developing and EMEs, has been used in the present study. The macroeconomic fundaments, considered as possible determinants of RER in case of India, are productivity differential, government spending, terms of trade (TOT), external openness, capital flows and net foreign assets. The justification for choosing these macroeconomic fundamentals as possible determinants of RER has been discussed below:

a. Productivity Differentials: The productivity differential impact refers to the Balassa-Samuelson model (Balassa, 1964; Samuelson, 1964). Balassa-Samuelson hypothesis presents that in an open economy, which is divided into two sectors i.e. traded and non-traded, the relative price of non-traded goods to traded goods influence the real exchange rate to large extent and productivity differentials in these sectors are reflected in their relative price movements. When traded sector experience large productivity gains, the wage rates in this sector moves upward commensurately, but at the same time, wage rates in non-traded sector also increase equally, *albeit* productivity rise remains significantly lower. Since wage increase in traded goods sector is matched by productivity improvement, the prices of traded goods

do not rise. Moreover, if it is small open economy, the price of traded goods are exogenously given. On the contrary, in the non-traded goods sector, acceleration in wage rates is more than productivity escalation and this difference leads to increase in the price. In this example, productivity differential eventually result to increase in price of non-traded goods in a small open economy, which in turn leads to an increase in the relative price of non-traded goods. So, productivity differential in traded and non-traded sectors causes rise in the price level of an open economy and appreciation of the home country's real exchange rate.

Assuming a Cobb Douglas production function with constant returns to scale in both sectors, the formal the Balassa-Samuelson effect could be expressed as under:

$$Y_T = A_T K_T^{1-\alpha} L_T^{\alpha} \quad (9)$$

$$Y_N = A_N K_N^{1-\beta} L_N^{\beta} \quad (10)$$

Where A_i represents total factor productivity, K_i capital and L_i labour in sector i, (i = T,N). Solving the equations 9 and 10, following could be derived:

$$\hat{q} = \hat{p}N - \hat{p}T = \frac{\beta}{\alpha}\hat{A}T - \hat{A}N \quad (11)$$

Where, a hat above a variable denotes growth rate. Thus, as per equation 11, the real exchange rate depends entirely on productivity differentials. Moreover, the Balassa-Samuelson effect can also be interpreted as the effect of the economic development on real exchange rate, i.e. the real exchange rate tends to appreciate in the fast growing countries as these economies witness large productivity gains and that get reflected in rise in general price level through upward movement in the prices of non-traded goods.

b. Capital Flows and Net Foreign Assets: BS hypothesis revolves around the core principle of international trade. And, until recently, the appreciation of the real exchange rate in emerging and developing countries was attributed to the BS effect through

increase in the relative prices of non-traded goods. The collapse of Bretton Woods system in early 1970s and heightened volatilities in foreign exchange markets across the world paved the way for capital flows. A large number of emerging and developing countries also introduced economic reforms comprising of macroeconomic stabililisation i.e. containing inflation, fiscal deficit and external debt and structural changes i.e. developing and strengthening money and financial markets, globalization (enhancing external openness through trade and financial flows), liberalization/ privatization etc. As a result, economic landscape underwent a transformation with increasing financial flows across the countries following increasingly integration of international financial markets during 1990s and 21st century.

Alongside increasing international financial markets integration, it was debated that besides productivity differential, there is something else also which explains the recurrent deviations in exchange rate from its PPP level and jury was out with capital flows as one of the crucial factors behind the movements in exchange rate. Therefore, it is broadly accepted that trade and capital flows influence the exchange rate. A surge in capital flows leads to an increase in consumption demand for both traded and non-traded goods. In case of non-traded goods, excess demand generated by capital flows is not proportionately matched with rise in supply and hence, result into rise in the price of non-traded goods to reach to equilibrium. On the other hand, elevated demand for traded goods is met with imported goods without any affect on the price reflecting law of one price (LOP) and this leads to widening trade deficit. Accordingly, increase in the relative price of non-traded goods would entails an appreciation of the real exchange rate.

Generally, a country's current account balance is matched with net capital flows. If, current account is in deficit (surplus), then there would be net capital inflows (outflows). However, there could also be a situation when net capital inflows are more (less) than current account deficit and lead to accretion (erosion)

of net foreign assets of the country. Thus, net foreign assets tend to influence a country's exchange rate and that is why, foreign exchange balance is commonly used as one of the determinants of real exchange rate. Lane and Milessi-Ferreti (1999) investigate the theoretical relationship between the real exchange rate and net foreign assets and finds that the net foreign assets as an important determinant of the real exchange rate for developing and developed countries.

Net foreign assets influence the real exchange rate through various channels. The portfolio-balances considerations suggest that a deficit in the current account creates an increase in the net foreign debt of a country, which has to be financed by international investors and they demand for a higher yield to adjust their portfolio (Antonia and Bara, 2006). At given interest rate, this can only be achieved through a depreciation of the currency of the debtor country. Furthermore, the servicing of external debt accumulated through funding current account deficit entails a country to generate addition foreign exchange through promoting exports of goods and services. Therefore, the country needs to depreciate its currency to increase competitiveness of its exports (balance of payments channel also requires that (Maeso-Fernandez, *et al* (2001)).

In sum, rising current account deficit would be financed with an increase in capital flows and excess capital flows would lead to appreciation in real exchange rate. In the process, either excess capital flows would result in appreciation of nominal exchange rate or rise in prices with increasing money supply in the system. It may be noted that if a country relies on foreign capital for high levels of domestic absorptions (investment), RER is bound to appreciate regardless of the exchange rate regime in vogue. Thus, the real exchange rate is expected to appreciate (depreciate) with rise (fall) in foreign assets of a country. Like other emerging and developing countries, capital flows are susceptible to influence the movement in real exchange rate in India[1].

c. Government Spending: The Balassa-Samuelson model presumes that real exchange rate is supply side phenomenon, means demand factors do not have any impact on the real exchange rate. BS model also assumes certain conditions in vogue viz., prefect competition in goods market, free factors mobility between two sectors of production, international capital mobility, law of one price and constant returns to scale in both trade and non-traded sectors (Froot and Rogoff (1995) and De Gregorio *et al*. (1994)). However, in practice, all these conditions are difficult to be in existence especially in emerging and developing countries. Jorge and Restout (2008) mention that demand factors can have an effect on the relative price of non-traded goods if one of the above conditions is relaxed. In this regard, Aguirre and Calderon (2005) introduce monopolistic competition in the non-traded sector in Lane and Milesi-Ferretti's (2004) model and consider demand factors to determine the real exchange rate. Institutively, it is believed that the government expenditure is disproportionately incurred on non-traded goods, which leads to upward pressure on relative price of non-traded goods and appreciation in exchange rate. Otherwise also, generally higher government expenditure tends to be inflationary as it pushes the aggregate demand upward and supply response is not contemporaneous.

d. Terms of Trade: Terms of trade (ToT) affect the real exchange rate through income effect and substitution affect and net affect depends on the relative strength of these affects as both effects work in reverse direction to each other. Therefore, theoretical models although provide the importance of ToT disturbances as potential source of real exchange rate fluctuations, their impact on the real exchange rate remains undefined. On the one hand, deterioration in ToT generates negative income effect through decline in the domestic purchasing power and adversely affects the private demand for non-traded goods and leads to decline in prices eventually resulting into real depreciation of the exchange rate. On the other hand, weakening ToT induces substitution

effect and makes the consumption of imported goods more expensive. The substitution effect result into shift of demand in favour of non-traded goods increasing their prices and real appreciation in exchange rate. As mentioned above, the total effect of a ToT worsening on real exchange rate would depend on the strength of the income and substitution effects. However, recent empirical studies have found that the income effect is predominant; hence, ToT improvements are associated with real appreciation in the long-run.

e. **External openness:** The extent of external openness of an economy influences the movement in real exchange rate in many ways. Firstly, increase in external openness through reduction in tariffs makes imports cheaper and shift the demand away from non-traded goods towards imported goods. The prices of non-traded goods decline and real exchange rate depreciates in this process to ensure equilibrium in non-traded goods segment. The second influence channel of external openness on real exchange rate has been provided in the model by Obstfeld and Rogoff (2002). As per their model, there exist a negative relationship between external openness and real exchange rate volatility. Basic tenet of their model is that monopoly/ monopolistic competition like market conditions prevail in non-traded goods segment and hence, promote the aggregate price rigidity. While traded goods allow the convergence of the domestic price indices. Because of aggregate price rigidity, a larger real exchange rate changes would be needed for a relatively closed economy to ensure equilibrium in domestic market. Hau (2002) mentions that more open countries behave more like flexible prices economies with smaller real exchange rate fluctuations since more imported goods provide a channel for quick adjustment of the national price indices. Using a panel of forty eight countries, Hau provids evidence of the negative relationship between real exchange rate volatility and trade openness. So, it is amply clear that increasing external sector openness leads to lower volatility as well as depreciation in real exchange rate.

Section III
Evolution of Real Exchange Rate in India

The evolution of India's real exchange rate may be viewed in line with the shifts in India's exchange rate policies over the last few decades from a par value system to a basket-peg and further to a managed float exchange rate system. During the period from 1947 to 1971, India followed the par value system of exchange rate. Initially, the rupee's external par value was fixed at 4.15 grains of fine gold. The Reserve Bank maintained the par value of the rupee within the permitted margin of ±1 per cent using pound sterling as the intervention currency. Since the sterling-dollar exchange rate was kept stable by the US monetary authority, the exchange rates of rupee in terms of gold as well as the dollar and other currencies were indirectly kept stable. The devaluation of rupee in September 1949 and June 1966 in terms of gold resulted in the reduction of the par value of rupee in terms of gold to 2.88 and 1.83 grains of fine gold, respectively. The exchange rate of the rupee remained unchanged between 1966 and 1971. Therefore, evolution of real exchange rate during this period was guided mainly by the changes in prices in India as well as its trading partners.

With the breakdown of the Bretton Woods System in 1971 and the floatation of major currencies, the rupee was also linked with pound sterling in December 1971. Since sterling was fixed in terms of US dollar under the Smithsonian Agreement of 1971, the rupee also remained stable against dollar. In order to overcome the weaknesses associated with a single currency peg and to ensure stability of the exchange rate, the rupee, with effect from September 1975, was pegged to a basket of currencies. The currency selection and weights assigned were left to the discretion of the Reserve Bank. The currencies included in the basket as well as their relative weights were kept confidential in order to discourage speculation. Indian rupee exchange rate continued to be pegged to the basket of currencies until early 1990s when market determined exchange rate was introduced.

During 1970s, changes in real exchange rate were largely conditioned by the prices in India and its trading partners as real

effective exchange rate (REER) depreciated by an average of about 2 per cent while nominal effective exchange rate (NEER) appreciated by an average of 0.4 per cent indicating not much of movements. The nominal exchange rate, however, became more active during 1980s and a larger part of the movements in REER were driven by change in NEER. During this period, REER depreciated averagely by 2.0 per cent lower than an average depreciation of 3.0 per cent witnessed by NEER (Table 1).

By the late 1980s and the early 1990s, it was recognised that both macroeconomic policy and structural factors had contributed to balance of payments difficulties. Devaluations by India's competitors had aggravated the situation. Although exports had recorded a higher growth during the second half of the 1980s (from about 4.3 per cent of GDP in 1987-88 to about 5.8 per cent of GDP in 1990-91), trade imbalances persisted at around 3 per cent of GDP. This combined with a precipitous fall in invisible receipts in the form of private remittances, travel and tourism earnings in the year 1990-91 led to further widening of current account deficit. The weaknesses in the external sector were accentuated by the Gulf crisis of 1990-91. As a result, the current

Table 1: Real Effective Exchange Rate (REER) and Nominal Effective Exchange Rate (NEER) (36 Countries)

Period	Index		Appreciation (+)/ Depreciation (-)	
	REER	NEER	REER	NEER
1970s*	161.3	220.7	-2.1	0.4
1980s	153.9	208.5	-2.0	-3.0
1990s	100.9	101.7	-2.5	-5.2
2000s	99.9	89.2	-0.1	-0.5
2000-01	100.1	92.1	4.3	1.2
2001-02	100.9	91.6	0.8	-0.6
2002-03	98.2	89.1	-2.7	-2.7
2003-04	99.6	87.1	1.4	-2.2
2004-05	100.1	87.3	0.5	0.2
2005-06	102.4	89.9	2.3	2.9
2006-07	98.5	85.9	-3.8	-4.4
2007-08	104.8	93.9	6.4	9.3
2008-09	94.4	86.2	-9.9	-8.3

* Second half of 1970s.

account deficit widened to 3.2 per cent of GDP in 1990-91 and the capital flows also dried up necessitating the adoption of exceptional corrective steps.

Against this backdrop, India embarked on stabilisation and structural reforms in the early 1990s of which trade policies, exchange rate policies and industrial policies formed an integrated policy framework to improve the overall productivity, competitiveness and efficiency of the economic system, in general, and the external sector, in particular. As a stabilsation measure, a two step downward exchange rate adjustment by 9 per cent and 11 per cent between July 1 and 3, 1991 was resorted to counter the massive drawdown in the foreign exchange reserves, to instill confidence among investors and to improve domestic competitiveness. A two-step adjustment of exchange rate in July 1991 effectively brought to close the regime of a pegged exchange rate. Following the recommendations of the High Level Committee on Balance of Payments (Chairman: Dr. C. Rangarajan) to move towards the market-determined exchange rate, the Liberalised Exchange Rate Management System (LERMS) was put in place in March 1992 initially involving a dual exchange rate system. Under the LERMS, all foreign exchange receipts on current account transactions (exports, remittances, etc.) were required to be surrendered to the Authorised Dealers (ADs) in full. The LERMS was essentially a transitional mechanism and a downward adjustment in the official exchange rate took place in early December 1992 and ultimate convergence of the dual rates was made effective from March 1, 1993, leading to the introduction of a market-determined exchange rate regime. The dual exchange rate system was replaced by a unified exchange rate system in March 1993, whereby all foreign exchange receipts could be converted at market determined exchange rates. On unification of the exchange rates, the nominal exchange rate of the rupee against both the US dollar as also against a basket of currencies got adjusted lower, which almost nullified the impact of the previous inflation differential.

From March 1993 began a new chapter in the evolution of the real exchange rate of India wherein market determined nominal

exchange rate of the rupee started conditioning the real exchange rate besides relative prices. REER depreciated by an average of 2.5 per cent during 1990s significantly lower that the average depreciation of 5.2 per cent in NEER indicating that transmission of NEER depreciation to REER was controlled to a large extent by relative higher rate of change in domestic prices. During 2000s, both REER and NEER witnessed a marginal average depreciation of 0.1 and 0.5 per cent, respectively.

Section IV
Data Description and Research Methodology

Data Description

The variables used in the present study are real exchange rate (REF) of Indian rupee against USA dollar, differential growth rate between India and USA (DG), government final consumption expenditure as percentage of GDP (GC), foreign exchange assets (FX), terms of trade (TOT) and external openness (OP). Data series are quarterly ranging from Q2 of 1997 to Q2 of 2009. The RER has been calculated taking nominal exchange rate of rupee against US dollar, wholesale price index (WPI) of India and producers' price index (PPI) of USA. We have used bilateral RER of rupee against US dollar keeping in view that India's about 80 per cent of the international trade is invoiced in US dollar. Since nominal exchange rate has been taken as rupees per US dollar, increase/ decrease in RER mean depreciation/ appreciation. Due to non-availability of data on sectoral productivity, many studies have used the GDP per capita relative to trading partners as a proxy for the Balassa-Samuelson effect (productivity differential). In the present study, we have used difference in growth rate of India and USA to examine the Balassa-Samulson effect on the RER in the absence of quarterly GDP per capita. Higher growth differential, which has been presumed to be largely driven by traded goods sector, will lead to increase in prices of non-traded goods on account of Balassa-Samuelson effect. Foreign exchange assets have been considered to factor in the impact of capital flows and net foreign assets on the RER. The terms of trade

have been derived taking exports as percentage of exports. The external sector openness has been taken in broader term and computed aggregate current and capital account inflows and outflows as percentage of GDP.

Data on India i.e. nominal exchange rate, WPI, government final consumption expenditure (GC), foreign exchange assets (FX), exports and imports, current account inflows & outflows, capital account inflows & outflows, and gross domestic product (GDP) both at current and constant prices are sourced from Handbook of Statistics of Indian Economy, Reserve Bank of India. Producer's price index and GDP growth of USA are taken from International Financial Statistics (IFS), International Monetary Fund (IMF).

Research methodology

A number of unit root tests, *viz*., Augmented Dickey Fuller (ADF), Dickey Fuller-Generalized Least Square (DF-GLS), Phillips-Perron and KPSS have been used in the present study. ADF test investigates the presence of unit root in time series data. Strong negative numbers of unit root reject the null hypothesis of unit root at some level of confidence. ADF framework to check the stationarity of time series has been given in following equation:

$$\Delta x_t = \beta_1 + \beta_2 t + \theta x_{t-1} + \alpha_i \sum_i^n \Delta x_{t-1} + \varepsilon_t \qquad (12)$$

Where, ε_t is white noise error term.

Basically, this test determines whether the estimates of θ are equal to zero or not. Fuller (1976) has provided cumulative distribution of the ADF statistics by showing that if the calculated-ratio (value) of the coefficient is less than critical value from Fuller table, then x is said to be stationary. However, this test is not reliable for small sample data set due to its size and power properties (Dejong *et al*, 1992; Harris, 2003). For small sample data set, these tests seem to over-reject the null hypotheses when it is true and accept it when it is false. Therefore, the findings of ADF test needs to be corroborated with other unit root tests discussed above.

The Phillips-Perron (PP) unit root tests differ from ADF test mainly in how they deal with serial correlation and heteroskedasticity in errors. Particularly, where the ADF tests use a parametric autoregression to approximate the ARMA structure of the errors in the test regression, the PP test ignores any serial correlation. The test regression for the PP test is:

$$\Delta y_t = \beta'^{D_t} + \pi y_{t-1} + \square_t \quad (13)$$

Where $\square_t$ is *I*(0) and may be heteroskedastic. The PP test correct for any serial correlation and heteroskedasticity in the errors $\square_t$ of the test regression directly modifying the test statistics.

The ADF and PP unit root tests are for the null hypothesis that a time series y_t is *I*(1). Stationarity test, on the other hand, is for the null that y_t is *I*(0). The derivation of the most commonly used KPSS stationarity test starts with the model

$$y_t = \beta'^{D_t} + \mu_t + u_t \quad (14)$$

$$\mu_t = \mu_{t-1} + \square_t, \square_t \sim WN(0, \sigma_\epsilon^2) \quad (15)$$

Where D_t contains deterministic components (constant or constant plus time trend), u_t is *I*(0) and may be heteroskedastic. μ_t is a pure random walk with innovation variance σ_ϵ^2. The null hypothesis that y_t is *I*(0) is formulated as H0 : σ_ϵ^2 =0, which implies that μ_t is a constant. Although not directly apparent, this null hypothesis also implies a not moving average root in the ARMA representation of Δy_t. The KPSS test statistics is the Lagrange multiplier (LM) or score statistics for testing σ_ϵ^2 =0 against the alternative that σ_ϵ^2 >0 and given by:

$$KPSS \xrightarrow{d} \int_0^1 V1\,(r)dr \quad (16)$$

The stationary test is a one-sided right-tailed test so that are rejects the null of stationarity at the 100% level if the KPSS test statistics is greater than the 100.

