RESERVE BANK OF INDIA
OCCASIONAL PAPERS

RESERVE BANK OF INDIA

Articles

Special Notes

Book Reviews

In Search of a Better Estimator of Interest Rate Risk of Bonds: Convexity Adjusted Exponential Duration Method

A. K. Srimany and Sneharthi Gayen*

We have proposed a new method, using modified duration and convexity, to estimate the interest rate risk of bonds which can be considered as a conceptual improvement over the 'Exponential Duration' method proposed by Miles Livingston and Lei Zhou [2005]. We have analytically and experimentally proved that this new method is better than traditional method based on modified duration and also the 'Exponential Duration' method, at least for the international market covering bonds of major economies. However, a pertinent question will be the performance of this proposed method vis-à-vis the traditional method based on modified duration and convexity. Indication based on sample cases reveals that the performance of this proposed method is better than all the above methods. A rigorous analysis of the performance of our proposed method as compared to the traditional method based on modified duration and convexity will be our next attempt in this direction.

Introduction

With the introduction of the concept of bond duration in 1938 by Macaulay, it has been used by financial analysts as a measure of the sensitivity of bond prices to changes in interest rate. A commonly used measure of duration is modified duration which is Macaulay's duration divided by one plus bond's yield to maturity per period. Modified duration provides a good approximation of

the actual change in price of bond if the change in interest rate is small. For larger changes in interest rate, modified duration based estimate is less accurate. To improve the accuracy, the concept of convexity was introduced subsequently. Now modified duration and convexity are widely used by financial analysts to measure the interest rate sensitivity of a bond. Subsequent to the introduction of duration and convexity, many researchers wanted to introduce different measures of interest rate risk, e.g. M-absolute, M-square (Nawalkha S K, Soto G M and Beliaeva N A, 2005), Garbade's convexity[1] (Louis D'Antonio and Thomas J. Cook, 2004), etc. M-absolute model immunizes risk caused by the shifts in the slope, curvature, and all other term structure shape parameters by selecting a minimum M-absolute bond portfolio with cash flows clustered around its planning horizon date, though the model immunizes only partially against the height shifts. The M-absolute of a bond portfolio is given as the weighted average of the absolute distances between cash flow maturities and the planning horizon of the portfolio. A bond portfolio selected with minimum M-square has cash flows clustered around its planning horizon date and hence protects the portfolio from immunization risk resulting from nonparallel yield curve shifts. The M-square of a bond portfolio is given as the weighted average of the squares of the distance between cash flow maturities and the planning horizon of the portfolio. Garbade defines convexity as the "weighted average of the squared difference between (1) the time remaining to a future payment and (2) the duration of the bond." However, these measures are slightly more complicated and are not very popular at present. Market preference is also mostly towards the twin measures of modified duration and convexity. Many database providers like Bloomberg, Datastream provide information on these twin measures of interest rate risk for each outstanding bond issue.

Utilizing the concept of modified duration, Miles Livingston and Lei Zhou [2005] introduced the method of 'exponential duration' which, they proved, is uniformly better than the traditional duration method of estimating price movements under different yield

movement scenarios. However, they observed that traditional duration plus convexity method gives smaller errors than the 'exponential duration' method in most cases, though the differences are small. In this article, we introduce 'convexity adjusted exponential duration' method and compare the performance of the proposed method as against traditional duration method, 'exponential duration' method as well as traditional duration plus convexity method in measuring interest rate sensitivity of bonds.

The outline of the paper is as follows. We first review in Section I the traditional approach to estimate the interest rate risk using duration and convexity. We then present in Section II our estimation procedure of interest rate risk named as 'convexity adjusted exponential duration' method. In the process, we have derived the 'exponential duration' method as suggested by Miles Livingston and Lei Zhou [2005], as the first level approximation. This is followed by mathematical analysis in Section III, where we prove that our method is more accurate than the traditional duration based method and 'exponential duration' method for decrease in yield level, in case of zero coupon bonds and perpetual bonds. As we are unable to prove mathematically the dominance of our methodology over traditional duration method and 'exponential duration' method for nominal bonds and for increase in yield level in case of zero coupon bonds and perpetual bonds, we have presented in Section IV the results of our experiments through grid search covering major types of bonds available in international market for a wide range of residual maturity and increase / decrease in yield level up to the magnitude of 300 basis points; change in yield beyond this level in a short time span is a very unlikely situation in the international market covering bonds of major developed economies. We have observed therein empirically that our method provides far more accuracy in price movement as compared to the traditional duration and 'exponential duration' methods in almost all cases. In Section V, we have presented some initial results comparing our method and traditional duration plus convexity method. In Section VI, we conclude with the findings of the paper.

Section I

Traditional Approach: Duration plus Convexity

Price (P) of a bond with face value *100*, annual coupon rate *C*, number of coupon payments remaining *n*, frequency of coupon payment *f* (1 for annual, 2 for half-yearly, etc.) and annual yield to maturity *y* can be expressed as the sum of the present values of the cash flows as below.

$$P = \sum_{j=1}^{n} \frac{C/f}{(1+y/f)^{w+j-1}} + \frac{100}{(1+y/f)^{w+n-1}} \tag{1}$$

Here w ($0 < w \leq 1$) represents the ratio of the number of days from the settlement date up to the next coupon date and the number of days in the coupon period in which the settlement date falls. On coupon dates, $w=1$. It may be noted that this price represents dirty price of the bond. Further, instead of bonds, one can apply all our experiments / results on any fixed-income assets.