After testing for integrated order of data series, next logical step is to estimate the relationship with appropriate econometric techniques. Since present study deals with time series data and all the level variables are not stationary, it would be appropriate to apply some technique which can circumvent the problem of stationarity in the time series data. The data could be converted into stationary form taking first difference and relationship could be estimated with ordinary least square (OLS) regression, but there would be greater loss of information and hence, estimates may not be that robust.

Econometric literature has abundant techniques to investigate relationships among non-stationary macroeconomic variables and prominent among them are univariate co-integration technique (Engle-Granger (1987)), multivariate co-integration technique (Johansen (1988); Johansen and Juselius (1990); and Johansen's (1995)) and newly developed auto regressive distributed lag (ARDL) model (Pesaran and Shin, 1995, 1998; Pesaran *et al*., 1996; Pesaran *et al.*, 2001). The recent studies indicate that the ARDL approach to cointegration is preferable to other conventional cointegration approaches such as Engle and Granger (1987), Johansen (1988) etc. mainly because of its applicability irrespective of whether the underlying regressors are purely $I(0)$, purely $I(1)$ or mutually co-integrated. The statistic underlying this procedure is the familiar Wald or F-statistic in a generalized Dickey-Fuller type regression, which is used to test the significance of lagged levels of the variables under consideration in a conditional unrestricted equilibrium error correction model (ECM) (Pesaran, *et al*., 2001). Another reason for preferring the ARDL approach over other approaches is that it is more robust and performs better for small sample sizes.

In the present study, ARDL approach has been used for estimating long-run relationship and short-run dynamics because of the obvious reasons cited above for its preferability i.e. all the variables are not integrated of the same order and small sample is size. The ARDL approach involves estimating the conditional error correction version of the ARDL model for variables under estimation. The conditional VECM

in the ARDL framework of interest of the present study could be specified as under:

$$\begin{aligned}\Delta rer_t = {} & c_0 + \emptyset_1 rer_{t-1} + \emptyset_2 dg_{t-1} + \emptyset_3 gc_{t-1} + \\ & \emptyset_4 fx_{t-1} + \emptyset_5 tot_{t-1} + \emptyset_6 op_{t-1} + \\ & \sum_{i=1}^{p} \varphi i\, \Delta rer_{t-i} + \sum_{j=1}^{q} \partial j\, \Delta dg_{t-j} + \\ & \sum_{l=1}^{q} \mu_l\, \Delta gc_{t-l} + \sum_{m=1}^{q} \omega m\, \Delta fx_{t-m} + \\ & \sum_{n=1}^{q} \vartheta n\, \Delta tot_{t-n} + \sum_{r=1}^{q} \beta r\, \Delta op_{t-r} + \epsilon_t\end{aligned} \tag{17}$$

Where ϕ_i are the long run multipliers, c_0 is the drift and ε_t are white noise error terms.

First step in the ARDL bounds testing approach is to estimate equation (17) by ordinary least squares (OLS) in order to test for the existence of a long-run relationship among the variables by conducting an F-test for the joint significance of the coefficients of the lagged levels of the variables, i.e., H_n: $\phi_1 = \phi_2 = \phi_3 = \phi_4 = \phi_5 = 0$ against the alternative H_A: $\phi_1 \neq \phi_2 \neq \phi_3 \neq \phi_4 \neq \phi_5 \neq 0$.

Two asymptotic critical values bounds provide a test for cointegration when the independent variables are *I*(d) (where $0 \leq d \leq 1$); a lower value assuming the regressors are *I*(0) and an upper value assuming purely *I*(1) regressors. If the F-statistic is above the upper critical value, the null hypothesis of no long-run relationship can be rejected irrespective of the orders of integration for the time series. Conversely, if the test statistic falls below the lower critical value the null hypothesis cannot be rejected. Finally, if the statistic falls between the lower and upper critical values, the result is inconclusive. The approximate critical values for the F test have been obtained from Narayan, P. (2005).

Bounds test has several advantages over the traditional residual based cointegration analysis. First, it is applicable irrespective of the degree of integration of the variables and thus avoids the pre-testing of the order of integration of the variables. In the literature, testing of unit-root properties becomes particularly problematic where the power of unit root test are typically low, and there is switch in the

distribution function of the test statistics as one or more roots of the data series approach unity (Pesaran and Pesaran, 1997). Second, unlike residual based cointegration analysis, the unrestricted error correction model (UECM) employed in bound testing does not push the short-run dynamics into the residual terms (Banerjee *et al*., 1993). Third, the bounds test can be applied to small sample size. Fourth, it identifies the exact variable to be normalised in the long-run relationship. A limitation of bounds test, however, is that it is not appropriate in situations where there may be more than one long-run relationship among the variables. In other words, the test is appropriate only when one variable is explained by the remaining variables and not vice versa.

In the second step, once cointegration is established, the conditional ARDL (p_1 ,q_1 , q_2 ,q_3 ,q_4) long-run model for rer_t can be estimated as:

$$rer_t = c_0 + \sum_{i=1}^{p} \emptyset_1 \, rer_{t-1} + \sum_{i=0}^{q1} \emptyset_2 \, dg_{t-1} + \sum_{i=0}^{q2} \emptyset_3 \, gc_{t-1} + \sum_{i=0}^{q3} \emptyset_4 \, fx_{t-1} + \sum_{i=0}^{q4} \emptyset_5 \, tot_{t-1} + \sum_{i=0}^{q5} \emptyset_6 \, op_{t-1} + \epsilon_t \quad (18)$$

This involves selecting the orders of ARDL (p, q_1, q_2 , q_3, q_4, q_5) model in the six variables using Schwarz Bayesian Criterion. Finally, the short-term dynamic parameters by *estimating a*n error model associated with the long-run estimates can be estimated in the following specification:

$$\Delta rer_t = \alpha_0 + \sum_{i=1}^{p} \varphi i \, \Delta rer_{t-i} + \sum_{j=1}^{q} \partial j \, \Delta dg_{t-j} + \sum_{l=1}^{q} \mu l \Delta gc_{t-l} + \sum_{m=1}^{q} \omega m \, \Delta fx_{t-m} + \sum_{n=1}^{q} \vartheta n \, \Delta tot_{t-n} + \sum_{r=1}^{q} \beta r \, \Delta op_{t-r} + \delta ecm_{t-1} + \epsilon_t \quad (19)$$

Where φ, ∂, μ, ω, ϑ, β, and δ are the short-term dynamic coefficients of the model's convergence to the equilibrium and δ is the speed of adjustment towards long term equilibrium path.

Section V
Empirical Results

The results reported in Table 2 show that null hypothesis of ADF unit root is accepted in case of all variables except for ToT but rejected in first difference at 1% level of significance. Similarly, null hypothesis of unit root could not be rejected by DF-GLS unit root test in the levels, while it was not accepted in first difference except for GC and ToT. Both the unit root tests indicate that all the variables considered in the present study are difference stationary *I*(1) barring TOT which is level stationary *I*(0) only as per ADF test.

Phillips-Perron (PP) unit root test indicates that null hypothesis of unit root cannot be rejected in the level form in case of RER, DG, and OP, but discarded null hypothesis of unit root in GC and TOT in the level form. PP test, however, rejected the null hypothesis of unit root in the first difference of the RER, DG, TOT and OP. The results of KPSS stationary test have rejected the null of stationary in the level of DG, GC, FX, and OP, while accepted the null in the level of RER

Table 2: Results of Unit Root/ Stationary Tests

Variables	ADF Test		DF-GLS Test	
	Level	1st Difference	Level	1st Difference
RER	-1.79	-5.17***	-1.52	-5.15***
DG	-0.61	-5.87***	0.38	-7.65***
GC	-0.74	-19.81***	-1.09	-0.70
FX	2.91	-4.06***	0.10	-3.99***
TOT	-2.83*	-7.51***	0.14	0.95
OP	0.66	-8.72***	-0.37	-8.33***
Variables	Phillips-Perron Test		KPSS Test	
	Level	1st Difference	Level	1st Difference
RER	-2.05	-5.17***	0.36*	0.15***
DG	-1.83	-9.92***	0.91	0.03***
GC	-5.08***	-30.92***	0.83	0.29***
FX	0.40	-2.95***	0.83	0.21***
TOT	-2.85*	-19.17***	0.63**	0.14***
OP	-0.38	-8.71***	0.78	0.16***

Note: ***, **, and * denote statistical significance at 1%, 5% and 10% levels, respectively.

and TOT. The KPSS results further have found that null of stationary was accepted in the first difference of DG, GC, FX, and OP.

On the basis of the majority criteria, it has been inferred that variables, *viz*., RER, DG, GC, FX and OP are integrated of order one I(1), while TOT is integrated of order zero I(0). After seeing the unit root properties of the data series, cointegration among the variables have been tested using auto regressive distributed lag (ARDL) model has been used.

In order to test the presence of long-run relationship between RER and DG, GC, FX, and OP, equation (17) is estimated. A general-to-specific modeling approach guided by the short data span and SBC respectively to select a maximum lag order of 4 for the conditional ARDL-VECM is preferred because of quarterly frequency.

Firstly, an OLS regression is estimated for the first differences part of equation and then tested for joint significance of the parameters of the lagged level variables. The joint null hypothesis of the coefficients being equal to zero means no long-run relationship has been tested with F-statistics. The presence of cointegration between the variables is accepted if F-statistics reject the null at 95 per cent critical bound values generated by Narayan (2005) for small sample. The calculated F statistic presented in Table 3 is 4.8559 and is higher than the upper bound at 1% level of significance. Thus, null hypothesis of no cointegration is rejected, implying that there exists a long-run relationship among the variables RER, DG, GC, FX, TOT, and OP, when the regression is normalized on RER. It may, however, be noted that null hypothesis of no cointegration is accepted at 95 per cent critical value when regression is normalised on variables other than RER. This implies that there exists only one long-run cointegrating relationship.

Having established that a long-run cointegration relationship exists between dependent variable RER and independent variables DG, GC, FX, TOT and OP, the long-run relationship has been estimated using the specification defined in equation (18). The

Table 3: Bound Test for Cointegration

Dependent Variable (Intercept and no trend)			**SBC Lag**	**F-Statistic**	**Probability**	**Outcome**
F_{RER}(RER | DG, GC, FX, TOT, OP)			1	4.8559***	0.001	Cointegration
F_{DG}(DG | RER, GC, FX, TOT, OP)			1	0.8879	0.517	No Cointegration
F_{GC}(GC | RER, DG, FX, TOT, OP)			1	0.8109	0.575	No Cointegration
F_{FX}(FX | RER, DG, GC, TOT, OP)			1	3.2669	0.108	No Cointegration
F_{TOT}(TOT | RER, DG, GC, FX, OP)			1	1.5692	0.194	No Cointegration
F_{OP}(OP | RER, DG, GC, FX, TOT)			1	1.6110	0.354	No Cointegration
Critical Values						
T	1% Level		5% Level		10% Level	
	I(0) Lower Bound	I(1) Upper Bound	I(0) Lower Bound	I(1) Lower Bound	I(0) Upper Bound	I(1) Lower Bound
Narayan P (2005)						
45	3.593	4.981	2.694	3.829	2.276	3.297
50	3.543	4.839	2.670	3.781	2.259	3.264

***Significant at 1 per cent level.

maximum time lag of 4 was selected based on Schwarz's Bayesian Criterion (SBC).

The estimated coefficients of the long-run relationship show that productivity differential (DG) has a statistically significant negative impact on real exchange rate, which is in line with theoretical argument that increase in productivity differential leads to higher price level and eventually result into appreciation of RER. Similarly, the long-run coefficients of FX and TOT have negative sign and are significant at 1% level, indicating that increase in forex exchange assets and terms of trade affect appreciation in RER, which is again in tandem with *a priori*. The long-run coefficient of OP is positive and significant at 1% level of significance implying that augmenting external sector openness result into depreciation of RER and is consistent with theoretical argument as well as results of numerous studies undertaken in the past with reference to different countries. The coefficient of GC is positively signed and against the theoretical argument, but it is not statistically significant even with wider confidence intervals (Table 4). The results of long-run relationship

Table 4: Estimated Long-run Coefficients using ARDL Model

ARDL(1,0,0,0,0,0) selected based on SC. Dependent variable RER_t.				
Regressor	Coefficient	Standard Error	T-Ratio	Probability
DG_t	-0.28419**	0.14405	-1.9729	0.056
GC_t	0.068204	0.11720	0.58196	0.564
FX_t	-0.0001162*	0.00001579	-7.3587	0.005
TOT_t	-0.11589*	0.024582	-2.9880	0.000
OP_t	0.13259*	0.033447	3.9642	0.000
C	55.7714*	3.6230	15.3935	0.000

Note: *, **, and *** denote statistical significance at 1%, 5% and 10% level, respectively.

establish that DG, FX, TOT and OP are main determinants of real exchange rare in India.

It has also been explored whether actual RER is far away from the RER fitted by the selected fundamentals. It could be seen from Chart 1 that actual RER largely follows the fitted RER implying that there has not been any major deviations in the actual RER from its long-run path fitted by fundamentals in India.

Furthermore, short-run dynamics from error correction have been estimated within the ARDL framework given in equation (19). It could be seen in Table 5 that signs of short-run dynamic impact are consistent with long-run coefficients. Error correction term is negative

Chart 1: Actual versus Fitted Values of RER

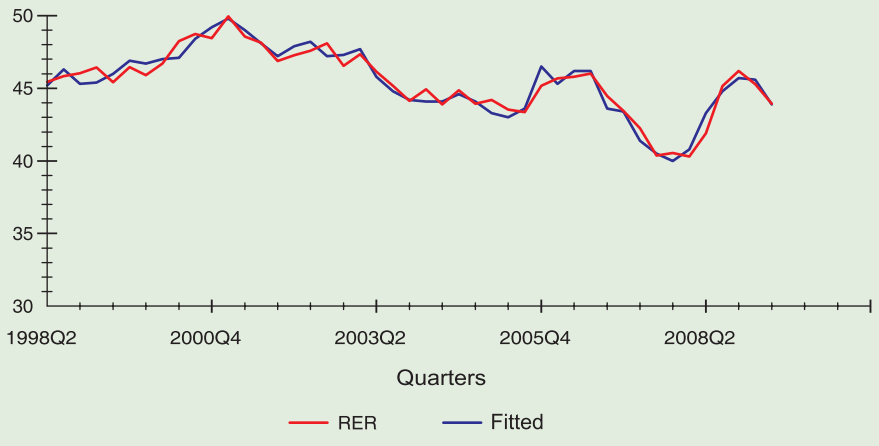

Table 5: Error Correction Representation for the Selected ARDL Model

ARDL(1,0,0,0,0,0) selected based on SC. Dependent variable ΔRER_t.				
Regressor	Coefficient	Standard Error	T-Ratio	Probability
dDG_t	-0.13037**	0.59660	-2.1835	0.035
dGC_t	0.031263	0.052436	0.59621	0.555
dFX_t	-0.0001162*	0.00001579	-7.3587	0.000
$dTOT_t$	-0.053123*	0.012488	-4.2540	0.000
dOP_t	0.060777*	0.013592	4.4714	0.000
dC	25.5644*	4.7553	5.3760	0.000
Ecm(-1)	-0.45838*	0.077881	-5.8856	0.000

Note: *, **, and *** denote statistical significance at 1%, 5%, and 10% level, respectively.

and significant at 1% significant level implying that there is convergence to long-run equilibrium path. The coefficient of the ECM is very high at (-) 0.46 implying a fairly high speed of adjustment to the long-run disequilibrium after a shock. Approximately 46 per cent of the deviation in RER from the long-run equilibrium level is corrected in the next quarter.

Section VI
Concluding Remarks

The volatility and misalignment of RER from its equilibrium level adversely affects the competitiveness and economic growth of developing countries as non-tradable goods constitute a large segment of the goods market. Therefore, RER stability and alignment have assumed critical importance in policy formulations particularly in EMEs and developing countries to improve economic performance during recent years. Given the fact that RER movements and economic growth have got some association positive or negative, the determinants of RER have become important. The macroeconomic fundamentals viz., productivity differential, capital flows/foreign exchange assets, government consumption, terms of trade, external sector openness have been given as main determinants of RER. Balassa and Samuelson hypothesis provides that productivity differential in traded and non-traded sectors cause rise in the price level of an open economy and appreciation of the home country's real exchange rate. A surge in capital

flows leads to an increase in aggregate demand and rise in the price of non-traded goods, which would eventually reflect in appreciation of the real exchange rate. Furthermore, excess capital flows would lead to nominal appreciation in exchange rate. The government expenditure, which is disproportionately incurred on non-traded goods, leads to upward pressure on relative price of non-traded goods and appreciation in exchange rate. The deterioration in terms of trade generates negative income effect leading to decline in prices and eventually resulting into real depreciation of the exchange rate, while, at the same time it induces substitution effect in favour of non-traded goods increasing their prices and real appreciation in exchange rate. Increasing external openness of an economy may increase demand for imported goods and decline for demand of non-traded goods, which would result to decline in the prices of non-trade goods and real exchange rate depreciation. The impact of aforementioned macroeconomic fundamentals has been tested estimating ARDL cointegration model.

The bound tests of cointegration indicate that there exist a long-run relationship between RER and independent variables *viz.,* differential growth, government consumption, net foreign assets, terms of trade and openness. The estimated coefficients of the long-run relationship show that productivity differential (differential growth), net foreign assets and terms of trade have negative sign and are significant at 1% significance level, indicating that increase in these variables lead to appreciation in RER. The long-run coefficient of openness is positive and significant at 1% level of significance implying that augmenting external sector openness result into depreciation of RER. The coefficient of government consumptions is, however, positively signed but it is not satistically significant. Therefore, the results of long-run relationship establish that productivity differential, foreign assets, terms of trade and openness are main determinants of real exchange rare in India. Productivity differential exerts largest influence on the RER. Further, the signs of the short-run dynamic impact have been found consistent with long-run coefficients and error correction term is negative and significant implying convergence to long-run equilibrium path. About 46 per cent at the deviation in the long-run equilibrium RER is corrected during the next quarter.

The appreciation in RER is generally seen as deterioration in the competitiveness of the traded goods sector. The results of present study, however, shows that appreciation in RER should not always be seen as decline in competitiveness as some of the factors contributing to appreciation in RER viz., increase in productivity differential and net foreign exchange assets and decline in terms of trade are attributed to higher growth reflecting improvement in the traded goods sector competitiveness.