If we take first derivative of price with respect to yield to maturity and divide it by price we get minus of modified duration, that is,

$$Modified\ Duration, D \quad \equiv \quad -\frac{1}{P} \cdot \frac{dP}{dy} \tag{2}$$

For bonds, convexity[2] is generally defined as the second derivative of price with respect to yield to maturity divided by price:

$$Convexity, V \quad \equiv \quad \frac{1}{P} \cdot \frac{d^2 P}{dy^2} \tag{3}$$

In the traditional approach, percentage change in price is estimated by multiplying minus of modified duration with the change in yield as a first-order approximation. Second-order approximation is obtained by taking the product of one-half, square of yield change and convexity and then adding it to the first-order approximation. Let P_0 represents initial price when yield is y and P_1 represents new price when yield changes to y+Δy. Also let P_{1TD} and P_{1TDC} represent

the estimates of new price under the traditional duration and traditional duration plus convexity methods, respectively. Then,

$$P_{1TD} \quad = \quad P_0(1 - \Delta y.D) \tag{4}$$

$$P_{1TDC} \quad = \quad P_0\left(1 - \Delta y.D + \frac{1}{2}(\Delta y)^2 V\right) \tag{5}$$

It may be noted that these two approximations are nothing but the first and the first two terms of the Taylor series expansion of price as a function of yield:

$$P_1 \quad = \quad P_0 + \Delta y \frac{dP}{dy} + \frac{1}{2}(\Delta y)^2 \frac{d^2 P}{dy^2} + ... \tag{6}$$

Henceforth we will denote traditional duration and traditional duration plus convexity methods by TD and TDC, respectively.

Section II

Convexity adjusted Exponential Duration Method

Let us start with natural logarithm of price (lnP) in stead of price (P). By Taylor's theorem, change in log of price can be written as the following; for some y* lying in the interval (y,y+Δy),

$$\ln P_1 - \ln P_0 = \Delta y \frac{d \ln P}{dy} + \frac{1}{2}(\Delta y)^2 \frac{d^2 \ln P}{dy^2} + \frac{1}{3!}(\Delta y)^3 \left[\frac{d^3 \ln P}{dy^3}\right]_{at\ y^*}$$

$$= \Delta y.\frac{1}{P}.\frac{dP}{dy} + \frac{1}{2}(\Delta y)^2 \frac{d}{dy}\left(\frac{1}{P}.\frac{dP}{dy}\right) + \frac{1}{3!}(\Delta y)^3 \left[\frac{d^3 \ln P}{dy^3}\right]_{at\ y^*}$$

$$= \Delta y.\frac{1}{P}.\frac{dP}{dy} + \frac{1}{2}(\Delta y)^2 \left(\frac{1}{P}.\frac{d^2 P}{dy^2} - \frac{1}{P^2}.\left(\frac{dP}{dy}\right)^2\right) + \frac{1}{3!}(\Delta y)^3 \left[\frac{d^3 \ln P}{dy^3}\right]_{at\ y^*}$$

$$= -\Delta y.D + \frac{1}{2}(\Delta y)^2 (V - D^2) + \frac{1}{3!}(\Delta y)^3 \left[\frac{d^3 \ln P}{dy^3}\right]_{at\ y^*} \tag{7}$$

Considering only first term of the above expression, we get an estimate of price (P_{1ED}) as:

$$P_{1ED} = P_0 e^{-\Delta y.D} \tag{8}$$

Miles Livingston and Lei Zhou [2005] arrived at the same expression of the estimate of price through a slightly different approach and introduced this method of estimating price as 'Exponential Duration' method. Henceforth we will denote this method by ED method.

We consider first two terms of (7) to get an estimate of price (P_{1CED}) as

$$P_{1CED} = P_0 e^{-\Delta y.D \ + \ \frac{1}{2}(\Delta y)^2 (V - D^2)} \tag{9}$$

We call the new method as 'Convexity adjusted Exponential Duration' method. Henceforth we will denote this method by CED method.

Note that the second term in the exponent of (9) does not contain simply convexity (V), rather an adjusted value of convexity (V-D^2). If we consider only $P_0 e^{-\Delta y.D + \frac{1}{2}(\Delta y)^2 V}$, we observe that it performs poorly as an estimator of price. The adjustment factor D^2 improves the estimate dramatically as may be observed from Tables 1-3.

Performance of CED method:

To understand *prima facie* the performance behavior of CED method, we have presented here price behavior of three types of bonds as used by Miles Livingston and Lei Zhou [2005] for the purpose of illustration.

Table 1 presents comparative position of different estimates for a 30-year par bond with 5% annual coupon rate. In every situation, CED method outperformed TD, TDC and ED methods. For example, if yield increases by 1%, actual price become 86.24 and TD method gives an estimate of price at 84.63, ED method at 85.75, TDC method at 86.38 and CED method at 86.24. Thus, error in CED method is

Table 1: Thirty-Year Par Bond with 5% Annual Coupon Rate*

Change in YTM	New YTM	Actual New Price	TD Estimate	TDC Estimate	ED Estimate	CED Estimate
1	2	3	4	5	6	7
-3.00%	2.00%	167.19	146.12	161.89	158.59	166.95
-2.50%	2.50%	152.33	138.43	149.38	146.86	152.19
-2.00%	3.00%	139.20	130.74	137.75	136.00	139.14
-1.50%	3.50%	127.59	123.06	127.00	125.93	127.56
-1.00%	4.00%	117.29	115.37	117.12	116.62	117.28
-0.50%	4.50%	108.14	107.69	108.12	107.99	108.14
0.00%	5.00%	100.00	100.00	100.00	100.00	100.00
0.50%	5.50%	92.73	92.31	92.75	92.60	92.73
1.00%	6.00%	86.24	84.63	86.38	85.75	86.24
1.50%	6.50%	80.41	76.94	80.88	79.41	80.43
2.00%	7.00%	75.18	69.26	76.26	73.53	75.23
2.50%	7.50%	70.47	61.57	72.52	68.09	70.56
3.00%	8.00%	66.23	53.88	69.65	63.05	66.38

*Modified duration being 15.3725 and convexity 350.4667.

only 0.01%, which is significantly less compared to the errors of TD method (-1.86%), ED method (-0.56%) and TDC method (0.17%).

In Table 2, we present comparative position of different methods for estimating the price of 30-year zero coupon bond. Here also it

Table 2: Thirty-Year Zero Coupon Bond*

Change in YTM	New YTM	Actual New Price	TD Estimate	TDC Estimate	ED Estimate	CED Estimate
1	2	3	4	5	6	7
-3.00%	2.00%	55.21	42.97	51.75	54.52	55.19
-2.50%	2.50%	47.67	39.66	45.76	47.26	47.67
-2.00%	3.00%	41.20	36.36	40.26	40.97	41.20
-1.50%	3.50%	35.63	33.05	35.25	35.52	35.63
-1.00%	4.00%	30.83	29.75	30.72	30.79	30.83
-0.50%	4.50%	26.70	26.44	26.69	26.69	26.70
0.00%	5.00%	23.14	23.14	23.14	23.14	23.14
0.50%	5.50%	20.06	19.83	20.08	20.06	20.06
1.00%	6.00%	17.41	16.53	17.50	17.39	17.41
1.50%	6.50%	15.12	13.22	15.42	15.07	15.12
2.00%	7.00%	13.14	9.92	13.82	13.07	13.14
2.50%	7.50%	11.42	6.61	12.71	11.33	11.42
3.00%	8.00%	9.94	3.31	12.09	9.82	9.94

*Modified duration being 28.5714 and convexity 843.5374.

may be observed that CED method gives superior estimate than TD, TDC and ED methods. For example, if yield increases by 3% from the present level of 5%, actual price reduces to 9.94. TD method estimates the new price at 3.31, ED method at 9.82 and TDC method at 12.09, whereas CED method estimates almost precisely at 9.94.

In Table 3, we present comparative position of different methods for a perpetual bond with 5% annual coupon rate. It may be observed that CED method gives superior estimate than TD, TDC and ED methods. For example, if yield increases by 3% from its present level of 5%, actual price goes down to 62.50; TD method estimate price at 40.00, ED method at 54.88 and TDC method at 76.00, whereas CED method gives closest estimate at 65.70.

Table 3: Perpetual Bond with 5% Annual Coupon Rate*

Change in YTM	New YTM	Actual New Price	TD Estimate	TDC Estimate	ED Estimate	CED Estimate
1	2	3	4	5	6	7
-3.00%	2.00%	250.00	160.00	196.00	182.21	218.15
-2.50%	2.50%	200.00	150.00	175.00	164.87	186.82
-2.00%	3.00%	166.67	140.00	156.00	149.18	161.61
-1.50%	3.50%	142.86	130.00	139.00	134.99	141.20
-1.00%	4.00%	125.00	120.00	124.00	122.14	124.61
-0.50%	4.50%	111.11	110.00	111.00	110.52	111.07
0.00%	5.00%	100.00	100.00	100.00	100.00	100.00
0.50%	5.50%	90.91	90.00	91.00	90.48	90.94
1.00%	6.00%	83.33	80.00	84.00	81.87	83.53
1.50%	6.50%	76.92	70.00	79.00	74.08	77.49
2.00%	7.00%	71.43	60.00	76.00	67.03	72.61
2.50%	7.50%	66.67	50.00	75.00	60.65	68.73
3.00%	8.00%	62.50	40.00	76.00	54.88	65.70

*Modified duration being 20 and convexity 800.

Thus we have observed that CED method, as proposed by us, is superior to TD, TDC and ED methods, in these cases.

Section III
Greater Accuracy in CED method as compared to TD and ED methods

In this section we have analyzed the performance of CED method as compared to traditional duration method and exponential duration method for different types of bond. As may be observed from the analytical and experimental evidences here, CED method is better than TD and ED methods, except for certain exceptional situations.

Proposition 1: The estimate of price under CED method (P_{1CED}) is always more than that under ED method (P_{1ED}).