Notes:

[1] While theoretically, capital flows would equal to zero in the long-run, most less developed countries are expected to be capital importers for the future, therefore, most empirical studies of developing economies use a measure of sustainable capital flows rather than a zero capital account. Models of the RER in these countries often include capital flow as a determinant of the equilibrium real exchange rates (see Joyace and Kamas (2003)).

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Determinants of Overnight Index Swap (OIS) Rates: Some Empirical Findings from an Emerging Market Economy, India

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This paper uses the financial sector variables over the last two years to analyse the determinants of the Overnight Index Swap (OIS) rates in India. Among the financial variables considered, in the short run, Gsec rate and call rate had positive and significant correlation with the OIS rate, while inflation rate was not contemporaneously related with the OIS rate. The other factor that significantly caused the OIS rate movement was the liquidity conditions in the Indian money market, measured by the difference between the call and repo rate. The above factors remained crucial even during and in the aftermath of the global financial crisis. The impulse response functions indicated that the market was resilient to shocks. The long run equilibrium relationship between OIS, Gsec and Call rates was confirmed by existence of at least one cointegrating vector. The coefficient of Gsec rate in the estimated cointegration was found to be positive and significant. However, the coefficient of call rate was found to be negative (and low). It could indicate that a high (low) call rate today was expected to converge to the long term market expectation as indicated by the OIS rate. The error correction term, though negative, was not found to be statistically significant at the conventional levels. This could be because of low volume in the OIS market, which is likely to pick up with further money market activities and future financial product developments.

JEL Classification : E40, G10, G31.

Keywords : Overnight Index Swap, OIS, Money Market, Yields, Overnight Rate, Inflation.

Introduction

Interest risk management has assumed predominant importance in the management of any financial institution after the deregulation of the interest rates. In the deregulated market, every financial

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organization recognizes and quantifies its risk-taking appetite. Banks and corporates face the risks on their investment portfolios, cost of raising working capital on account of the volatility in the movement of interest rates. One of the commonly used risk management practices is the use of overnight index swap (OIS). It is one type of interest rate swaps where the floating leg of the swap is linked to an overnight index, compounded every day over of the payment period. The parties agree to exchange the difference in the accrued interest arrived according to the fixed and floating interest rates at the maturity on the notional principal amount.

Use of OIS generally brings many benefits to the financial community. OIS helps in hedging the interest rate risks. Additional benefits include reduction of credit risk, creation of synthetic overnight-index-linked liability for corporates, etc.. It allows the financial institutions the flexibility to move to the interest rate basis of its choice, manage various features of their debt portfolios, the duration of its investment portfolio.

Research in money market microstructure is a relatively recent development and has mainly focused on developed markets. In contrast, research on emerging market economies (EMEs) is rather limited - perhaps because of the narrow and underdeveloped nature of the market in such economies. This paper makes an attempt to address this anomaly by analysis of relationship of the OIS rates with other financial variables. In particular, we attempt an evaluation of the determinants of Overnight Index Swap (OIS) rate and the causal relation between OIS rate and different financial variables, their short run and long run relationship. This paper is organized as follows: Section 2 concentrates on the cross country experience, Section 3 describes the data, Section 4 devotes itself to the empirical analysis and Section 5 concludes the major findings. Finally, OIS and Call rates around the recent policy dates and the market expectations (gathered from different print media) are reported in Table A1 and A2 in Annex, respectively.

Section II

Cross Country Experience

While not many academic articles on OIS were available in the public domain, reasonable literature search on the subject found the following:

In Australia the overnight index swap market started in late 1999, and has witnessed rapid growth in the subsequent years. The market is more liquid in relatively shorter end as compared with its longer counterpart. The liquidity in the OIS market makes it useful in forecasting the market expectations about the future movement of the *Cash rate*, though they are not perfect indicator of the same. In Australia, banks are the main players in the overnight interest rate swaps market. In view of its success, some Australian investment banks and fixed-income brokers introduced the OIS in the New Zealand markets (February 2002). However, there were no formal price-making arrangements in the OIS market of New Zealand. Trades between banks and their institutional clients were also low. A few Australian investment banks dominated the market, and the domestic players were insignificant. The turnover in the OIS market was only around 10 per cent of the more established FRA and bank bills futures market in New Zealand. The trades were mostly for taking a view on the direction and magnitude of changes in the *official cash rate* (OCR) so far. The OIS market remained more developed and broad-based in Australia as compared with New Zealand.

In Japan the OIS was launched in mid-1997 but it remained shallow till recently. The main reasons were the prevailing effective zero overnight interest rates and very low short-term interest rates. As the bankers did not need to hedge against short-term interest rate risks, there was no need for the financial institutions to operate in this OIS market. The OIS transactions began to grow as market participants expected the end of the Quantitative easing Policy before the crisis. Gradually, the OIS transaction volume exceeded that of all non-OIS interest rate swaps with terms of less than one year. The Japanese financial institutions benefited from utilizing the OIS by directly managing the risk of a rise in overnight rates and from the possibility of arbitrage opportunities. As the Japanese money markets become more active and interest rates become more volatile, demands for hedging

and arbitrage operations are expected to grow further; and consequently the Japanese OIS market is expected to be more broad-based and liquid.

The ushering of the global economic crisis / sub-prime crisis brought to fore a new variable as a measure of financial health. The measure is the spread between 3-month LIBOR and the 3-month Overnight Index Swap (OIS) rate. The OIS rate is a measure of market expectation of the money market rates. Expectations also play major roles on all term loans, inlcluding 3-month LIBOR. The difference between LIBOR and OIS rate thus captures factors other than interest rate expectations, such as credit and liquidity risks (Taylor 2008). An increase in the spread, holding the OIS constant, will increase the cost of such loans and have a contractionary effect on the economy. Bringing this spread down therefore became a major objective of monetary policy, as well as a measure of its success in dealing with the market turmoil.

The Interest rate swaps in India is relatively new, with the first interest rate swap being traded in July 1999. Among the Interest rate swaps, the OIS is the most popular and liquid. As the name implies the benchmark here is the overnight rate. The floating benchmark is MIBOR (Mumbai inter-bank offered rate), against which the swap is settled. The floating leg of the transaction is compounded and settled only at pre-decided frequency (generally semi-annually). Though OIS are quoted in different maturities, anecdotal evidence indicates that tenors upto five-year are liquid (according to the number of deals). In India the OIS market is generally dominated by the foreign banks and some of the segments of the OIS market remain quite illiquid.

Section III

Data and Descriptive Statistics

This study concentrates on the last two-and-half year daily data on one-year and five-year OIS rates (from August 2007 to November 2009) and attempts to identify their determinants. The major data sources for this study are the Reuters database and Weekly Statistical Supplement. The rate / financial sector variables considered for this study are as follows:

- 1-year FIMMDA generic yield (Gsec1);

- 5-year FIMMDA generic yield (Gsec5);
- Call/notice money market rate(CALL);
- Repo Rate, Reverse Repo rate & Cash reserve ratio (CRR);
- Call money spread (call_spd) is the difference between the Call rate and the repo rate (Call_spd), and the increase in the same is an indicator of the stringent liquidity conditions in the inter-bank money market.
- Weekly WPI Inflation Rate (the inflation rate is repeated for other days of the week). For October and November 2009, the inflation rate is repeated for all days in the month.

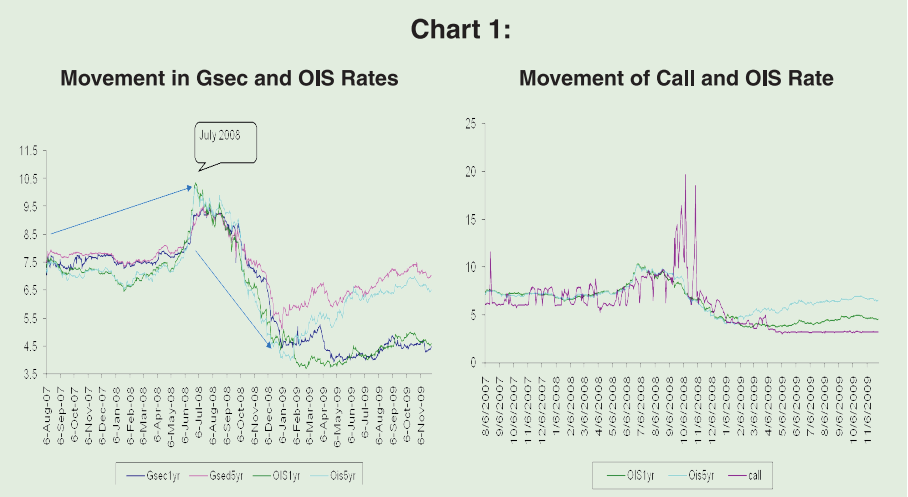
The choice of these variables was guided by opportunity cost and liquidity considerations, and supply/demand situation in the underlying and OIS market. From the cost angle 1-year and 5-year Government security yields were taken as measures of benchmark risk-free interest rates of one-year and five-year maturities. The call rate and the call spread were included as indicators of overall liquidity in the system.

Trends in One-year and five-year OIS rate

The trends in the one-year and five-year OIS rates along with Gsec rate during the period under consideration are plotted in Chart 1.

As evident from the above chart, there have been three distinct phases in the OIS market. In the first phase, i.e. from August 2007 to June 2008, the OIS rate followed an increasing trend in general, which reflected the inflationary pressures, cumulative increase in CRR and increase in the repo rate. Beginning July 2008, there was a change in the underlying trend and the OIS rate generally declined, perhaps reflecting the global financial crisis, expectations for the easing rate and liquidity conditions in the Indian money markets. Finally, from beginning of December 2008, the rate in the OIS market started increasing gradually. In the entire period under consideration the data indicated a close co-movement between OIS rates and Gsec

Chart 1:



rates. The OIS rates mostly remained below the Gsec rates. It may be mentioned that the inflation measured by change in WPI index was very volatile during the period under consideration. The descriptive statistics for the level variables for the entire period (August 2007 to November 2009) are as under:

Table 1: Descriptive Statistics

	OIS1YR	OIS5YR	GSEC1YR	GSEC5YR	CALL	INF
Mean	6.19	6.81	6.44	7.36	5.87	5.11
Median	6.69	6.82	7.31	7.51	6.05	4.26
Maximum	10.35	10.20	9.46	9.50	19.70	12.91
Minimum	3.69	3.97	3.93	5.09	2.99	-1.14
Std. Dev.	1.80	1.34	1.77	0.94	2.44	4.18
Skewness	0.25	0.38	-0.06	0.07	1.19	0.43
Kurtosis	1.96	3.20	1.49	2.63	6.40	2.08

The co-movements of the rate variables with the OIS rate observed in the charts were confirmed statistically by a correlation analysis (Table 2). Generally, the factors considered have positive relationship with the OIS rates, which were found to be statistically

Table 2: Correlation Coefficient (level of variables)

	OIS1YR	OIS5YR	GSEC1YR	GSED5YR	CALL	INF
OIS1YR	1					

OIS5YR	0.85906	1				
P-value	0	-----				
GSEC1YR	0.968361	0.774268	1			
P-value	0	0	-----			
GSED5YR	0.926591	0.945672	0.884833	1		
P-value	0	0	0	-----		
CALL	0.794012	0.622974	0.847253	0.698309	1	
P-value	0	0	0	0	-----	
INF	0.810181	0.62994	0.809903	0.701048	0.775022	1
P-value	0	0	0	0	0	-----

significant at 1 per cent level (P-value). A more detail study of the correlation coefficients, causal relationship and the long term co-movement are undertaken in the following sections.

Section IV

Empirical Findings

(a) Stationarity Tests

Before proceeding to the test of overall relationship between OIS rate and other explanatory variables, it is appropriate that all the series be tested for stationarity or for the 'same statistical property'. Accordingly, in order to test for the stationarity of the series, the Phillips Peron (PP) test was conducted. The PP test showed that all the variables (i.e. OIS1, OIS5, Gsec1, Gsec5, Call and Inflation rate) were non-stationary for the period under consideration.

(b) Correlation Analysis

In view of the non-stationarity of the variables under consideration the correlations were computed using the variables in differenced

form. The correlation coefficients and their P-values are reported in Table 2(a) below:

Table 2(a): Correlation Coefficient-August 07 to Nov 09, Differenced Variable

	DOIS1	DOIS5	DGESC1	DGSEC5	DCALL	DINFLATION
DOIS1	1					Correlation
	-----					Probability
DOIS5	0.95963	1				
	0	-----				
DGESC1	0.878981	0.90181	1			
	0	0	-----			
DGSEC5	0.928576	0.953497	0.935967	1		
	0	0	0	-----		
DCALL	0.135003	0.156635	0.173708	0.159345	1	
	0.0014	0.0002	0	0.0002	-----	
DINFLATION	0.012975	-0.02169	-0.01949	-0.00917	-0.00981	1
	0.7597	0.6092	0.646	0.8288	0.8171	-----

The contemporaneous correlations indicate high degree of association of OIS rates with Gsec rates (both one and five year(s)). They also indicate moderate association of OIS rates with call rate. The correlations coefficient in the differenced form also broadly supported the direction of the association between the variables. However, unlike the correlations in the level variables, the correlation with the differenced inflation series was found to be low and not statistically significant. It may be mentioned that the *Dinflation* series has all zeros except one differenced number for each week.

Though the direct impact of the sub-prime crisis on Indian banks/ financial sector was muted mainly because of limited exposure to the troubled assets, prudential policies put in place by the Reserve Bank and relatively lower presence of foreign banks in the Indian banking sector; there was a sudden change in the external environment following the Lehman Brothers' failure in mid-September, 2008. The knock-on effects of the global crisis manifested in not only as reversals in capital inflows but also adverse market expectations causing sharp correction in asset prices (on the back of sell-off in

the equity market by the foreign institutional investors (FIIs)), and pressures on the exchange rate. The cumulative effect of Reserve Bank's operations in the foreign exchange market as well as transient local factors such as build up in government balances following quarterly advance tax payments, however, adversely impacted the domestic liquidity conditions. Consequently, during July-November 2008, the LAF was in the injection mode. However, as a result of the slew of measures initiated by the Reserve Bank the money market rates declined and remained below the upper bound of the LAF corridor since November 2008. The LAF also turned into net absorption mode since December 2008 and remained in significant surplus mode in 2009-10.

The contemporary literature (Jorion, 2007) emphasizes on the changes in the correlation coefficient for financial markets variables during the crisis. To analyze the possibility of such changes in the correlation coefficient for the Indian money markets, table 2(b) reports the correlation coefficients along with their p-values in the crisis period and its aftermath (July 2008 – November 2009). A comparison of the correlation coefficients between pre and post crisis periods indicated that the contemporaneous association between OIS

Table 2(B): Correlation Coefficient-July 08-Nov 09, Differenced Variable

	DOIS1	DOIS5	DGESC1	DGSEC5	DCALL	DINFLATION
DOIS1	1					Correlation
	-----					Probability
DOIS5	0.96359	1				
	0	-----				
DGESC1	0.901547	0.918199	1			
	0	0	-----			
DGSEC5	0.94689	0.962503	0.949425	1		
	0	0	0	-----		
DCALL	0.152932	0.17446	0.185793	0.175483	1	
	0.0065	0.0019	0.0009	0.0018	-----	
DINFLATION	0.012589	-0.02705	-0.02935	-0.01484	-0.01597	1
	0.8239	0.6324	0.6038	0.793	0.7777	-----

rate and Gsec rate generally remained unchanged. However, the sensitivity to changes in OIS rate and Gsec rates has increased in the second period (July 08–November 09) as compared with the entire period. There has also been marginal increase in association between OIS rate and call rate in the second period as compared with the entire period. The relationship between differenced inflation and the other differenced variables, however, continues to remain small and insignificant.

(c) Causality Analysis

The sections above concentrated on the contemporaneous association between the variables. In an attempt to analyze the causal relationship among these variables (taking into account the lead & lagged effects) and the direction of such causality, we undertook pair-wise Granger causality test. In general, the test considers the lagged values of the dependent variable[1] and the explanatory variable and evaluates the incremental explanatory power of the second set of variable on the first. The different pair of variables considered for the causality test along with their F-Statistics and P-values are reported in the Table 3.

The F-Statistics and their P-values for the entire period under consideration indicate that the yield on Government securities (both 1 year and 5 year) were the major factors driving the OIS rate movements. But the reverse (i.e. the bi-directional) causality was not found to be statistically significant. It may be mentioned that the number of participants are much larger in the Gsec market (as compared to the OIS market), as Gsec forms a part of the statutory requirement (SLR) in India. Moreover, the Gsec is a funding based instrument while OIS is more of a (notional principal) hedging instrument which is settled by netting the difference. Therefore, the rate discovery has taken place in the Gsec market and it has percolated to the OIS market and not vice-versa. The other factor, which caused the 5-year OIS for the entire period was the call spread (difference between Call rate and repo rate), an indicator of liquidity conditions.

Table 3: Pairwise Granger Causality Tests

Null Hypothesis:	F-Statistic	Prob.	F-Statistic	Prob.
	Aug 2007-Nov 2009		July 2008-Nov 2009	
DGSEC1 does not Granger Cause DOIS1	**9.98**	**0.00**	**4.45**	**0.00**
DOIS1 does not Granger Cause DGSEC1	0.55	0.65	0.42	0.83
DGSEC5 does not Granger Cause DOIS1	**22.96**	**0.00**	**7.93**	**0.00**
DOIS1 does not Granger Cause DGSEC5	2.12	0.10	0.45	0.82
DCALL does not Granger Cause DOIS1	0.27	0.85	0.15	0.98
DOIS1 does not Granger Cause DCALL	0.09	0.97	0.17	0.97
CALL_SPD does not Granger Cause DOIS1	1.33	0.26	1.58	0.17
DOIS1 does not Granger Cause CALL_SPD	0.52	0.67	0.62	0.69
INF does not Granger Cause DOIS1	**0.48**	**0.70**	**2.03**	**0.07**
DOIS1 does not Granger Cause INF	0.09	0.97	0.06	0.99
DGSEC1 does not Granger Cause DOIS5	3.64	0.01	**2.09**	**0.07**
DOIS5 does not Granger Cause DGSEC1	0.77	0.51	0.62	0.68
DGSEC5 does not Granger Cause DOIS5	**12.18**	**0.00**	**4.67**	**0.00**
DOIS5 does not Granger Cause DGSEC5	0.46	0.71	0.10	0.99
DCALL does not Granger Cause DOIS5	0.05	0.99	0.11	0.99
DOIS5 does not Granger Cause DCALL	0.03	0.99	0.08	0.99
CALL_SPD does not Granger Cause DOIS5	**2.49**	**0.06**	**2.65**	**0.02**
DOIS5 does not Granger Cause CALL_SPD	0.18	0.91	0.24	0.94
INF does not Granger Cause DOIS5	0.44	0.72	1.52	0.18
DOIS5 does not Granger Cause INF	0.13	0.94	0.09	0.99

For the bold figures, null Hypothesis Rejected at conventional significance level.

The granger causality was also used to evaluate the plausible changes in the causal relationship over period of global crisis and its aftermath. However, the causality result for July 2008 to November 2009, generally supported the predominance of Gsec rate. The liquidity conditions factored in the model through *call spread* has statistically significant causal relationship with long term OIS rate. The inflation[2] was the additional factor that had an impact (though at

lower confidence level) on the long term OIS rate during July 2008 to November 2009. It may be mentioned that there was a large swing in the inflation rate during the period under consideration, which could explain the observed causal relationship.

(d) Impulse Response Function

The above section indicated existence of causal relationship between changes in OIS rate to changes in Gsec rate, call rate, and inflation. In this section we investigate the direction and magnitude of such change on OIS' rate in the short run. In particular we attempt to analyze the impact of a shock / impulse in call rate and Gsec rates on the OIS rates.

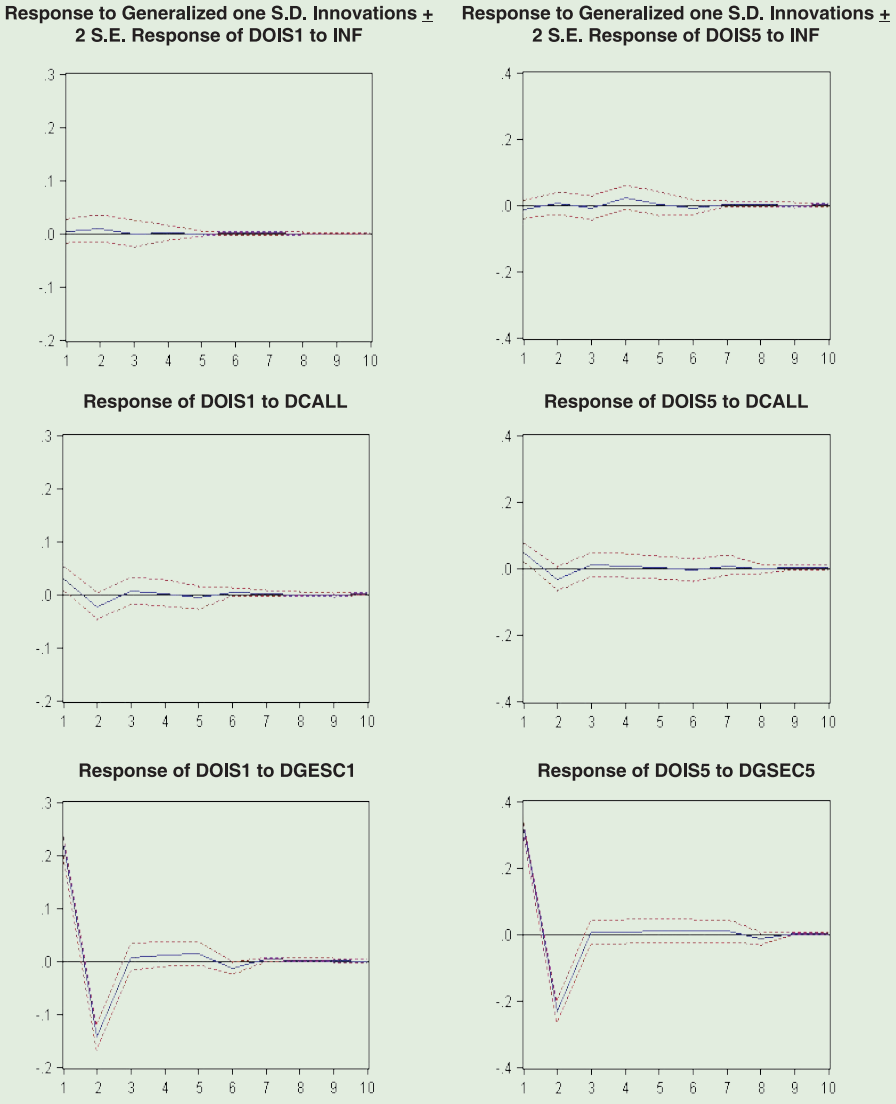
For analyzing the same a three equation Vector Auto Regression (VAR) model was estimated using differenced OIS rate, call rate, Gsec yields and their lagged (with three lags) values. Inflation was used in their levels to minimize information loss. One of the major criticisms of unrestricted VAR models is that they are susceptible to ordering of variables. We tried to address this shortcoming by using *Generalized Impulse Response* function. Generalized Impulses, as described by Pesaran and Shin (1998), construct an orthogonal set of innovations that does not depend on the VAR ordering. The generalized impulse responses from an innovation to the *j*-th variable are derived by applying a variable specific Cholesky factor computed with the *j*-th variable at the top of the Cholesky ordering (Eviews User Guide).

Using the estimated set of equations, generalized impulse responses of a change in the above-mentioned three variables were plotted in Chart -3. The impulse response charts indicated the following:

- The impulse to inflation has a miniscule impact on OIS. The impact of one standard deviation shock to call had more noticeable impact on the OIS rate in the first period. The maximum impact was observed in the case of one SD generalized shock to the one-year Government Securities rate. These shocks had similar impact for one-year and five-year OIS rates.

- The effect of a shock on these financial variables (on OIS rates) died down within a short while (within ten days). This observation indicates the resilience of the market, notwithstanding the fact that is a leveraged market (i.e. positions are taken on the basis of notional principal) and participation is comparatively less.

Chart 2: Short Run Movements in OIS, Call and Gsec and inflation Rates



(e) Long Run Cointegration Analysis

So far we have analysed the short run impacts of other financial market variables on the OIS rate. In this section we consider the possible long run co-movement of the rate variables. The OIS, Gsec, Call were found to be non-stationary. Therefore, the long run equilibrium relation among them is best established using cointegration approach. This involves testing for the *null hypothesis* that there are *no cointegrating vectors*. On the basis of sample data, if this *null is rejected*, then the cointegrating vector is estimated using a Vector Error Correction Model (VECM). Using the full sample period (August 2007 to November 2009) the estimated value for the test statistic leads to the rejection of the null hypothesis under different assumptions (both the trace and Max-eigenvalue test) and indicate existence of at least one cointegrating vector at 5 per cent level of significance.

After confirming the existence of contegrating vector, using the Johansen methodology (1991), the Vector error correction model was estimated. A dummy variable for the period July 2008 to November 2008 was introduced as an exogenous variable in the cointegrating VAR. The estimated long run cointegration vector is as follows (figures in the parenthesis report the t-statistic values).

OIS5= -9.06+ 2.94*Gsec5 - 0.99*Call; Error correction term = -0.002
(7.93) (5.96) (-0.63)

In the estimated cointegration equation, the Gsec yield has expected (positive) sign and is significant at 1 per cent level, indicating co-movement of five year OIS and Gsec rates. A negative relationship between call and OIS rate, on the other hand, may appear counterintuitive in nature. However, it could actually indicate the long term expectations of the market participants. The call rate today could be high (low) depending on the demand and supply conditions in the market; however the five-year OIS rate adjust accordingly taking into account the long term expectation of the money market rates.

The error correction term has the right (negative) sign. As expected, the magnitude of the same is low mainly because (as the study uses daily data) it represents daily adjustment to the disequilibrium. However, the coefficient is statistically insignificant at 10 per cent level. It makes the adjustment to the equilibrium path weak. The significance could improve with the increase in depth and liquidity in the Indian OIS markets. It might be mentioned that the major market makers in the OIS market in India are the handful of foreign banks and the volume of trade are slowly picking up.

Section V

Conclusions

There haven't been many published studies on the Overnight Index Swap (OIS) for an Emerging economy. This study is an attempt in this direction, which concentrated on India. In India, the overnight market started in July 1999 and gradually developed. Anecdotal evidences suggest that the volume in the OIS market has remained low as compared with the Gsec market and the private/foreign banks have remained the major players in this market.

Among the financial variables considered in this study, the Gsec rate had high and significant positive contemporaneous correlation with the OIS rate. The call rate was also found to have positive and significant correlation with OIS rate. However, the inflation rate was not found to be contemporaneously related with the OIS rate. The above correlation didn't considerably change during the global financial crisis or in its aftermath. This could be because of the fact that the global financial crisis had a muted impact on the Indian economy.

The causality analysis generally indicated unidirectional causality from Gsec to OIS rate. The other factor that significantly caused the OIS movement was the liquidity conditions in the Indian money market, measured by the difference between the call and repo rate. While the above factors remained crucial even during and in the aftermath of the global financial crisis, inflation became a factor causing one year OIS movement in the post-crisis period. It may be mentioned in this context that inflation changed considerably during

and after the crisis period. Call rate didn't significantly cause the OIS rates or vice-versa. This could be because of the fact that the causality analysis results are indicative of a short period adjustment (as the lag length of three days is selected through HQ information criteria).

Anecdotal evidences suggested shocks to financial variables affect OIS rate movement. To evaluate the impact of such impulses, the generalized impulse response functions were considered. In this framework, the one standard deviation shocks to inflation, differenced gsec rate and differenced call rate positively impacted the OIS rate in the 1st period. However, the impact of such shocks died down over a ten working day period indicating the resilience of the OIS market.

Moving to the long-run equilibrium relationship between OIS rate, call rate and the Gsec rate, the test for cointegration indicated the presence of at least one conitegrating vector. The coefficient of Gsec rate in the estimated cointegration was found to be positive and significant. However, the coefficient of call rate was found to be negative (and low). It could indicate that a high (low) call rate today was expected to coverage to the long term market expectation as indicated by the OIS rate. The error correction term, though negative, was not found to be statistically significant at the conventional levels. This could be because of low volume in the OIS market, which is likely to pick up with further money market activities and future financial product developments.

While this is just the beginning, the road ahead for some of the empirical research in this area includes (a) the issues relating to the predictive power of the OIS rate, (b) the behavior of the MIBOR-OIS spread for India during different phases and (c) the reasons for OIS rate being lower than the risk free GoI bond rate.

Table A1: Policy Measures and Rate Movement

	Table 2: Policy Measures and Rate Movement	**Call**	**Call**	**Call**	**OIS**	**OIS**	**OIS**
Dates	**Measures announced**	**t-1**	**t**	**t+1**	**t-1**	**t**	**t+1**
16-Sep-08	SLAF reintroduced on daily basis from September 17,2008	10.59	13.07	9.98	9.28	9.08	8.64
	Additional liquidity support under the LAF up to 1% of NDTL						
	Interest rates raised in FCNR(B) and NR(E)RA deposits						
10-Oct-08	CRR was reduced by 150 basis points to 7.50 per cent wef October 11,2008	10.54	19.7	9.92	7.38	7.8	7.05
14-Oct-08	Introduction of a special 14 day term repo facility	9.92	9.95	10.04	7.05	7.14	6.87
15-Oct-08	Reduction of CRR to 6.5 per cent with retrospective effect from October 11,2008	9.95	10.04	6.94	7.14	6.87	6.73
20-Oct-08	Repo rate was reduced by 100 bps to 8.0 per cent with immediate effect	6.95	6.78	6.09	6.81	6.65	6.48
1-Nov-08	Reduction in the LAF repo rate to 7.5 per cent from November 3,2008	18.59	-	6.99	6.51	-	6.39

Table A1: Policy Measures and Rate Movement

15-Nov-08	Reduction in the risk-weightage to certain sectors	7.15	-	6.98	5.87	-	5.83
28-Nov-08	Continuing the special refinance facility up to June 30,2009	6.44	6.61	6.21	5.42	4.83	5.53
6-Dec-08	Reduction in the LAF rates by 100 basis points	6.10		5.26	4.97		4.97
11-Dec-08	Refinance facility to NHB and Exim Bank	5.26	5.37	5.53	4.97	4.83	4.61
2-Jan-09	Cut in repo rate,reverse repo rate and CRR rate	5.25	5.08	4.63	4.34	4.14	4.18
4-Mar-09	Cut in repo and reverse repo rate	4.07	4.07	3.64	3.79	3.94	3.83
21-Apr-09	Cut in repo and reverse repo rate	3.48	3.46	3.25	3.93	3.74	3.82
5-May-09	Withdrawal of second LAF on a daily basis	3.23	3.18	2.99	3.89	3.82	3.75
29-Sept-09	Suspension of OMO	3.35	3.38	3.24	4.69	4.70	4.79
27-Oct-09	Withdrawal of Term repo, forex swap and Special refinance facilities	3.22	3.23	3.23	4.91	4.81	4.78

Table A2: Market Expectations on OIS Rate movements during the crisis period and its aftermath (collated from different prit media)

Date	Expectations	
September 8, 2008	1	Five-year OIS yield moved down more than one year OIS yield
	2	Market expected OIS yield to take direction from Gsec
September 15, 2008	1	OIS curve got inverted further on liquidity worries
	2	Market expected OIS yields to be under pressure on expected liquidity tightness.
September 22,2008	1	OIS curve come off sharply and flattened after RBI announced liquidity measures
	2	Market expected the five-year OIS to be higher on interest rate worries
October 6, 2008	1	OIS saw yields come off on positive interest rate sentiments
October 13, 2008	1	The one-over-five spread flattened by 82 bps to close at 13 bps levels.
	2	Market expected OIS yields to give back some gains.
October 20, 2008	1	OIS saw yields come off on positive interest rate sentiments.
	2	Market expected OIS yields see long unwinding after the next policy review.
October 27, 2008	1	OIS curve steepened on the back of interest rate uncertainties
	2	Market expected the curve to flatten on liquidity worries
November 3, 2008	1	OIS curve flattened owing to the spike in overnight rates.
November 10, 2008	1	OIS curve steepened on the back of easing liquidity

Table A2: Market Expectations on OIS Rate movements during the crisis period and its aftermath (collated from different prit media)

Date	Expectations	
November 17, 2008	1	Market expected the OIS yields to stay bullish given rate cut expectations.
November 24, 2008	1	OIS curve fell on expectations of a cut in the reverse repo rate
	2	Market expected the OIS yields to stay bullish given rate cut expectations.
December 1, 2008	1	OIS curve moved up on profit-taking at lower levels
December 8, 2008	1	OIS curve steepened on rate-cut expectations.
	2	Market expected the curve to factor in further rate cuts and to trend down.
December 15, 2008	1	OIS curve fell on rate-cut expectations
December 22, 2008	1	OIS curve fell on rate-cut expectations, and one-over-five spread remained unchanged
December 29,2008	1	OIS curve moved up on profit-taking
	2	Market expected the curve to take its cue from government bond movements.
January 12, 2009	1	OIS curve moved up on the back of rising government bond yields, and the one-over-five spread steepened
	2	Market expected the OIS curve to take direction from the movement of government bond yields.
January 19, 2009	1	OIS curve moved down on the back of falling government bond yields.
February 2, 2009	1	Overnight index swaps (OIS) saw the curve become steeper on the back of rising government bond yields.

Table A2: Market Expectations on OIS Rate movements during the crisis period and its aftermath (collated from different prit media)

Date	Expectations	
February 9, 2009	1	Overnight index swaps (OIS) saw the curve steepen.
	2	The OIS market is expected a reverse repo rate cut and betted that the higher borrowing by the government would keep yields pressured at the long end of the curve.
February 16, 2009	1	Overnight index swaps (OIS) saw the curve fall on the back of rate cut expectations.
	2	Market expected the OIS curve would flatten if there is positive news on the OMO window.
March 16, 2009	1	Overnight Index Swaps (OIS) saw the curve move higher on the back of government bond yields moving up.
	2	Market expected the OIS curve come off with a flattening bias on the back of RBI actions.
March 23, 2009	1	Overnight Index Swaps (OIS) saw the curve move down on the back of lower government bond yields.
	2	Market expected the OIS curve to take its cue from the government borrowing calendar.
March 30, 2009	1	Overnight index swaps (OIS) saw the curve steepen on the back of the rise in ten-year government bond yields.
April 5, 2009	1	Overnight index swaps (OIS) saw the curve fall on better bond market sentiments.
April 20, 2009	1	Overnight index swaps (OIS) saw the curve rise on hedging by the market.
	2	Market expected the OIS curve would take its cue from RBI policy actions.

Table A2: Market Expectations on OIS Rate movements during the crisis period and its aftermath (collated from different prit media)

Date	Expectations	
April 26, 2009	1	Overnight index swaps (OIS) saw the curve come off on the back of policy rate cuts.
	2	Market expected the OIS curve would take its cue from gilt yield movements.
May 4, 2009; May 11, 2009 & May 18, 2009	1	Overnight index swaps (OIS) saw the curve move up on the back of higher government bond yields.
	2	Market expected the OIS curve would take its cue from government bond yield movements.
May 24, 2009	1	Overnight index swaps (OIS) saw the curve steepen as the five-year OIS saw good paying interest at higher levels on the back of rise in global bond yields.
June 1, 2009	1	Market expected the five-year OIS yield to be volatile on the back of uncertain interest rate environment.
June 8, 2009	1	Overnight index swaps (OIS) saw the curve flatten as the five-year OIS saw yields move down marginally while one year OIS yields moved higher.
June 22, 2009 & June 28, 2009	1	Market expected the OIS curve to trend down on the back of stable government bond yields.
July 6, 2009	1	Overnight index swaps (OIS) saw the curve almost flat week-on-week.
July 13, 2009; July 20, 2009 & July 27, 2009	1	Overnight index swaps (OIS) saw the curve trend down week-on-week on the back of fall in global bond yields.
	2	Market expected the OIS curve to trend down in the coming weeks on the back of improved interest rate sentiments.

Table A2: Market Expectations on OIS Rate movements during the crisis period and its aftermath (collated from different prit media)

Date	Expectations	
August 3, 2009	1	Market expected the OIS curve to take its cue from government bond movements this week.
August 9, 2009	1	Market expected the OIS curve to flatten further as markets frets on liquidity.
Aug 17, 2009	1	Overnight index swaps (OIS) saw the curve almost unchanged week on week.
	2	Market expected the OIS curve take its cue from gilt yield movements.
Aug 31, 2009	1	OIS saw the curve move up week on week.
	2	Market expected the OIS curve to follow domestic bond yield movements rather than global bond yields.
September 7, 2009	1	Overnight index swaps (OIS) saw the curve flatten week-on-week.
	2	Market expected the OIS curve flatten further
Sept 20, 2009	1	Overnight index swaps (OIS) saw the curve move down week-on-week on the back of a rally in government bonds.
	2	Market expected the OIS curve to flatten further as market factors in higher rates at the short end of the curve.
Sept 27, 2009	1	Overnight index swaps (OIS) saw the curve move down week-on-week.

Notes:

[1] We selected the lag order on the basis of Hannan Quinn (HQ) information criteria, the optimal lag length was found to be 3 (days).