<u>Proof:</u> It may be observed from (8) and (9) that $P_{1CED} = P_{1ED}.e^{\frac{1}{2}(\Delta y)^2(V-D^2)}$. Grandville (see p.163 Olivier de La Grandville, [2001]) proved that $V - D^2 = \dfrac{S}{(1+y)^2} + \dfrac{D}{1+y}$, where S is the dispersion or variance of the payment times of the bond and as such S is always positive. Hence, V-D² is always positive. Therefore, $e^{\frac{1}{2}(\Delta y)^2(V-D^2)} > 1$ for all non-zero Δy and thus the estimate of price under CED method (P_{1CED}) is always more than that under ED method (P_{1ED}), except at $\Delta y=0$ when both become equal. This completes the proof of Proposition 1. □

Specific case of zero coupon bonds:

For a zero coupon bond with *T*-years remaining till maturity, price is given by $\dfrac{100}{(1+y)^T}$, where *y* is yield to maturity. Using (2) and (3) one can see that it has modified duration $\dfrac{T}{1+y}$ and convexity $\dfrac{T(T+1)}{(1+y)^2}$.

Proposition 2: CED method provides better estimate of price than TD and ED methods for zero coupon bonds, when yield decreases.

Proof: First, we prove that in case of zero coupon bonds CED method under-estimates the actual price when yield decreases and over-estimates when yield increases. From (7) and (9), it follows that for some y* lying in the interval (y,y+Δy),

$$\ln P_{1CED} - \ln P_1 = -\frac{1}{3!}(\Delta y)^3 \left[\frac{d^3 \ln P}{dy^3} \right]_{at\ y^*}$$

In the above expression, if we plug the values of the third derivative of log-price for zero coupon bond, we get

$$\ln P_{1CED} - \ln P_1 \quad = \quad \frac{1}{3!}(\Delta y)^3 \left[\frac{2T}{(1+y^*)^3} \right],$$

which is greater than, equal to or less than zero if and only if Δy is greater than, equal to or less than zero, respectively. This implies that CED method under-estimates price when yield decreases and over-estimates price when yield increases. That is P_{1CED}<P_1 for Δy < 0 and P_{1CED}>P_1 for Δy > 0.

Under Proposition 1 we have proved that CED estimate is higher than ED estimate for all Δy. We have just seen that in case of zero coupon bonds, CED under-estimates the actual price when yield decreases (i.e. P_{1CED}<P_1 for Δy<0); this implies that P_{1CED} lies in between P_{1ED} and P_1 i.e. P_{1ED}<P_{1CED} <P_1 for Δy<0. Thus, CED is better than ED method for Δy<0. Since ED method is known to be better than TD method [Miles Livingston and Lei Zhou, 2005]; it implies that CED method will also be better than TD method. This completes the proof of Proposition 2. □

Further, empirically through grid search, it is observed that for zero coupon bonds CED method provides better estimate of price than TD and ED methods, when yield increases (empirical evidence through grid search is presented in Section IV under Grid Search Result 1).

Specific case of perpetual bonds:

For a perpetual bond or consol, having annual coupon rate of c, yield to maturity y and frequency of coupon payment f (1 for annual, 2 for half-yearly, etc.), price is given by $\dfrac{c}{y}.(1+y/f)^{1-w}$, where w ($0 < w \le 1$) represents the ratio of the number of days from the settlement date up to the next coupon date and the number of days in the coupon period in which the settlement date falls. On coupon dates, $w=1$. This price includes accrued interest.

The above expression for price of a perpetual bond can be derived either of the following two ways. First, as the limiting value of the price of nominal bonds from (1) when $n \to \infty$. Second, by noting that the price of a perpetual bond on last coupon day was c/y and after that ($1-w$) amount of time (measured in the units of frequency of coupon payment) has passed and hence present value is

$$\frac{c}{y}.(1+y/f)^{1-w} .$$

It is not difficult to work out the modified duration of a perpetual bond to be $\dfrac{1}{y} - \dfrac{1-w}{y+f}$ and convexity to be $\dfrac{2}{y^2} - \dfrac{2(1-w)}{y.(y+f)} - \dfrac{w(1-w)}{(y+f)^2}$, using (2) and (3) respectively. Note that modified duration and convexity are not dependent on coupon rate of the perpetual bond.

Proposition 3: CED method provides better estimate of price than TD and ED methods for perpetual bonds, when yield decreases.

Proof: First, we prove that in case of perpetual bonds CED method under-estimates the actual price when yield decreases and over-estimates when yield increases. As we have seen earlier, for some y* lying in the interval $(y, y+\Delta y)$,

$$\ln P_{1CED} - \ln P_1 = -\frac{1}{3!}(\Delta y)^3 \left[\frac{d^3 \ln P}{dy^3} \right]_{at\ y^*}$$

In the above expression, if we plug the values of third derivative of log-price for perpetual bond, we get

$$\ln P_{1CED} - \ln P_1 \quad = \quad \frac{1}{3!} \cdot \frac{2(\Delta y)^3}{y*^3} \cdot \left[1 - (1-w) \left(\frac{y*}{y*+f} \right)^3 \right]$$

The term within the square bracket is positive since $0<w\leq1$ and $0<y*/(y*+f) < 1$. Thus error in log-price is greater than, equal to or less than zero if and only if Δy is greater than, equal to or less than zero, respectively. This implies that CED method under-estimates when yield decreases and over-estimates when yield increases in case of perpetual bond. That is $P_{1CED}<P_1$ for $\Delta y < 0$ and $P_{1CED}>P_1$ for $\Delta y > 0$. Also we have seen under Proposition 1 that $P_{1ED}<P_{1CED}$ for all Δy. Combining these we get $P_{1ED}<P_{1CED}<P_1$ for $\Delta y < 0$. Since ED method is known to be better than TD method [Miles Livingston and Lei Zhou, 2005]; it implies that CED method will also be better than TD method. This completes the proof of Proposition 3. □

Further, empirically through grid search, it is observed that in case of perpetual bonds CED method provides better estimate of price than TD and ED methods almost always, when yield increases. Empirical evidence through grid search is presented in Section IV under Grid Search Result 2.