[2] Used in levels; it may be noted that the weekly WPI inflation numbers were repeated for the days of the week as the differenced inflation series actually incorporates the difference on Thursday / Friday leaving zero for all other days.

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International Outsourcing from India: A Study

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World trade in services is growing at a much faster rate than trade in goods. Outsourcing of intermediate goods and business services are the most rapidly growing components of international trade. This paper analyzes the business service/IT outsourcing from India. The paper proves that India is having revealed comparative advantage in exports based on ITES-BPO services. The rapid rise in world trade in services would give a good opportunity to India to raise its share of world trade. The Government of India has already taken some initiatives in this regard by giving fiscal concessions to service sector. IT infrastructure and general business environment are two areas where India clearly lags behind other competitor countries in outsourcing arena. Another important finding is that even though there is lot of media attention on outsourcing sector in India and other developing countries, the maximum surplus in services trade is actually generated by developed countries. Even though India maintains its lead status as a source country for a variety of IT related services, there are number of emerging challenges like anti-outsourcing legislation and protectionism in western countries, rise of competitor countries *etc*. In short India has already made an impact in the outsourcing area. However, to maintain its lead and capture new markets and areas, Indian service industries should remain vigilant.

JEL Classification : F13, F14.

Keywords : Outsourcing, Trade in Services

1. Introduction

Outsourcing of intermediate goods and business services is one of the most rapidly growing components of international trade. Companies are outsourcing an ever expanding set of activities, ranging from product design to assembly, from R&D to marketing, distribution

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and after sales service. It may be noted that, many of the modern day firms have become "virtual" manufacturers, owning designs and plans for many products but making almost nothing themselves. Vertical disintegration is clearly evident in international trade. Annual report of the World Trade Organization (WTO) (1998) details, for example, the production of a particular American car as follows:-

"Thirty percent of the car's value goes to Korea for assembly, 17.5 per cent to Japan for components and advanced technology, 7.5 per cent to Germany for design, 4 per cent to Taiwan and Singapore for minor parts, 2.5 per cent to the United Kingdom for advertising and marketing services, and 1.5 per cent to Ireland and Barbados for data processing. This means that only 37 per cent of the production value…is generated in the United States".

Outsourcing of services could be within a country, from one state to another (inshore outsourcing), and also between countries (offshore outsourcing). Literature on outsourcing has given maximum attention on the effect on employment in developed countries. The objective of this study is to show the different facets of India's Information Technology Enabled Services/Business Process Outsourcing (ITES/BPO). This study tries to capture comprehensive information on this topic by utilizing information/data from diverse source. The study also attempts a comparison between India's and China's ITES/BPO sector, the competitiveness of Indian ITES/BPO companies, the business environment existing in this regard in other competitor countries, emerging challenges *etc.*

This paper has been organized into 6 sections. Section 1 covers introduction and discusses the concepts related to outsourcing. Section 2 reviews the literature on outsourcing and spells out the methodology adopted in this study. Section 3 provides a cross country perspective of services exports and items closely related to outsourcing. It also discusses the major characteristics of India's outsourcing sector and its importance for economic development. Section 4 attempts a comparison of outsourcing sector in India and

its competitor countries. It also discusses Indian Government's policy towards IT sector. Section 5 presents the emerging challenges for India's outsourcing sector and Section 6 presents the conclusions emanating from the study.

There is no commonly accepted definition for outsourcing. Some of the interpretations of outsourcing as discussed in the literature are as follows.

The Oxford dictionary (1998) defines outsourcing as "obtain goods or a service by contract from an outside supplier. Outsourcing can dramatically lower total costs". According to McKinsey study (2003), effective outsourcing implies identifying and managing the "natural owner" of every activity in the value chain. Bhagwati, Panagariya and Srinivasan (2004), have explained outsourcing as a process in which the innovating firms introduce a product in the domestic market and once the product matures, the production of this product is shifted to countries where it is cheaper to produce, with the innovating country eventually becoming an importer of the product. It could also consist of arm's-length, or 'long –distance' purchase of services abroad, mainly *via* electronic mediums.

WTO under its General Agreement on Trade in Services (GATS), categorizes four different ways in which services can be traded. Mode 1, Mode 2, Mode 3 and Mode 4. In Mode 1, trade in services involves arm's- length supply of services, with the supplier and buyer remaining in their respective locations. Mode 1 purchases have come into prominence because of the advances in electronic information and communication technology. Both individuals and firms can provide Mode 1 services. In the former category, independent designers, architects and consultants who sell their services to customers abroad electronically are included whereas latter consists of large firms that manage call centers, back offices and software programmers. It is said that, trade in Mode 1 services is what most economists have meant when they discuss "outsourcing" (Bhagwati, Panigariya and Srinavasan 2004). Mode 2 involves movement of the consumer to the location of the supplier. Under Mode 3, services are

sold in the territory of a member by legal entities that have established a presence there but originate in the territory of another member. Mode 4 includes services requiring the temporary movement of natural persons.

In brief, outsourcing means employing cheap and efficient labour available in different countries to produce a product or supply a service. Literature on outsourcing of services uses different terminologies for outsourcing and there is no uniformity even though they broadly mean ITES and BPO. Data/information on outsourcing is scattered. For capturing maximum information on outsourcing, this study makes use of the information/data reported under the terms ITES, BPO, Business Process Service (BPS), Information technology exports, business service exports, other business services, computer services exports, software exports *etc*. A broad classification of outsourcing is set out in table 1.

Section II

Literature on Outsourcing related to India

Bhagwati, Panagariya and Srinivasan (2004) indicate that in the process of outsourcing the home country will lose low-wage jobs, but gain high wage jobs. On the balance outsourcing will lead to the

Table 1: Broad classification of Offshoring services

Call/contact centre services	Back-office services	IT services
Help desk	Claims processing	Software development
Technical support/advice	Accounts processing	Application testing
After-sales	Transaction processing	Content development
Employees enquires	Query management	Engineering and design
Claims enquires	Customer administration Processing	Product optimization
Customer support/advice	HR/payroll processing	
Market research	Data processing	
Answering services	IT outsourcing	
Prospecting	Logistics processing	
Information services	Quality assurance	
Customer relationship management	Supplier invoices	

Source: World Investment Report 2004, United Nations Conference on Trade and Development.

transition of the innovator country to a high-value job oriented country. The study also points out that, it is wrong to believe that most of the service jobs will be outsourced to India and China. This is because majority of the jobs in the US are in service industries, such as, retailing, restaurants, tourism, *etc*., that require both consumer and producer to be present at the same place, and, therefore, cannot be outsourced. In conclusion, this study points out that outsourcing is a relatively small phenomenon in the US labour market.

A study by Amiti and Wei (2004) brings out three interesting findings: (1) the notion that large industrialized countries outsource more intensely is not correct; (ii) outsourcing does not lead to decline in employment in industrialized countries; and, (iii) in terms of economic size, it is the smaller economies which outsource intensively. This study shows that increases in service outsourcing in US manufacturing and services goes together with greater labour productivity. Manufacturing firms outsource business services in a large way. This is due to firms sourcing their least efficient process of production from cheaper countries. Outsourcing may lead to shedding of labour but ultimately, the increased efficiency could lead to higher production and an expansion of employment in other lines of work. However, the authors point out that there could be a change in the skill mix of jobs. The authors cite a study by McKinsey (2003), which indicates more than 69 per cent of workers who lost jobs due to imports in the USA between 1979 and 1999 were re-employed. These results suggest that service outsourcing would not induce a fall in aggregate employment.

Taganas and Kaul (2006) explore the strategies of firms in the Indian IT industry and their innovative behavior. The study concludes that India's software industry has generally been weak to spur innovation within the industry. Most of the innovations are incremental rather than radical in nature. The pattern of innovation is market driven rather than based on fundamental technological research. Competition compels firms to cut costs and put emphasis on marketing

cooperation. The study point out that there is wide scope for IT firms to collaborate with the more technologically competent MNCs. It suggests that Indian IT firms should further increase their focus on R&D to sustain their growth.

The study by NASSCOM (2007) focuses on growth of IT software and services industry in China and India. It is based on a series of interactions with Chinese officials and interviews with IT software companies. The study indicates that Chinese IT-BPO has much to learn from India. Even though the Chinese IT sector is expected to continue growing at a rapid pace, it is unlikely to displace India in the near future. Strong Government support, excellent quality of infrastructure, rapid pace of growth of domestic economy, *etc.*, are the major strength of Chinese IT-BPO sector. Further the geographical proximity and cultural similarity to advanced markets like Japan and Korea is a great help to Chinese IT-BPO sector. The average wage in China is significantly lower than other competitor countries. However, lack of transparency in procedures and weak intellectual property protection are major weakness of China. The study puts forward a strong case for increased partnership between India and China to tap the growing IT-BPO market in the world.

There are some interesting studies on labour conditions and trade unions in ITES-BPO sector. Ramesh (2004) point out the vulnerabilities for laborers in India's BPO sector. The study is based on field survey of call centers. Firms often terminate the job to get rid of long-term commitments towards employees. Laborers, who work on voice processes, are forced to live as Indian during the day and Westerner after the sundown. Many a times, customers are irritatable and abusive. Further, odd working time conflicts with the natural rhythm of human body resulting in increased healthcare costs besides affecting personal and social life. Workers are not entitled for national / religious holidays, as the firms work with clients' calendar. The study also observed workers developing poor eating habits, smoking, excessive drinking of coffee, *etc.*, to cope up with the psychological and physical stress. The long-term opportunity costs of BPO work could be still

higher as most of the young workers are burning out their best time for higher education working as "cyber coolies". Further, Women's scope in the job is extremely constrained due to odd timings of work. Sandhu (2006) examines the difficulties of unionizing BPO sector. It point out that there have been attempts at unionizing the call centre industry since the year 2000. Information Technology Professionals' Forum (ITPF) is the result of this, and it gained recognition as an official organization from the Karnataka State Government as a society rather than a trade union. The study indicate BPO workers opposed unions because they associate it with the pre-1991 era of slow economic growth and limited opportunities. BPO workers associate their work with upward mobility, clean work clothes, shiny buildings, *etc*. In short, the study point out that even though BPO workers are overworked and stressed, they are not interested in unionization. Taylor *et al* (2008) examines the issue of working conditions and employee rights in ITES-BPO industry. The study suggests that there is a constituency for UNITES in Indian ITES-BPO. UNITES was formed in September 2005 on the foundations laid by the Centre for Business Processing Outsourcing Professionals (CBPOP) in 2004. UNITES has secured legal status under Trade Disputes Act (1926) and has been granted 'provisional affiliation' to Indian National Trades Union Congress (INTUC). The study collected information through questionnaires mainly from UNITES members. Majoriy of the respondents reported that UNITES is helping to improve work conditions. About 65 per cent of respondents indicated "working times" which include shift length, night-time work, *etc*., as crucial issues for them. In short, the study indicates that there are numerous work related concerns in Indian ITES-BPO industry.

It may be pointed out that, even though outsourcing has attracted much attention in the media, there is a dearth of comprehensive study on outsourcing from India. Most of the available studies focus on outsourcing and issues related to job loss. The study by Amiti and Wei (2004) is very relevant in the context of anti-outsourcing legislations in developed countries like the US. It points out that if we take into

account the size of the economy, developing countries like India not only export but also are a large importer of business services. This study is a coherent one and removes many misconceptions about outsourcing. Ahuja (2004) sets out the benefits from outsourcing, such as, cost reduction and suggests a tax on profits of beneficiary firm so as to fund the relocation of workers who lose their jobs due to outsourcing. The Study by Ramesh (2004) is unique as it focuses on labour issues and harsh conditions of work in BPOs located in India and point out the negative side of employment in BPOs. However, the recent reports indicate that there are positive sides of employment in BPOs. Many BPOs had started taking measures for the welfare of their workers like, leisure trips, physical and mental exercises for destressing, social interaction programmes, financial incentives, *etc*. Tata Indicom is planning to employ visually challenged individuals in its call centres which may boost the morale and employment opportunity of differently able people. In conclusion, it may be said that most of the literature points out that offshoring of IT and IT-enabled services will increase in the coming years without significantly reducing the employment levels in the countries that offshore jobs. Nor will it dramatically change the overall employment situation in the countries providing the offshored services. In this context, World Trade Report (2005), indicates that the impact of offshoring services jobs is far stronger in the popular perception than on actual production, employment and trade patterns. The number of jobs affected by offshoring IT services is small when compared to the overall employment levels in the developed countries. It is also small in the countries which have started exporting IT services when compared to their total employment. However, many of the studies mention about initial loss of employment or change in skill mix due to outsourcing in the service importing country.

2.1 Methodology

Under Balance of Payments format, services come under invisibles. Services can be further subdivided into Travel, Transportation, Insurance, Government Not Included Elsewhere and

Miscellaneous services (including IT/BPO exports). Outsourcing of ITES and Business Process has become prominent in recent years and therefore there is no uniform comparable data for outsourcing to and from different countries in the global context. But a broad comparison can be attempted using the IMF data. In its BoP statistics, the IMF reports services, which includes the categories most closely related to outsourcing- 'computing and information services' and 'other business services'. According to IMF (2006), computer and information services comprise transactions between resident and nonresident related to hardware consultancy, software implementation, information services (data processing) *etc,*; the item 'other business services' covers transactions between residents and nonresidents relating to professional and technical services, miscellaneous business services, merchanting and other trade-related services.

Since a single source of data does not give a comprehensive picture, this study mainly uses three sets of data, *viz*., data compiled by Reserve Bank of India, under Balance of Payments Statistics, NASSCOM, and IMF.

The objectives and the scope of this study are as follows: Firstly, an analysis using the IMF data is attempted to find out countries that dominate in service exports. Secondly, it computes Revealed Comparative Advantage (RCA) index for different countries to examine countries that have a comparative advantage in business services (proxied as BPOs) and computer software related exports. It also examines whether India has comparative advantage in merchandise goods exports or services exports. Thirdly, it uses firm level data from NASSCOM to study the specific characteristics of India's ITES-BPO sector. Fourthly, it examines ITES-BPOs in India and China so as to find out their relative strengths and weaknesses. Fifthly, it explores the weakness and emerging problems in India's ITES-BPO exports. Finally, it also tries to find out whether the global economic slowdown has had any impact on Software and business service export. Though this study have used the descriptive statistics for most of the stated objectives, it has used the Balassa

Index (1965) to measure the 'Revealed Comparative Advantage' (RCA). This is stated in equation 1.

$$RCA=(X_{ij}/X_{it})/(X_{nj}/X_{nt})=(X_{ij}/X_{nj})/(X_{it}/X_{nt}) \quad \ldots.1$$

Where X represents exports, *i* is a country, *j* is a commodity (or industry), *t* is a set of commodities (or industries) and *n* is a set of countries. RCA measures a country's exports of a commodity (or industry) relative to its total exports and to the corresponding exports of a set of countries. A comparative advantage is 'revealed', if RCA > 1. If RCA is less than unity, the country is said to have a comparative disadvantage in exports of the commodity/industry (Utkulu and Seymen, 2004).

Section III

Service Sector Exports: A Cross-Country Perspective

Since IT/BPO exports are included under service exports, this study present the broad trend in international trade in services. Over the last decade, international trade in services has been growing at a higher rate than trade in goods. The world economy has fast turned into a 'service economy' since the 1990s. Around 70 per cent of global GDP comprises of services. The growth of services sector has overtaken the growth in real GDP in a number of countries. While developed countries still account for a major share of services in world GDP and trade, developing countries are catching up in terms of increasing their share in global trade in services. In India, traditionally services relating to trade in goods, such as transportation and financing were the major constituents, the rapid developments in telecommunications and information technology has facilitated the emergence of business and computer services as the main drivers of the export growth (RBI, 2010). This is evident from the rapid rise in India's share of service exports in world which has shown steady growth from 0.6 per cent in 1994 to 2.7 per cent in 2008 (Ranked 12th in world, China stood 8th with a share of 3.8 per cent in 2008) (Table 2).

The share of India's service exports in its total exports of goods and services has also shown a rapid rise from around 26.4 per cent in 2000-01 to 35.0 per cent in 2008-09 (Table 3).

Table 2: Top Service Exporting Countries (Share in World)

(in per cent

	1995	2000	2002	2003	2004	2005	2006	2007	2008	Rank
United States	17.7	19.5	17.6	15.9	15.3	15.1	15.0	14.5	14.1	1
United Kingdom	6.5	7.9	8.3	8.4	8.7	8.1	8.2	8.2	7.4	2
Germany	6.5	5.5	6.3	6.5	6.4	6.4	6.6	6.5	6.4	3
Europe	4.9	4.8	4.8	5.1	5.3	5.6	5.7	6.0	6.7	4
France	6.8	5.3	5.3	5.2	5.0	4.8	4.5	4.3	4.3	5
Japan	5.3	4.6	4.0	4.1	4.3	4.3	4.1	3.7	3.9	6
Spain	3.3	3.5	3.7	3.9	3.8	3.7	3.7	3.7	3.7	7
China,P.R.	1.6	2.0	2.4	2.5	2.7	2.9	3.2	3.5	3.8	8
Italy	5.0	3.7	3.7	3.8	3.7	3.5	3.4	3.2	3.2	9
Netherlands	3.7	3.2	3.4	3.3	3.2	3.1	2.9	2.8	2.7	10
Ireland	0.4	1.2	1.8	2.2	2.3	2.4	2.4	2.7	2.6	11
India	0.6	1.1	1.2	1.3	1.7	2.1	2.4	2.5	2.7	12
China,:HKong	–	2.7	2.7	2.5	2.4	2.5	2.5	2.5	2.4	13
Singapore	2.1	1.9	1.8	1.9	2.1	2.1	2.2	2.3	2.2	14
Belgium	–	–	2.3	2.4	2.3	2.2	2.1	2.2	2.2	15

Source: Balance of Payments Statistics (February 2010), IMF.

Amongst the different services sectors, trade in software services has witnessed rapid expansion in recent years. This is largely due to the increased demand from developed countries like US and EU,

Table 3: India's Exports of Services

(in US $ million)

	1995-96	2000-01	2004-05	2005-06	2006-07	2007-08	2008-09
Goods and Services	39,654	61,720	128,455	162,811	202,668	256,504	290,679
Services Export	7,344	16,268	43,249	57,659	73,780	90,342	101,678
Services export as per cent of goods and service export	18.5	26.4	33.7	35.4	36.4	35.2	35.0
Computer and Information services	....	4,727	16,344	21,875	29,088	37,491	49,379
Computer and Information services as per cent of Services export		29.1	37.8	37.9	39.4	41.5	48.6
Computer services	....	4,633	16,204	21,711	28,787	37,032	48,626
Computer services export as per cent of Services export		28.5	37.5	37.7	39.0	41.0	47.8
Other business services	2,120	4,149	8,153	12,764	17,536	20,734	20,426
Other business services export as per cent of Services export	28.9	25.5	18.9	22.1	23.8	23.0	20.1

Source: Monthly Bulletin, various issues, Reserve Bank of India (for goods and services exports) and Balance of Payments Statistics (February 2010) IMF.

which are outsourcing their non-core activities to take advantage of the low-cost high-skilled professionals from the developing countries like India. India exhibits a strong revealed comparative advantage (RCA) in services. India's comparative advantage in this area has made India a favorable destination for outsourcing and also exports oriented FDI projects in IT and related area (Table 4).

A Report (2005) by United Nations Conference on Trade and Development (UNCTAD) points out that many of the poorest countries continue to have very low Information and Communication Technology (ICT) penetration rates, in particular those with a large rural population and relatively high-priced basic ICT infrastructure. Only 3.1 per cent

Table 4: Export oriented FDI projects in call centres, shared service centres, IT services and regional headquarters, by destination, 2002-2003

(Number and per cent)

	Call centres		Shared service centres		IT services		Regional HQs	
	No of projects	Share of total (%)	No of projects	Share of total (%)	No of projects	Share of total (%)	No of projects	Share of total (%)
World	513	100	139	100	632	100	565	100
Developed countries	279	54	48	35	293	46	339	60
EU	169	33	38	27	198	31	185	33
Developing economies	203	40	72	52	315	50	209	37
Asia	167	33	66	47	283	45	195	35
China	30	6	4	3	60	9	38	7
Hong Kong, China	2	–	–	–	14	2	37	7
India	**60**	**12**	**43**	**31**	**118**	**19**	**7**	**1**
Korea, Rep.	5	1			5	1	6	1
Malaysia	16	3	6	4	8	1	17	3
Phillipines	12	2	1	1	9	1	4	1
Singapore	16	3	8	6	35	6	36	6
Taiwan	4	1	–	–	9	1	4	1
Hungary	11	2	7	5	4	1	4	1
Ireland	29	6	19	14	14	2	15	3
UK	43	8	7	5	73	12	64	11
United States	15	3	2	1	26	4	80	14
Canada	56	11	3	2	14	2	25	4
Germany	20	4	1	1	34	5	22	4

Source: World Investment Report 2004, United Nations Conference on Trade and Development.

of Africans had access to the Internet in 2004, compared with 62.6 per cent North Americans. In EU 15 country average is 50 per cent. This indicates a vast stock of potential outsourcing opportunities for countries like India once the ICT picks up in these regions.

3.1 Exports of Computer and Information Services

IMF data shows that during 2008, India ranks first before industrialised countries like Ireland, UK, US and Germany in exports of computer and information services (Table 5). India's surplus position in trade in computer and information services is rapidly rising (Chart 1). India is attractive because of its low cost of operations, high quality of products and services and availability of skilled manpower.

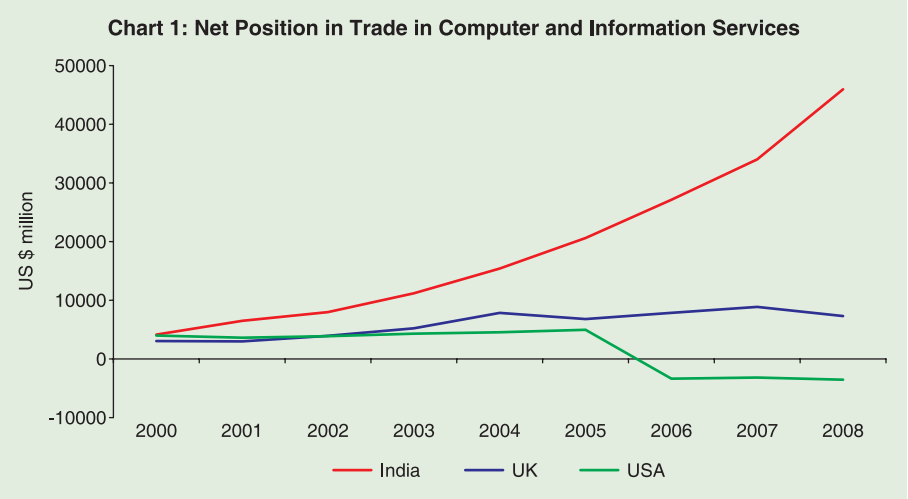
Further, India's share of export of computer and information services in the total service exports is high compared to other countries (Table 6). This indicates the importance of this emerging sector within the growing services sector. Regarding import of computer and

Table 5: Exports of Computer and Information services

(US $ million

	1995	2000	2002	2003	2004	2005	2006	2007	2008	Rank
India	....	4,727	8,889	11,876	16,344	21,875	29,088	37,491	49,379	1
Ireland	....	7,490	10,447	14,238	18,774	19,586	21,040	29,825	34,162	2
U.K	1,250	4,320	5,930	8,160	11,260	10,820	12,560	14,210	13,580	3
Germany	1,400	3,800	5,530	6,700	8,090	8,390	9,910	12,600	15,130	4
U.S.A	2,420	5,620	5,390	6,250	6,700	7,320	10,080	11,640	12,600	5
Sweden	....	1,191	1,472	1,993	2,537	2,688	3,585	6,526	7,647	6
Netherlands	620	1,166	1,422	2,884	3,702	3,723	4,969	6,419	6,684	7
Israel	....	4,246	4,180	3,409	4,407	4,529	5,289	5,809	6,852	8
Spain	1,033	2,043	2,490	2,913	2,964	3,606	3,960	5,358	6,119	9
Canada	1,011	2,428	2,266	2,796	3,014	3,600	4,296	4,597	4,642	10
China,P.R.	....	356	638	1,102	1,637	1,840	2,958	4,345	6,252	11
Belgium	....	....	1,774	2,132	2,441	2,581	2,869	2,982	3,616	12
France	360	800	1,190	1,260	1,490	1,710	1,970	1,900	1,530	13
Finland	743	203	503	566	755	1,511	1,475	1,846	8,250	14
Austria	82	296	420	657	899	1,234	1,503	1,833	2,155	15

Source : Balance of Payments Statistics (February 2010), IMF.



information services in the world, the top five importers during 2008 were US, Germany, UK, Netherlands and Japan. India occupied 6th position with import valued at US $ 3.4 billion and China stood at 8th position with import of US $ 3.2 billion.

3.2 Exports and Imports of 'other Business Services'

In dollar terms, the top exporters of business services in 2008 are the USA (US $ 87 billion), the UK (US $ 83 billion) and Germany

Table 6: Share of Computer and Information Services Export in their Total Services Export

	1995	2000	2002	2003	2004	2005	2006	2007	2008
India	-	28.3	45.6	49.7	42.7	41.6	41.7	43.1	48.0
Ireland	-	40.4	34.9	33.9	35.6	32.7	30.4	32.0	33.6
Israel	-	27.6	34.3	25.0	27.5	26.0	27.6	27.5	28.4
U.K	1.6	3.6	4.4	5.1	5.7	5.2	5.3	5.0	4.7
U.S.A	1.1	1.9	1.9	2.1	1.9	1.9	2.3	2.3	2.3
Germany	1.7	4.6	5.4	5.4	5.5	5.1	5.2	5.6	6.1
Netherlands	1.3	2.4	2.5	4.6	5.0	4.6	5.9	6.6	6.3
Spain	2.6	3.9	4.1	3.9	3.4	3.8	3.7	4.2	4.3
China,P.R.	-	1.2	1.6	2.4	2.6	2.5	3.2	3.6	4.2
Belgium	-	-	4.7	4.8	4.6	4.6	4.8	4.0	4.2
France	0.4	1.0	1.4	1.3	1.3	1.4	1.5	1.3	0.9

Source: Balance of Payments Statistics (February 2010), IMF.

(US $ 80 billion). India, a country that has received the maximum attention as a recipient of outsourcing, is ranked 15th (US $ 20 billion) and China ranked 5th, receive contract worth US $ 46 billion (Table 7). It is interesting to note that eventhough India is highlighted in the media as one of the biggest exporters of business services in the world, there are many industrialized countries ahead of it.

Amiti and Wei (2004) shows that, the media reports indicating US and other developed countries alone outsource (or contract out services) to developing countries like India and China to take advantage of lower cost in these countries is not entirely correct. This is clear from an analysis of IMF data on import of other business services. Comparable data shows that top three importers of business services in 2008 are Germany, US and France. India and China- two countries that are major topic of discussion as major recipients of

Table 7: Exports of Other Business Services

(US $ million)

	1995	2000	2001	2003	2004	2005	2006	2007	2008	Rank
U.S.A	29,080	48,220	52,310	60,160	66,020	71,730	65,140	77,640	87,040	1
U.K	17,200	33,880	35,770	47,300	57,010	60,450	68,880	81,160	83,370	2
Germany	20,010	24,200	25,880	33,240	43,180	50,680	62,380	72,250	80,400	3
China,P.R.	3,740	7,663	8,448	17,427	19,952	23,283	28,973	40,408	46,349	4
Japan	24,440	17,710	16,240	18,040	21,910	27,280	30,680	32,920	41,130	5
Italy	13,154	13,789	17,024	21,000	24,345	28,216	30,769	35,204	38,853	6
France	23,710	19,300	20,010	24,130	24,930	29,410	29,570	31,630	38,560	7
Netherlands	12,161	15,527	16,599	23,599	26,705	29,924	29,642	33,246	36,107	8
Spain	4,289	8,018	9,385	13,407	16,081	17,886	21,884	27,456	32,862	9
Ireland	1,389	1,908	4,386	7,862	10,498	16,232	18,724	28,279	31,355	10
Singapore	6,689	8,318	8,343	14,378	18,371	21,219	24,732	30,676	30,242	11
Belgium	....	....	....	14,714	16,501	17,577	17,462	23,342	29,457	12
Switzerland	4,376	5,224	5,266	7,744	12,382	15,681	17,659	21,271	29,190	13
Sweden	2,566	6,482	6,912	11,148	14,020	15,583	18,120	22,942	27,070	14
India	2,120	4,149	2,349	2,229	8,153	12,764	17,536	20,734	20,426	15
Canada	5,853	10,402	9,451	12,011	13,354	15,183	15,774	17,164	17,945	16
Austria	11,836	5,384	6,341	8,254	9,618	11,423	12,635	14,362	16,652	17
Brazil	1,249	4,568	4,613	4,133	4,938	6,722	8,568	11,064	14,331	18
Norway	1,682	4,014	3,458	4,470	5,708	6,670	9,123	12,517	13,551	19
Korea, Republic of	6,761	7,200	6,388	6,687	8,125	9,422	10,532	14,421	13,157	20

Source: Balance of Payments Statistics (February 2010), IMF.

outsourcing are themselves significant outsourcers of business services (with a value of US $ 21 billion for India and US $ 38 billion for China, and ranked 13th and 7th in the world respectively. This clearly points out that the biggest importers in business services are leading developed countries like US and UK followed by emerging countries like India and China. Amiti and Wei 2004, pointed out that there is nothing unusual in larger economies like USA, UK *etc,* trading more than smaller ones. To get an idea of relative importance of outsourcing for an economy, it is important to know the share of imports in the economy, *i.e* imports as per cent of GDP. If one scales imports of business services by domestic GDP, smaller African economies like Angola, Congo *etc*. are much more outsourcing-intensive than developed countries like US and UK. In conclusion, we can say that even though industrialized countries outsource (contract work to other countries) more than developing countries in absolute terms, in terms of size of economy (GDP), it is poor countries which import more than developed countries. The belief that global service trade is dominated by lopsided one-way outsourcing from developed countries to developing countries is not supported by the available data. It is particularly important to note that developed countries like US and UK who are big exporters and importers of services are also gaining from trade in services. Short term job losses in these countries if any, due to outsourcing are well compensated by cost reduction and productivity gain made by these countries. The net result of outsourcing is that, both developing countries and developed countries are ultimately gaining. For example, while industrial countries gain in terms of productivity, cost reduction *etc*., developing countries gain in terms of employment, foreign exchange earning *etc*.

3.3 Revealed Comparative and Competitive Advantage in India's Service Exports: An International Comparison

Tables 8 and 9 presented below gives the RCA indices calculated using IMF BoP statistics. A broad comparison clearly points out that India have advantage in exporting services which includes outsourcing

Table 8: RCA-Export of Goods of Select Countries

	1995	2000	2002	2003	2004	2005	2006	2007	2008
Mexico	1.1	1.1	1.2	1.2	1.2	1.2	1.2	1.2	1.2
China,P.R.: Mainland	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Germany	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Netherlands	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Japan	1.1	1.1	1.1	1.1	1.1	1.0	1.0	1.0	1.0
Philippines	0.8	1.1	1.1	1.1	1.1	1.1	1.1	1.0	1.0
Singapore	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
France	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
United States	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
India	1.0	0.9	0.9	0.9	0.8	0.8	0.8	0.8	0.8
United Kingdom	0.9	0.9	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Ireland	1.1	1.0	0.9	0.8	0.8	0.8	0.7	0.7	0.7

Source: Author's calculation based on IMF February (2010) data.

of services when compared with export of goods. Further, the indices point out that in case of India, the revealed comparative advantage in goods export is gradually coming down while that of services export is going up.

Data for calculating RCA at a more disaggregated level is available only for few countries. Computation of RCA indices for select countries shows that India and Ireland have clear revealed

Table 9: RCA-Export of Services of Select Countries

	1995	2000	2002	2003	2004	2005	2006	2007	2008
Ireland	0.5	1.0	1.3	1.6	1.7	1.9	2.1	2.2	2.4
United Kingdom	1.3	1.5	1.6	1.7	1.8	1.8	1.8	2.0	2.0
India	0.9	1.4	1.4	1.4	1.6	1.7	1.9	1.8	1.8
United States	1.4	1.4	1.4	1.5	1.5	1.5	1.5	1.5	1.5
France	1.2	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Singapore	0.8	0.8	0.9	0.9	0.9	0.9	1.0	1.1	1.0
All Countries	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Philippines	1.8	0.4	0.4	0.4	0.5	0.5	0.6	0.8	0.9
Japan	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.9
Netherlands	1.0	1.0	1.0	1.0	0.9	1.0	0.9	0.9	0.8
Germany	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
China,P.R.	0.7	0.6	0.5	0.5	0.5	0.5	0.4	0.5	0.5
Mexico	0.6	0.4	0.4	0.4	0.3	0.4	0.3	0.3	0.3

Source: Author's calculation based on IMF February (2010) data.

Table 10: RCA-Export of Computer and Information Services of Select Countries

	2000	2005	2006	2007	2008
India	9.4	9.9	9.2	9.0	9.2
Ireland	13.4	7.8	6.7	6.7	6.4
Netherlands	0.8	1.1	1.3	1.4	1.2
Germany	1.5	1.2	1.1	1.2	1.2
United Kingdom	1.2	1.2	1.2	1.0	0.9
China,P.R	0.4	0.6	0.7	0.7	0.8
Philippines	0.7	0.5	0.3	0.7	0.8
United States	0.6	0.5	0.5	0.5	0.4
Singapore	0.3	0.2	0.4	0.4	0.4
France	0.3	0.3	0.3	0.3	0.2
Japan	0.8	0.2	0.2	0.2	0.1

Source: Author's calculation based on IMF February (2010) data.

advantage in export of computer and information services over developed country like USA (Table 10).

3.3.1 Sources of Comparative Advantage of Indian Outsourcing sector

Low salary, vast talent pool, suitable geographical time zone and proficiency in English language are the major source of comparative advantage of Indian outsourcing sector. ITES/BPO firms rely upon a business model that arbitrages between high employee salaries abroad with low cost personnel in India. Even though salary is rising, the Indian outsourcing sector continues to enjoy comparative advantages because many of the ITES/BPO firms are expanding their operations to second-tier cities where cheap labour and space are still available. The Indian diaspora also played a major role in making India a preferred destination for outsourcing. In US, the Indian population (approx 1.9 million) is the third largest Asian group after China (2.7 million) and Filipinos (2.4 million). Over 25 per cent of all scientists and engineers in Silicon valley high-technology companies are from India. Many of them have contributed to the growth and success of service industry in India (Varma and Rogers, 2004). It is expected that they will continue to help India retain its edge and move up value chain in outsourcing. Further, favorable time zone difference with North America and

Europe is an advantage to India as the foreign companies can outsource their work from India in night and thus can function without any interruption to their operations and customer service (almost like working for 24 hours a day).

3.4 ITES/BPO firms and Inclusive Growth

Inclusive growth remains a major goal for the Indian Government and industry. High GDP growth has to be accompanied by more balanced development, with the benefits of progress being shared by citizens at the grass root levels. The Indian IT-BPO sector can be instrumental in bringing about financial, cultural, gender and digital inclusion (Table 11). By setting up BPO centres in a Tier-III location (outside city limits), a company would not only be providing

Table 11: IT-BPO sector and India's Inclusive Growth

Key Area	Role for IT-BPO sector
Healthcare	50 per cent of Indians do not have access to primary healthcare-Information technology can provide it at half the cost
	Effectively increase outreach to rural populations
	Enable remote access to doctors through electronic diagnostic devices and real time video conferencing
	Building and operating next-generation processes
Financial services	A large chunk of Indian households are unbanked. Technology can enable access for 200 million families
	Overcome challenges to provide financial services in rural areas
	mobile banking and remittance; Internet kiosks for distribution of select financial products; Low cost ATM
Education and skill development	India faces a three-fold shortage in teachers-technology can address this through remote solutions
	ICT solutions can overcome challenges of teaching(*e.g.*, virtual classrooms, recorded lectures by senior faculties, modular multimedia content)
Public services	India suffers from a leakage of 40-50 per cent in public food distribution-Information technology can ensure transparency
	e-Governance enhancing basic citizen services
	UIDAI to create identity for each citizen in the country
Connectivity and Access	Community service centres, with broadband connectivity, to provide all government to citizen services-also create opportunities for livelihood

Source: NASSCOM, Strategic Review, 2010.

employment for the persons involved in the process work, but also for individuals employed in administration, back office duties and other clerical work.

In conclusion, the excitement regarding India's software exports is not just about foreign exchange earnings or employment-generation. Rather, it can be an instrument for multifold impact on the economy.

3.5 Major characteristics of Indian ITES and Outsourcing Sector

This section analyse the Indian ITES and BPO sector using two sets of complementary data. The data from balance of payments statistics compiled by Reserve Bank of India and the industry level data provided by NASSCOM. BPO and IT enabled services form part of the item invisibles under current account of India's BoP. The RBI data shows that share of software services and non-software miscellaneous services exports (which includes outsourcing) in total services exports is increasing (Table 12 & 13).