Specific case of nominal bonds:

Unlike TD, TDC and ED methods, it is difficult to say analytically whether CED will under-estimate or over-estimate the actual price in case of nominal bonds when yield decreases or increases; rather it will depend on various characteristics of the bond like time to maturity, coupon, frequency, yield, etc. It is also difficult to prove the performance of CED as compared to TD and ED analytically for nominal bonds. We have tried to gauge its performance through empirical grid search method and presented in Section IV under Grid Search Result 3. It is observed that CED performs better than TD and ED always.

Section IV

Empirical Results through Grid Search[3]

Grid Search Result 1 (Zero Coupon Bonds):

For the purpose of checking performance of CED method against ED and TD methods in case of zero coupon bonds when yield increases, we employed a grid search by varying time to maturity from 1 month to 30 year incrementing by 1 month and yield from 0.01% to 25% incrementing by 1 basis point and increase in yield from 0.01% to 3% incrementing by 1 basis point. Observations from the grid search are as follows:

(i)   Absolute error of CED method is less than those of TD and ED methods.

(ii) Maximum absolute percentage error observed under TD, ED and CED methods are 75.71%, 1.31% and 0.03%, respectively.

Grid Search Result 2 (Perpetual Bonds):

For the purpose of checking performance of CED method against other methods in case of perpetual bonds when yield increases, we used grid search by varying frequency of coupon payment to be annual and half-yearly, yield from 0.01% to 25% incrementing by 1 basis point, w from 0.01 to 1 incrementing by 0.01. For low level of initial yield, when extent of increase in yield is higher than the initial yield level, absolute errors of all the methods are very high and do not give any meaningful estimate. Hence, in the grid we considered increase in yield from 0.01% to min{initial yield, 3%} incrementing by 1 basis point. Coupon rate is not required to be varied in the grid, since percentage errors in price under various methods are independent of coupon rate. Observations from the grid search are as follows:

(i)   Absolute error of CED method is less than that of TD method.

(ii) Absolute error of CED method is less than that of ED method when initial yield level is higher than 0.03% i.e. practically always.

(iii) Maximum absolute percentage error observed under TD, ED and CED methods are 100%, 26.42% and 21.31%, respectively.

Grid Search Result 3 (Nominal Bonds):

We experimented with different nominal bonds by employing grid search. We varied time to maturity of the bonds from 3 months to 360 months with an increment of 3 months, coupon rate from 0.5% to 20% with an increment of 50 basis points, yield to maturity from 0.5% to 20% with an increment of 50 basis points, frequency of coupon payment half-yearly and annual, yield change from -3% to 3% (to be precise from max{-initial yield,-3%} to 3%) with an increment of 5 basis points. The grid covers the commonly observed scenarios in the major markets of the world. Observations from the grid search are as follows:

(i)   Absolute error of CED method is less than those of TD and ED methods.

(ii) Maximum absolute percentage error observed under TD, ED and CED methods are 62.93%, 5.94% and 0.47% respectively.

(iii) As a by-product of the empirical exercise, we have observed that (a) for annual bonds with time to maturity up to 10 years or bearing 9.5% or higher coupon, (b) for semi-annual bonds with time to maturity up to 5 years, (c) for par annual bond with time to maturity up to 10 years or bearing 5.5% or higher coupon, (d) for par half-yearly bond with time to maturity up to 5 years or bearing 10% or higher coupon, CED under-estimates (over-estimates) price when yield decreases (increases). In view of the Proposition 1 also, we can infer that CED will be superior to ED in all these cases, when yield falls.

Section V

Performance of CED method vis-à-vis TDC method (sample cases)

In the earlier section, we have observed the superiority of CED over TD and ED methods under prevailing international bond

market conditions. As regards its performance *vis-à-vis* TDC method, we have checked some sample cases covering different aspects of bonds and the results are presented visually in this section. We have presented estimation errors (in percent) under different methods pictorially for nominal bonds in figures I to XII, for zero coupon bonds in figures XIII to XV and for perpetual bonds in figures XVI to XVIII. As may be observed visually therefrom the estimation errors under CED method are significantly less as compared to other methods (in particular TDC method), for all types of bonds.

We have presented comparative position of absolute values of percentage errors under CED method with those under ED and TDC methods for different time to maturity and change in yield in three-dimensional graphs, for 5% and 10% annual par bonds. Difference of absolute values of percentage errors are plotted in figures XIX to XXII and ratio of absolute values of percentage errors in figures XXIII to XXVI.

In figures XIX to XXII, negative (positive) difference in absolute values of percentage errors will mean that CED is better (worse) than ED/ TDC method, depending on which competing method is used. It may be observed that the difference is negative implying that CED is better. Further, as time to maturity or the amount of change in yield increases, difference also increases in magnitude implying thereby degree of superiority of CED method compared with ED/ TDC methods increases with these parameters.