Table 12: Break up of India's Services Exports (Share in per cent)

	Travel	Transportation	Insurance	G.N.I.E	Software services	Non-software miscellaneous services	Total services in US $ million
1990-91	32.0	21.6	2.4	0.3	–	43.6	4,551
1995-96	36.9	27.4	2.4	0.2	–	33.1	7,342
2000-01	21.5	12.6	1.7	4.0	39.0	21.3	16,268
2001-02	18.3	12.6	1.7	3.0	44.1	20.3	17,140
2002-03	16.0	12.2	1.8	1.4	46.2	22.4	20,763
2003-04	18.7	11.9	1.6	0.9	47.6	19.2	26,868
2004-05	15.4	10.8	2.0	0.9	40.9	29.9	43,249
2005-06	13.6	11.0	1.8	0.5	40.9	32.1	57,659
2006-07	12.4	10.8	1.6	0.3	42.4	32.4	73,780
2007-08	12.6	11.1	1.8	0.4	44.6	29.6	90,342
2008-09	10.7	11.1	1.4	0.4	45.5	30.9	1,01,678

Source: Monthly Bulletin, various issues, Reserve Bank of India.

Table 13: Export and Import under Miscellaneous Services

(US $ million)

	Exports		Imports	
	2007-08	**2008-09**	**2007-08**	**2008-09**
Miscellaneous services	67,010	77,691	29,298	27,879
Of which:				
Communication	2,408	2,172	860	1087
Construction	764	867	707	896
Financial	3,217	3,948	3,133	2,958
Software	40,300	46,300	3,358	2,814
New agency	503	800	506	385
Royalties, copyrights etc	157	133	1,037	1,722
Business services	16,772	16,445	16,553	15,435

Source: Monthly Bulletin (2010), Reserve Bank of India.

3.5.1 Market Scenario and Delivery Model

Nasscom,2010 projects that IT services is expected to grow by 2.4 per cent in 2010 and 4.2 per cent in 2011 as companies coming out of recession use information technology to create competitive advantage. Further, government IT spending continues to rise across the world, focusing on infrastructure and security. Apart from these services, some other important upcoming segments in the outsourcing industry include payments services, administration and content development. Several services in developed countries, which are previously not globally sourced, are expected to do so in the immediate future. For example, due to the increased spending requirement on health care and pensions (driven by ageing population), the public sector and health care providers will increasingly depend on technology and service providers for solutions to reduce the cost to serve. Further, energy companies and utilities will look for solutions to monitor and optimize their carbon footprint in line with emission requirements (Nasscom, 2010). Country wise, US and UK are primary geographic segments for the Indian IT-BPO sector. Relatively better economic growth in Asian countries compared with Europe means Asia turning into an important market for services. One important fact to note is that, historically US has

displayed increased IT spending post recession, and this time it is not different. This is because US companies are following the strategy of cutting costs and increasing competitiveness through outsourcing to face recession (Nasscom, 2010). Indian vendors are now actively developing the Asia Pacific region as a potential market. Japan and Middle East also offer significant untapped potential. Indian companies have increased their efforts to train their employees in various foreign languages and business culture, especially German and French. ITES/BPO companies are also following the strategy of recruiting local executives abroad for selling and marketing and other client-facing functions. Joint ventures and tie ups with local firms are also attempted. Besides the export market, strong growth of Indian economy may expand the domestic IT-BPO services market. Nasscom, 2010 indicate that domestic BPO segment is expected to grow at a compound annual growth rate of 21 per cent in 2011.

Regarding delivery model, there is a trend towards growing share of offshore development, compared with on-site services. Onsite services are performed at client location/country by sending professionals abroad while offshore services are performed at software development centers located in India. Billing rates for offshore software development are lower than onsite billing rates. The Services performed onsite generate higher revenues per-capita, but a lower gross margins in percentage as compared to the services performed at own development centres (Infosys 2009-10).

Section IV

Competitor Countries: A Comparative Study with China in Focus

Any study involving a comparison between India and China is very relevant as China is generally considered as a major competitor of India. The BPS and ITS sectors in China are predominantly serving the domestic market. China's domestic markets for BPS and ITS are rapidly growing due to increasing demand from Chinese and foreign-owned multinationals that operate in China.

Structure and scale: According to a Nasscom whitepaper (2007), China's IT/BPO growth is being driven by its domestic market while

India is having predominantly an export led growth. The domestic market accounts for over 85 per cent in China.

Export destination: Indian IT –BPO exports are predominantly serving the US and the UK markets, which together account for more than 80 per cent of the total exports. On the other hand, China's key export markets are Japan and Korea, where it has certain inherent linguistic / cultural advantages.

Service Portfolio: The portfolio of IT-BPO services exports from China is dominated by application development, coding/testing and localization services. The portfolio of services sourced from India is more broad based including, application management, infrastructure services, offshore product development and engineering services.

In short, the IT-BPO sectors in India and China are at different stages of evolution and are following different trajectories of growth. Many Indian BPS and ITS companies had approached China as an opportunity rather than a competitive threat. Leading Indian companies had established branch offices in China to take advantage of cultural similarities to serve clients in neighboring Japan and Korea. The rapidly growing domestic market in China also provides good opportunity. Further, China's reforms in the banking sector will put pressure on domestic banks to increase productivity and computerization and this is expected to increase the market for BPS and ITS.

In this context it may be indicated that a report by 'Deloitte' (2003) found that among offshoring supply countries, India is still the distant leader (Table 14). The key factors considered while selecting an offshoring location are cost (38 per cent), proficiency in language (22 per cent), industry expertise (18 per cent), technology infrastructure (9 per cent), time zone (5 per cent), political risk (4 per cent) and climate (1 per cent).

However, studies have shown that inadequate quality of infrastructure is one of the major disadvantages of Indian IT export

Table 14: Leading Countries in Offshoring Related Exports

Ist Tier	2nd Tier (Challengers with moderate offshoring capabilities)	3rd Tier (Up-comers-with only limited experience)
India	Canada China Czech Republic Hungary Ireland Israel Mexico Philippines Poland Russia Spain South Africa	Belarus Brazil Caribbean Egypt Lativia Mauritius Singapore New Zealand Ukraine Venezuela

Source: Deloitte (2003)

sector when compared to ITES exporting countries, such as, China, Canada, Ireland, Israel, South Africa and Philippines (Table 15).

Table 15: Overall Comparison of Indian IT sector with IT sector of Select Countries (2003)

	India	Canada	Ireland	Israel	Philippines	S. Africa
IT export industry size (US $ million)	9500	3780	1920	900	640	96
Active export focused IT professionals	195000	45000	21000	15000	20000	2000
IT employee cost (US $ per employee)	5000-12000	36000	25000-35000	25000	7000	18000
Number of CMM level 5 certified companies	60	NA	0	0	NA	NA
IT labour force	Low cost, high quality	High cost, High quality	High cost, High quality	High cost, High quality	Low cost, moderate	Moderate
Infrastructure	Average	Good	Good	Good	Good	Good
Main Advantages	English language skills, qualified workforce, good management	Near shore, highly compatible cultures with UK and US	Large development centers of companies like Microsoft	Advanced Technology	Good English and cultural compatibility	Language skills

Source: Nasscom (2004), Strategic Review.

4.1 Facing the Competition: Government Policy towards IT Sector

Supportive government policy has helped Indian outsourcing sector. The state funded IITs and other institutes of higher learning created a pool of skilled labour. The policy for construction of software technology parks allowed firms to increase revenues from offshore projects. The Export Oriented Units (EOUs) and units under Electronic Hardware Technology Parks (EHTPs), Software Technology Parks (STPs), Special Economic Zones (SEZs) and Bio-Technology Parks (BTPs) schemes are entitled to avail several facilities/benefits including exemption from payment of income tax under Section 10A and 10B of the Income Tax Act. Nasscom has called for the continuation of Software Technology Parks of India (STPI) scheme for a 10 year period as the number of start-up companies could decline in the absence of the scheme. The STPI scheme, allowed tax breaks to make IT business affordable for SMEs and start-ups.

Further, Government of India passed the IT Act 2000, which attempts to change outdated laws and provides ways to deal with cyber crimes. The Act offers the much-needed legal framework so that information is not denied legal effect, validity or enforceability, solely on the ground that it is in the form of electronic records (CYBERLAWSINDIA.net). In view of the growth in transactions and communications carried out through electronic records, the Act seeks to empower government departments to accept filing, creating and retention of official documents in the digital format. The Act has also proposed a legal framework for the authentication and origin of electronic records / communications through digital signature. These measures are expected to help further growth of ITES-BPO services from India.

Section V

Emerging Challenges for India's Outsourcing Sector

5.1 *IT Exports and Exchange rate*

The invoice in US dollar accounted for the maximum share of software services exports of India followed by Pound sterling and

Table 16: Invoicing Pattern of India's Software Service Exports

Currency	Exports (US $ million)	Share (in per cent)
US $	26,259	75.4
Euro	2,215	6.4
Pound Sterling	4,466	12.8
AUD	626	1.8
Indian Rupee	441	1.3
Other	834	2.3

Source: Monthly Bulletin (2009), Reserve Bank of India.

Euro (Table 16). Therefore, wide fluctuations in the value of US $ in a short period may have an impact on India's software exports and IT companies. However, it is also said that the margins in the software and BPO exports are large enough to absorb reasonable currency appreciation. To understand the full impact of exchange rate movements on exports, several indicators need to be examined such as the real effective exchange rates, the movement of relative exchange rates of competitor countries, price elasticity of products *etc*. Value addition, product and destination diversification, hedging, increased productivity, changing delivery mix to countries where the currency appreciation has not been steep provides cushion to IT/BPO firms. Table 17 indicates that in the past few years minor fluctuations in rupee have not affected the exports much.

Table 17: IT-BPO Exports and Exchange Rate

	REER	Fluctuations (in per cent)	Software Exports (US $ Million)	Growth Rate (in per cent)	Business service Exports (US $ Million)	Growth Rate (in per cent)
2000-01	98.67	-	6,341	-	334	-
2001-02	98.59	-0.1	7,556	19.2	519	-
2002-03	95.99	-2.6	9,600	27.1	807	-
2003-04	99.07	3.2	12,800	33.3	1296	-
2004-05	98.30	-0.8	17,700	38.3	5,167	-
2005-06	100.54	2.3	23,600	33.3	9,307	80.1
2006-07	97.42	-3.1	31,300	32.6	14,544	107.0
2007-08	104.52	7.3	40,300	28.8	16,772	15.3
2008-09	94.12	-10.0	46,300	14.9	16,445	-1.9

Source: Monthly Bulletin, various issues, Reserve Bank of India.

However, there is another view that the appreciating exchange rate along with rising costs may dampen the attractiveness of exports. In this regard, the IT industry is apprehensive that the rupee appreciation would have a multifold ramification for IT-ITES industry, especially once the tax holiday is over for Software Technology Park Scheme (STP). It may be indicated that if an industry is importing raw materials for exports, the severity of appreciation of currency is partially offseted (Table 18). This is not the case with IT/BPO firms as they are not import dependent. The NASSCOM, has expressed concern over the adverse impact of rupee appreciation on IT and BPO sectors, warning that it could affect their long-term prospects. The small and medium companies are hit hard. According to Nasscom one per cent rise in the rupee value would affect the bottom-line of the industry by 30 to 40 basis points.

Table 18: Impact of Currency Appreciation

Characteristics of Export	Output/Exports	Employment
High intensity in use of imported input in production	Rupee appreciation will reduce the import cost of inputs. These sectors must be able to partially / fully neutralize the affect of appreciation in export market	In these sectors employment in export units may not get hurt but down stream input sectors may have the pinch. If the sector uses inputs which are based on labour intensive technology, high import of inputs will negatively affect the employment as well as production of import-competing input sectors. If the sectors uses capital intensive production, there will be less severe effect on employment.
Low intensity in use of imported inputs in production	Rupee appreciation will make these sectors uncompetitive unless deflationary pressure reduces the cost of production sufficiently.	These sectors will receive maximum jolt. As export demand goes down, induced demand of inputs will also come down. Employment will be hard hit if the sector uses labor intensive technology.

Source: Annual Report (2007-08), Ministry of Commerce.

5.2 *Salary Rise*

The growth of IT sector and quality upgrading has been so fast that there are fears of an emerging shortage in talent (Srinivasan 2006). Wages in India have been rising at a rapid rate, from 13.7 per cent in 2004 to 14.5 per cent in 2007. Studies point out that even though wages are still lower in India (Table 19), the pay hike given in India is much higher than Japan, China and Philippines (2.7 per cent, 8.2 per cent and 8.4 per cent respectively). The human resource costs in the BPO sector which is pegged at 53 per cent of budgetary allocations is expected to rise in future (Rajawat, 2008). Faced with the rise in salary, Indian suppliers have started sub-contracting their routine works to China to capitalize the prevailing lower wage rates there.

5.3 *Information Security Environment in India*

In this area, Indian companies have robust practices and procedures. Indian companies primarily comply with BS 7799 (a global standard that covers all domains of security) (Nasscom factsheet). Companies sign service level agreement (SLA), which

Table 19: Wage indicator for Select Countries, 2005

	China	Czech Republic	India	Philippines
Average annual ITO salaries **(US $)**				
Entry level	5,700	12,000	5,700	7,300
Team Lead	9,600	19,500	9,400	11,900
Project Manager	15,000	36,100	14,600	18,400
Average annual non-voice BPO salaries **(US $)**				
Entry level	4,300	9,600	4,500	5,700
Team Lead	7,500	15,600	7,600	9,600
Project Manager	11,700	28,800	11,800	14,900
Average annual voice BPO salaries **(US $)**				
Entry level	4,100	9,100	4,300	5,500
Team Lead	7,100	14,600	7,200	9,200
Project Manager	11,100	27,100	11,200	14,200

Source: Organization for Economic Co-operation and Development (2007).

have very strict confidentiality and security clauses built into them at the network and data level. Most of the BPO companies providing services to UK clients ensure compliance with UK data protection act 1998 through contractual agreements. Many companies in India are undergoing / have undergone SAS-70 Audit. SAS-70 assignments helps service companies operating from India to implement and improve internal controls, ensure minimal disruptions to business and is potent marketing tool in the face of increasing competition (Nasscom factsheet). NASSCOM has taken a holistic view of information security through its 'Trusted sourcing initiatives' to strengthen the regulatory framework and further improve India's attractiveness as an outsourcing destination. This multi-pronged initiative is targeted at employees, organizations, enforcement agencies and policy amendment, through a '4E' framework- Engagement, Education, Enactment and Enforcement. Further, NASSCOM has undertaken to create, operate and maintain a national database of employees working in the IT/BPO sector in India, known as the National Skills Registry (NSR): a centralized database of all employees of the IT services and BPO companies in India. Launched in January 2006, NSR is a pan-India online database containing third party verified personal, qualification and career-related information of IT-BPO professionals (Nasscom factsheet).

5.4 *Business Environment*

The global IT competitiveness index (by Economist Intelligence Unit) ranks India 48th in the world in 2008. The study conducted in 66 countries ranks US as the most competitive country followed by Taiwan and UK. Improving the business environment is a major challenge for Indian outsourcing sector. To maintain competitiveness, domestic business environment have to be considerably improved in India. Almost all ITES exporting countries are having a better business environment than India (Table 20 & Chart 2).

Table 20: Ease of Doing business Rank

Economy	Singa.	USA	Ireland	Israel	Netherla.	S. Africa	China	Brazil	India	Philipp.
Ease of Doing Business Rank	1	4	7	29	30	34	89	129	133	144
Starting a Business	4	8	9	34	70	67	151	126	169	162
Dealing with Construction Permits	2	25	30	120	104	52	180	113	175	111
Employing Workers	1	1	27	90	123	102	140	138	104	115
Registering Property	16	12	79	147	29	90	32	120	93	102
Getting Credit	4	4	15	4	43	2	61	87	30	127
Protecting Investors	2	5	5	5	109	10	93	73	41	132
Paying Taxes	5	61	6	83	33	23	125	150	169	135
Trading Across Borders	1	18	21	11	13	148	44	100	94	68
Enforcing Contracts	13	8	37	99	30	85	18	100	182	118
Closing a Business	2	15	6	41	10	76	65	131	138	153

Note : Economies are ranked on their ease of doing business, with first place being the best. A high ranking on the ease of doing business index means the regulatory environment is conducive to the operation of business. The rankings are from the Doing business 2010 report covering period June 2008 through May 2009.

Source : World Bank (2010), Doing Business Report

5.5 *Quality of Infrastructure*

The quality of infrastructure in a country, including power and communications, is an important element in investment decisions for both domestic and foreign investors. India's internet scenario is plagued by low PC penetration and low telephone penetration. India lags behind other countries such as China, Japan, and Philippines in terms of internet penetration. Internet bandwidth infrastructure is critical to the growth of the ITES-BPO sectors in the country. India's position in IT

Chart 2: Ease of Doing Business Rank (2010 Report)

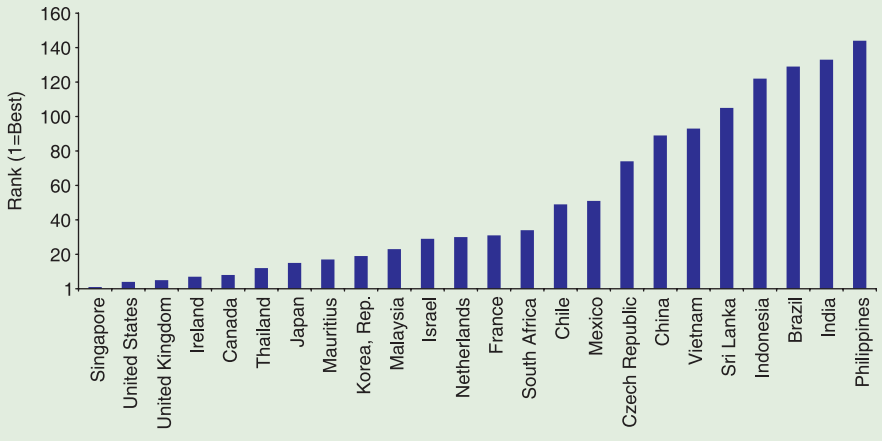


Table 21: Personal computers (per 100 people)

	2000	2001	2002	2003	2004	2005	2006
Netherlands	40	43	47	51	68	85	91
United States	57	62	-	-	76	78	81
United Kingdom	34	37	40	44	60	76	80
Singapore	48	51	56	62	66	69	72
Germany	34	38	43	48	55	61	66
France	30	33	35	42	50	57	65
Ireland	36	39	42	46	49	53	58
Czech Republic	12	15	18	21	24	27	-
Malaysia	9	13	15	17	19	22	23
Mexico	6	7	8	10	11	14	14
Philippines	2	2	3	3	4	5	7
China	2	2	3	4	4	5	6
India	0	1	1	1	1	2	3

Source: World Bank Online database

infrastructure, even though is improving, is not anywhere near the developed countries. Further, it heavily lags behind India's competitor countries like, China, Ireland, Czech, Netherlands, Philippines, *etc* in the case of availability of personal computer (Table 21). However, eventhough, India's quality of infrastructure is poor; it can be seen from the table that price for internet use in India is internationally competitive in US dollar terms (Table 22).