In figures XXIII to XXVI, a ratio of absolute values of percentage errors being less (greater) than unity here will mean that CED is better (worse) than ED/ TDC method, depending on which competing method is used. Ratio of absolute percentage error of CED to that of ED (figures XXIII and XXV) first decreases and then increases with time to maturity; it increases as the amount of yield change increases. From figures XXIV and XXVI, it may be observed that in case of CED versus TDC this ratio is less than unity and falls rapidly (implying thereby that performance of CED

becomes farther better than TDC) as time to maturity increases and it does not depend much on the amount of yield change. It may also be observed that for 5% (10%) annual par bonds, CED error is lower than $1/20^{th}$ ($1/10^{th}$) of ED error. Further, ratio is much lower in case of CED versus ED than CED versus TDC errors, indicating far superior performance of CED relative to ED than relative to TDC.

Thus, based on these sample cases, we find that CED is better than TDC in all the cases. However, more rigorous exercise is required to be done in this direction.

Section VI

Conclusion

We have introduced Convexity adjusted Exponential Duration (CED) method for estimating price movements under different yield movement scenarios. We have proved empirically that CED method performs better than TD and ED methods in case of zero coupon bonds and perpetual bonds, when yield decreases. We have verified empirically that CED method provides better precision in price movements as compared to TD and ED methods for zero coupon bonds when yield increases. Further, through empirical exercise, we have observed that CED method performs better than TD and ED methods for nominal bonds for increase/decrease in yield up to the magnitude of 300 basis points; change in yield beyond this level is a very unlikely situation in the international market covering bonds of major developed economies. For perpetual bonds, CED method performs better than TD always, and it performs better than ED method almost always (i.e. when initial yield level is higher than 0.03%).

Considering all these aspects we feel that the use of 'Convexity adjusted Exponential Duration' method, as proposed by us, will help in better estimation of interest rate risk as compared to Traditional Duration method and 'Exponential Duration' method as proposed by

Miles Livingston and Lei Zhou [2005] at least for international market covering bonds of major developed economies. Further, some sample exercises indicate that our proposed method performs better than Traditional Duration plus Convexity method. However, more rigorous analysis of the performance of our proposed method as compared to Traditional Duration plus Convexity method is required to be done to establish the superiority of our proposed method.

Notes:

[1] M-absolute, $M^A = \sum_{j=1}^{n} |t_j - H| w_j$

M-square, $M^2 = \sum_{j=1}^{n} (t_j - H)^2 w_j$

Garbade's convexity $= \sum_{j=1}^{n} (t_j - D_{Mac})^2 w_j$

where t_1, t_2, etc. are the cash flow timings (in years), H is the planning horizon (in years), f is the frequency of coupon payment, n is the number of cash flows, D_{Mac} is Macaulay duration of the bond, and weights (w_j, $\Sigma\ w_j{=}1$) are defined as the present values of the cash flows (C_j) divided by the bond price (P), that is,

$w_j = \dfrac{C_j}{(1+y/f)^{j-1}} / P$, or appropriately modified for continuously compounding .

[2] Some financial analysts use $\dfrac{1}{2P} \cdot \dfrac{d^2 P}{dy^2}$ as a measure of convexity.

[3] MATLAB programs will be provided on request.

References:

Louis D'Antonio and Thomas J. Cook (2004), 'Convexity: A comparison and reconciliation of its different forms', *The Journal of Financial Research*, Vol. XXVII, No.2, 251-272

Miles Livingston and Lei Zhou (2005), 'Exponential Duration: A more accurate estimation of interest rate risk', *The Journal of Financial Research*, Vol. XXVIII, No.3, 343-361

Nawalkha S K, Soto G M and Beliaeva N A (2005), 'Interest Rate Risk Modeling: Fixed Income Valuation Course', John Wiley & Sons, New Jersey

Olivier de La Grandville (2001), 'Bond Pricing and Portfolio Analysis – Protecting Investors in the Long Run', The MIT Press, Cambridge, MA.

Figure I: Estimation errors for 30-year 5% Annual Bond at 3% Yield

Figure II: Estimation errors for 30-year 5% Annual Par Bond

Figure III: Estimation errors for 30-year 5% Annual Bond at 7% Yield

Figure IV: Estimation errors for 30-year 10% Annual Bond at 5% Yield

Figure V: Estimation errors for 30-year 10% Annual Par Bond

Figure VI: Estimation errors for 30-year 10% Annual Bond at 15% Yield

Figure VII: Estimation errors for 30-year 5% Half-yearly Bond at 3% Yield

Figure VIII: Estimation errors for 30-year 5% Half-yearly Par Bond

Figure IX: Estimation errors for 30-year 5% Half-yearly Bond at 7% Yield

Figure X: Estimation errors for 30-year 10% Half-yearly Bond at 5% Yield

Figure XI: Estimation errors for 30-year 10% Half-yearly Par Bond

Figure XII: Estimation errors for 30-year 10% Half-yearly Bond at 15% Yield

Figure XIII: Estimation errors for 30-year Zero Coupon Bond at Yield Level of 3%

Figure XIV: Estimation errors for 30-year Zero Coupon Bond at Yield Level of 5%

Figure XV: Estimation errors for 30-year Zero Coupon Bond at Yield Level of 7%

Figure XVI: Estimation errors for 5% Annual Coupon Perpetual Bond at Yield Level of 3%

Figure XVII: Estimation errors for 5% Annual Coupon Perpetual Bond at Yield Level of 5%

Figure XVIII: Estimation errors for 5% Annual Coupon Perpetual Bond at Yield Level of 7%

Figure XIX: Difference in absolute values of percentage errors under CED and ED methods for 5% annual par bond

Figure XX: Difference in absolute values of percentage errors under CED and TDC methods for 5% annual par bond

Figure XXI: Difference in absolute values of percentage errors under CED and ED methods for 10% annual par bond

Figure XXII: Difference in absolute values of percentage errors under CED and TDC methods for 10% annual par bond

Difference in absolute values of percentage errors

Time till Maturity (Year)

Change in Yield (in per cent)
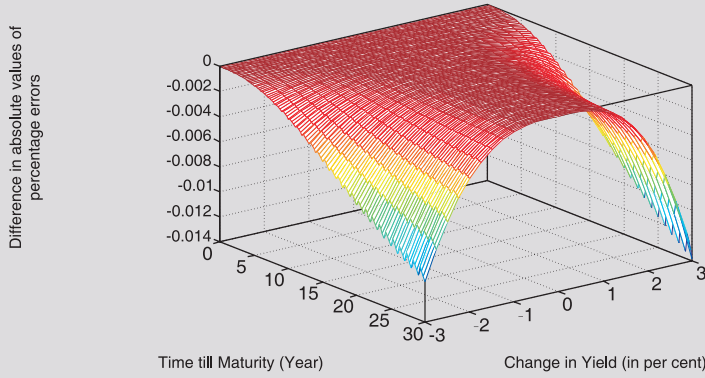
Figure XXIII: Ratio of absolute values of percentage errors under CED and ED methods for 5% annual par bond

Ratio of absolute values of percentage errors

Time till Maturity (Year)

Change in Yield (in per cent)
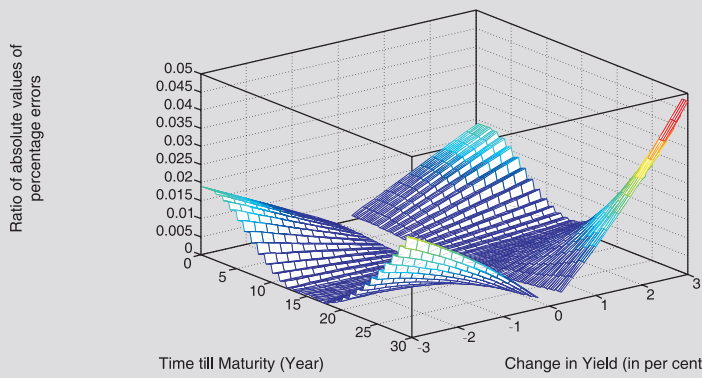
Figure XXIV: Ratio of absolute values of percentage errors under CED and TDC methods for 5% annual par bond

Ratio of absolute values of percentage errors

Time till Maturity (Year)

Change in Yield (in per cent)
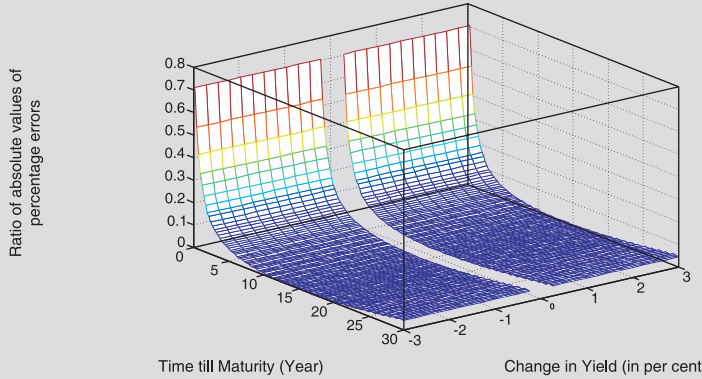
Figure XXV: Ratio of absolute values of percentage errors under CED and ED methods for 10% annual par bond
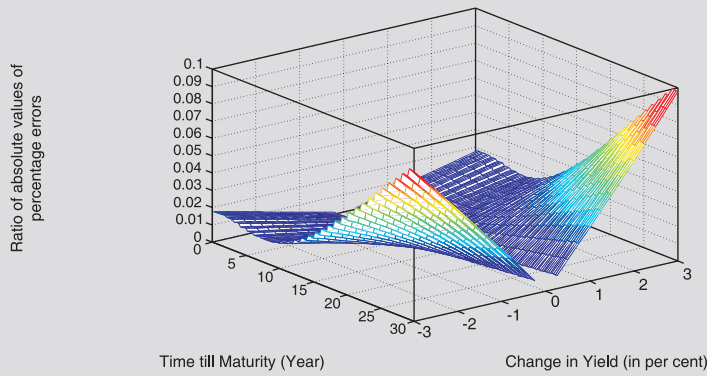
Figure XXVI: Ratio of absolute values of percentage errors under CED and TDC methods for 10% annual par bond
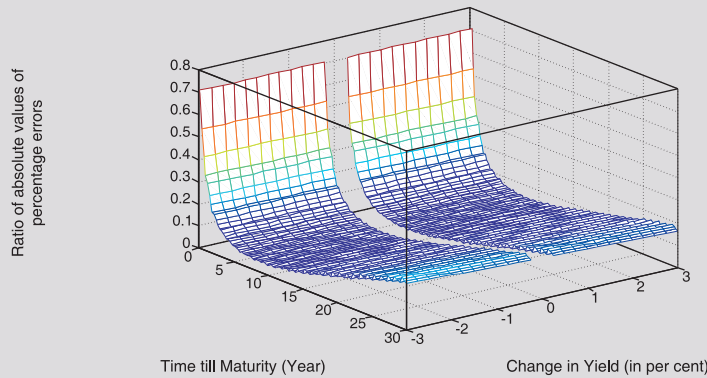
An Empirical Investigation of the Inter-Sectoral Linkages in India