Table 22: Fixed broadband Internet access tariff (US$ per month)

	2008
Netherlands	38
Ireland	38
Germany	38
France	38
Mexico	37
United Kingdom	29
Czech Republic	29
Philippines	23
Singapore	22
Malaysia	20
China	19
United States	15
India	6

Source: World Bank Online database.

5.6 *Free Trade Agreements*

Multilateral or bilateral trade agreement in services sector would be helpful for strengthening existing markets and exploring new markets and new areas of trade. India may enter into bilateral free trade agreement in services to intensively explore the foreign markets. In this context, the comprehensive economic cooperation agreement (CECA) between India and Singapore are worth noting. India and Singapore signed a CECA under which both the countries guarantee access into each other's market. Further, both the countries may not restrict access into their service market by imposing quantitative restrictions.

5.7 Anti-Outsourcing Legislations and protectionism

There is a rise in anti-outsourcing legislations world-wide. The Committee of European Banking Supervisors (CEBS) has put out a consultative paper proposing a total ban on outsourcing of strategic or core activities (Business Standard, 2004). However, it is also said that some of the anti-outsourcing bill in US may violate its international trade obligations and therefore will not be passed. But the fact that there is a general mood to prevent contracting of services to other countries under various pretext remains (Table 23).

Further, there are moves to impose restrictions on movement of professionals especially after the September 11, 2001 terror attack. Also, opposition to H1B quota of 65,000 exists due to growing unemployment in US (Varma and Rogers, 2004). Moreover, the Grossley-Durbin Bill in the US aims to set tougher wage standards (which may increase salaries of H-1 B workers) and also impose limits on the number of visa workers to 50 per cent of the workforce. This may force companies to hire more locals instead of professionals from India (Business Standard, 2009). In this context, it may also be noted that, a phenomenon known as 'reverse outsourcing' has begun to assert itself. For example, the Indian outsourcing firm Wipro has added many US based consultants to its staff.

Table 23: Proposed Anti-Outsourcing legislations in United States

State	Proposed legislation
Alabama	State contract restrictions on overseas work; call centre restrictions
Arizona	Ban on state contracts with foreign call centres, call centre and data transfer restrictions.
California	State contract ban, call centre, personal data and health-care information restrictions, outsourcing notification requirement
Colorado	State contract ban, ineligibility for state contracts and develop. assistance if outsourcing causes job losses
Florida	In-state resident requirement for state contractors
Georgia	State contract ban and call centre restriction, including state contract ban on foreign call centres
Hawai	Ban on state contracts with foreign call centres, call centre and data restrictions
Idaho	Employment preference for state residents
Illinois	State contract ban, in-state preferences
Indiana	State contract ban, in-state preferences
Iowa	State contract ban
Kansas	Ban on state contracts, call centres and data transfer restrictions
Kentucky	State contract ban
Louisiana	State contract ban, in-state preferences
Washington	Ban on state contracts, call centres and data restrictions
West Virginia	Call centre restrictions, seven-year ban on state contracts and assistance to companies that outsource overseas and have 100-person job loss.

Source: World Investment Report 2004, United Nations Conference on Trade and Development

5.8 *Diminishing Returns*

It is indicated that IT/BPO sector is also subjected to diminishing returns and this may eventually reduce its potential. Unchecked IT spending, unnecessary complexity, redundant systems *etc* may lead to diminishing returns from this sector. It is well known that huge investments in information technology has lead to the productivity gains in the US and other advanced countries during early stages (in the 1990s). Since then, companies have continued to spend heavily on IT systems. However, the contribution made to productivity growth has been steadily declining. Instead of supporting innovation, the bulk of spending ends up maintaining existing systems. It is reported that, in 2007, only 13 per cent of the average IT budget supported innovation in business processes or products. The remaining 87 per cent is meant for maintenance and upkeep (Pricewaterhousecoopers, 2008).

5.9 *Global Economic Slowdown and IT/BPO Exports*

A global survey by 'Goldman Sachs' has found that IT budgets of various companies were declining in 2009 when compared to 2008. The decline was across the sectors including Government IT budgets. Further, due to global economic slowdown, IT companies are going slow on H-1 B visa applications. It may be noted that for the financial year 2009 (till July 2009) approximately 44, 900 applications for H-1 B visas were filed against the quota of 65,000. On the other hand in 2007 and 2008, the 65,000 cap was met within just two days (Business Standard, 2009). Further, when compared with 2007-08, the average growth of India's ITES-BPO exports have come down significantly during 2008-09 and 2009-10 (Table 24).

5.10 *Other challenges*

Many Indian BPO's had lost orders due to various factors ranging from ignorance of 'cultural' issues of home countries, lack of language

Table 24: Recent Trends in IT/BPO Exports

(Growth in per cent)

	Software Services	Business Services	Total Services	Merchandise
2007-08				
April-June	25.5	11.0	18.0	23.4
July-Sept	27.1	13.3	28.0	17.5
Oct-Dec	26.4	24.3	30.7	39.7
Jan-March	34.3	12.4	14.9	34.7
Average	**28.3**	**15.3**	**22.9**	**28.8**
2008-09				
April-June	37.6	-5.5	21.8	57.0
July-Sept	35.0	24.3	32.9	39.6
Oct-Dec	19.1	-12.6	11.8	-8.4
Jan-March	-12.7	-15.1	-9.7	-20.0
Average	**19.8**	**-2.2**	**14.2**	**17.0**
2009-10				
April-June	-8.9	-27.4	-10.4	-34.0
July-Sept	-10.2	-48.3	-25.2	-21.8
Oct-Dec	15.3	-34.6	-12.3	13.2
Average	**-1.3**	**-36.8**	**-16.0**	**-14.2**

Source: Author's calculation based on Monthly Bulletin, various issues, Reserve Bank of India.

abilities other than English, lack of technical proficiency, credit card frauds and misuse of personal information. Further, some segments of outsourcing such as engineering services outsourcing has close links with manufacturing and it may be difficult for India to succeed in outsourcing sector without significantly enhancing manufacturing capabilities. India's weak engineering and physical infrastructures are likely to hamper the growth of services outsourcing in future.

Section VI

Conclusion

In conclusion, the study proves that India is having revealed comparative advantage in exports based on ITES-BPO services. World trade in services is growing at a much faster rate than trade in goods. This will give a good opportunity to India to raise its share of world trade if adequate attention is given to service sector especially to ITES-BPO sector. Government of India has already taken some initiatives in this regard by giving fiscal concessions to service sector. Regarding competition from China, as of today it is not a serious threat to outsourcing business of India. Indian companies had reasonably succeeded in maintaining an edge over Chinese companies in the quality and marketing of service exports. IT infrastructure and general business environment are two areas where India clearly lags behind almost all other competitors in outsourcing arena. Another important finding is that even though there is lot of media attention on outsourcing sector in India and other developing countries, especially regarding loss of employment in developed countries like US and UK due to contracting of services to abroad, the maximum gain from services trade is actually going towards these countries. McKinsey study revealed that more than three-fourth of the value being created in the global economy through offshoring goes to US and receiving countries like India get only 22 per cent (Dey 2004). Eventhough India maintain its lead status as a source country for a variety of IT related services, there are number of emerging challenges which require immediate attention. Anti-outsourcing legislation and growing protectionism in western countries need to be closely monitored.

There is an urgent need to diversify services export to other countries rather than concentrating only on US and Europe. In this regard, major Indian IT companies have adopted the strategy of acquisitions and alliances to increase the portfolio of services, and cater to new markets such as the Middle-east Asia, Singapore*, etc.* Indian service providers should move up the value chain to make up for the loss of rise in wage cost *etc* and to increase their profitability. Setting up of overseas offices through joint ventures and collaboration with foreign companies and recruiting local talents from abroad is a strategy to bridge the gap in culture and language while exporting to non-English speaking countries. Free trade agreements in services with other countries may be attempted to further consolidate the gains India already made. In short, India has already made an impact in the outsourcing area. However, to maintain its lead and capture new markets and areas, Indian service industries should remain vigilant.

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Asia and the Subprime Crisis, Chi Lo (Palgrave Macmillan: UK), 2009; pp XI+125, £60.

Many lessons can be learned from the recent subprime crisis. Those lessons have not been systematically addressed, perhaps because everyone has been busy with 'fighting the fire'. This is not a normal crisis period, and hence, no normal post-crisis recovery was expected. The financial wizards seem to remain overly optimistic that the crisis will be followed by a normal economic recovery so that life can get back to normalcy. There was huge economic imbalances built up in the 1990s and early 2000s, all financed by massive debt in the developed world. The advent of financial derivatives, thanks to the deregulation, had only made these imbalances, making crisis more complicated. To unwind these imbalances from the web of complicated financial instruments spread throughout the world will take a long time. The loss of public confidence only adds difficulties to finding a solution. There are also significant implications of the crisis on the regulatory, macroeconomic and financial fronts in the post-crisis era. In this book, the author has drawn parallels between financial crisis of Asian emerging countries and developed countries of European Union and the USA. Though the analysis is China-centric, some sporadic focus on other emerging Asian countries to draw lessons from the crisis.

It is properly mentioned in the book that, the epicenter of the crisis has changed from Asia (Asian Financial Crisis of 1997) to Europe and the USA. The buzzwords have also changed, from currency pegs, excessive corporate borrowing and foreign debt in the Asian crisis to securitization, subprime mortgages, and collateral debt obligations in the subprime crisis. However, it is properly clarified that the causes and symptoms of the subprime crisis are quite similar to those of the Asian crisis. So to say that the subprime crisis is an unexpected shock is a denial of human mistakes - greed is prevalent in both the subprime and Asian crises. Before the Asian crisis, massive foreign capital inflows to the region significantly boosted bank lending and corporate borrowing. Foreign investors were attracted by Asia's high-yield securities in the blind faith that the regional currency pegs would hold forever and

robust economic growth would support Asian Corporates' payment ability forever. Similarly, massive capital inflows flooded the USA and financed its huge current account deficit, fuelling excessive demand for credit and mortgage loans. The latter were repackaged into mortgage-backed securities and other credit derivatives like collateralized debt obligations (CDOs). Investors outside the USA were attracted by the high yields of these structured products in the blind faith that the underlying parties had AAA credit ratings. Imprudence follows greed. Ten years ago, the Asians indulged in imprudent lending to corporates based on relationship to mega projects and property development of dubious nature. Due diligence and commercial viability were totally ignored. In the subprime crisis, imprudence is seen in the proliferation of subprime mortgage loans and the so called *ninja* loans (no income, no jobs and no assets for backing).

Seed of the Subprime Crisis

The book has appropriately diagnosed the subprime crisis. It has mentioned that the global major central banks, such as, the US Federal Reserve, the Bank of England and the European Central Bank (ECB) in particular, had run an overly loose monetary policy in a dynamic, entrepreneurial, globalised and capitalist system, and ended up turning the original good economic policy intension into the seed of another shocking crisis. But that did not mean that capitalism had failed. Rather, the subprime crisis was a result of regulatory failure in the capitalist system.

The US monetary policy was not the only problem. The creation of the Euro zone in 1999, which centralized monetary policies of the member countries into ECB, also played a crucial role in creating the global credit bubble. Monetary union eliminates currency risk but not credit risk. With only one currency, the Euro, and one monetary policy, credit spreads in some Euroland countries should have risen to reflect their underlying risks. But the ECB, in an attempt to ensure stability in the early days of the Euro, had kept an overly loose monetary policy for a long time. Thus, asset bubbles, fuelled

by easy credit, emerged especially in the peripheral, smaller Euroland countries, such as, Ireland, Spain, Greece and Portugal.

Contesting Factors

The book has contested that the current subprime crisis is a 'black swan' event. The term *black swan* comes from the ancient western concept that all swans are white. In that context, a black swan was a metaphor for something that could not exist. Ever since black swans were discovered in Australia in the seventeenth century, the term *black swan* has been used to connote the actual happening of a highly unlikely event with unprecedented and devastating effects. The subprime crisis itself is not a *black swan* event, though the resultant credit crunch and confidence crisis may qualify. This is because all the events and factors leading up to the current crisis were known. From a macro perspective, the Asian crisis and the subprime debacle have similarities in their causes and symptoms - namely a prolonged period of low interest rates leading to moral hazard, imprudent lending, regulatory oversight, excessive investment, and asset bubble. But the advent of financial derivatives has made today's subprime crisis more complicated.

The deepening of the US subprime crisis after September 2008, despite the Fed's repeated massive liquidity injection, shows that the markets had failed to clear on their own and the global financial system had stalled. There would be two possible outcomes of the crisis - either a global financial meltdown or a full-scale government bailout. History and the Government actions suggest the latter. There is a conflict of interest problem, which often takes the form of a principal-agent problem. In the Asian financial crisis, bank managers just ignored shareholders and public interest and lent indiscriminately to companies and projects under political or influential business pressure. In the US subprime crisis, investors in mortgage based securities (MBS) and CDOs expected mortgage lenders and banks to keep their credit standards. But in the 'originate and distribute' model, in which the mortgage lenders and banks originate the loans and sell them off at once, they had little incentive to scrutinize and

keep the credit standards. Typically, mortgage lenders made the loans and at once sold them off to banks. The banks, in turn, securitized them and sold them off to investors throughout the world. The banks aimed at maximizing only their fee income from securitization but not the interest income from the loans. So they had the incentive to securitize and push the products off their books as soon as possible. Credit standards dropped sharply in the process, and no-one had any clues about the ultimate ownership of the underlying loans. So, when the US housing bubble burst, defaults surged, setting off a domino effect on the mortgage derivative instruments and shattering public confidence in the banking system as a whole.

Hence, those who argue that the subprime crisis was a *black swan* event are either naive or in denial. Despite numerous analyses of the subprime crisis, its causes and impact are still misread in many cases, especially from the Asian perspective. As the subprime-induced credit crunch pulled down asset prices indiscriminately, what was at first a liquidity crisis soon turned into a solvency crisis for individual banks, prompting the global authorities to employ radical measures such as partial bank nationalization, troubled-asset purchases and other forms of direct market interventions to contain the *credit quake* or *financial tsunami*, as it is called in Asia. Asia's policy response has remained relatively calm in this subprime debacle because it has learnt good lessons from the 1997-98 Asian financial crisis.

Subprime Generalised

The word 'subprime' in relation to mortgages in the USA generally refers to those mortgages targeted at borrowers with impaired or low credit ratings and low income level who may find it difficult to obtain finance through traditional sources, such as, prime mortgages and Alt-A. Subprime borrowers have the highest perceived default risk, as compared with Prime and Alt-A borrowers. In essence, subprime borrowers are those who have a history of loan delinquency or default, those with a record of bankruptcy, and those with low income levels relative to their mortgage payment ability.

The US subprime crisis was quickly transmitted to Europe, as the European banks were some of the largest holders of the US mortgage-related derivative instruments. During the good times, they loaded up the MBS and CDOs with cheap US dollar funding. But when the sub-prime crisis broke, US$ funding sources of all sorts, including money market funds, bank depositors and other investors, withdrew cash *en masse*. European banks soon found their funding increasingly difficult and expensive to replace. When the credit market eventually seized up after the failure of Lehman Brothers in September 2008, the domino effect was quickly felt in Europe, pulling down big banks like Fortis and HBOS and forcing them into government hands for rescue.

When the financial contagion hit Asia, it wreaked havoc in the regional financial and currency markets, even though the regional banks had very limited exposure to the sub-prime toxic assets. However, the overall impact on the regional financial system was relatively small. Asia's strong fundamentals, including large current account surpluses, huge foreign reserves, low foreign debts and high savings rates, have helped shield its financial systems from the *financial tsunami*. However, the region's heavy reliance on export growth has significantly pushed its economies deep into recession as global demand contracts under the weight of the post-bubble adjustment in the developed world.

While Asian growth experienced a V-shaped rebound a year after the Asian crisis of 1997-98, thanks to its young and vibrant economic structure and a quick return of confidence, don't bet on the same happening in Europe and the USA. Even if the US Troubled Asset Relief Programme (TARP) manages to turn confidence around and the European authorities finally wake up to reality and join in a concerted bailout effort, history shows that the post-bubble adjustment in developed economies will take a long time. Thus, to correct their mistakes, banks will have to become more boring, generating less profit from fancy financial engineering, and more heavily regulated relative to the past two decades. Granted, restrictions will hurt economic opportunities and profitability in the next economic upswing, but

it will be a small price to pay for greater protection from another, perhaps bigger, banking crisis in the future.

The correct message from these failures should be that Asia should ensure that any move away from traditional banking practices towards more innovative techniques is accompanied by enhanced risk management. It will be extremely unfortunate if the wrong message gets out and delays or even deters further financial liberalization in the developing world. Asian regulators should take the subprime crisis lesson seriously to improve their regulatory systems. As Asian financial markets expand into new terrain, policymakers should put in place measures to deal with risks posed by financial innovation, but should not shy away from financial liberalization or suppress financial innovation.

Bailout Approaches Converged

Before October 2008, there was no coordination between all the subprime crisis countries. They had only taken *ad hoc* steps to stem the crisis. Central banks had cut interest rates, governments had acted to strip toxic assets off bank balance sheets and regulators had injected capital into the banking sector. These moves were country-by-country solutions and had no broad coordination between governments, despite the fact that the global financial system was linked. No wonder they had failed to calm the markets and prevent the crisis from deepening.

Asia does not have a financial crisis, despite the global impact of the financial tsunami stemming from the western world. This is mainly because the Asian banking systems, except Korea, have de-leveraged since the aftermath of the Asian crisis. This is in sharp contrast to the over-leveraging of the US and European systems, which sowed the seed for the subprime crisis. This difference in the banking system fundamentals between the east and the west is best summarized by the loan-to-deposit ratio. Since the Asian crisis, Asian banks, except Korea, have de-leveraged significantly, while their western counterparts have indulged in lending.

The Painful Lessons

Despite all these micro, macro and unconventional measures taken by the global authorities to tackle the global credit crisis, the root problem has yet to be dealt with effectively. That is because what the western policymakers have done is to sustain household leverage and consumption at any price, when the only exit from the 'credit quack' involved a return to thrift by the over-leveraged.

The book is properly timed and appropriately mentioned that the subprime crisis was rooted in the irresponsible social behaviour of the USA and most of the developed world in the past two decades, which prioritized the desire for current consumption over the ability to pay for it. Financial engineering and deregulation had encouraged borrowing and discouraged thrift to finance excess spending *via* a gigantic credit bubble. That, in turn, led to huge global economic imbalances and distortions. This root cause explains why it is so difficult to solve the crisis. Desperate to preserve the value of asset prices inflated by this huge liquidity bubble, western policymakers have avoided the painful solution of allowing market clearing. The bailout programs, liquidity injections and fiscal stimulus packages are all meant to sustain asset prices, when these asset prices really need to fall to market levels so that they can be cleared.

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