Gunjeet Kaur, Sanjib Bordoloi and Raj Rajesh*

For a developing country like India where socio-economic problems such as poverty, unemployment and inequality influence policy decisions, it becomes important to study inter-linkages among the constituent sectors so that positive growth impulses emerging among the sectors could be identified and fostered to sustain the growth momentum. An in-depth understanding of inter-sectoral dynamics becomes all the more important for policy makers so that effective monetary, credit and fiscal policies could be designed in order to be able to achieve the broader objective of inclusive development. In this backdrop, the present paper endeavors to study inter-sectoral linkages in the Indian economy both through input-output (I-O) approach and econometric exercises using co-integration and state-space models. Co-integration analysis is carried out both at sectoral and sub-sectoral levels since mid-1980s. At the broad sectoral level, primary, secondary and tertiary (excluding community, social and personal services) sectors display strong lo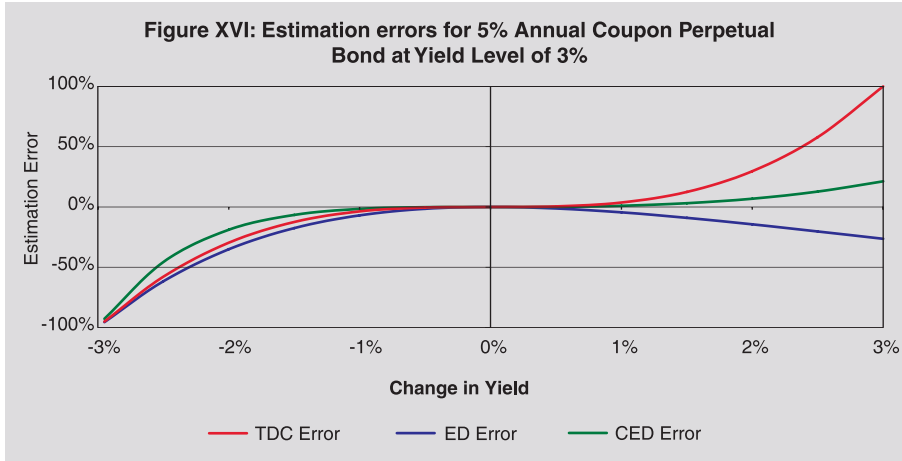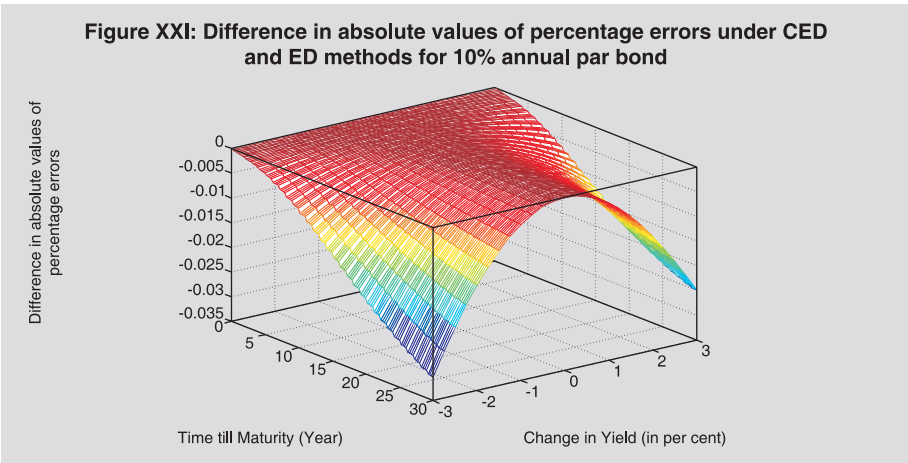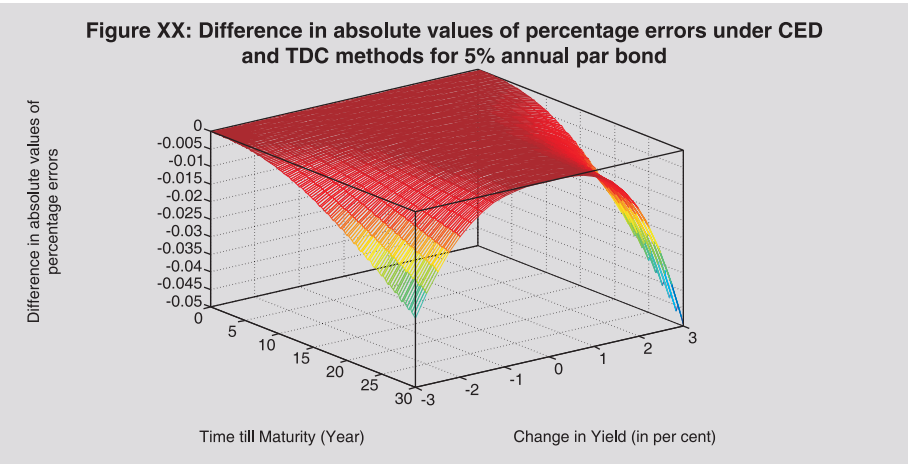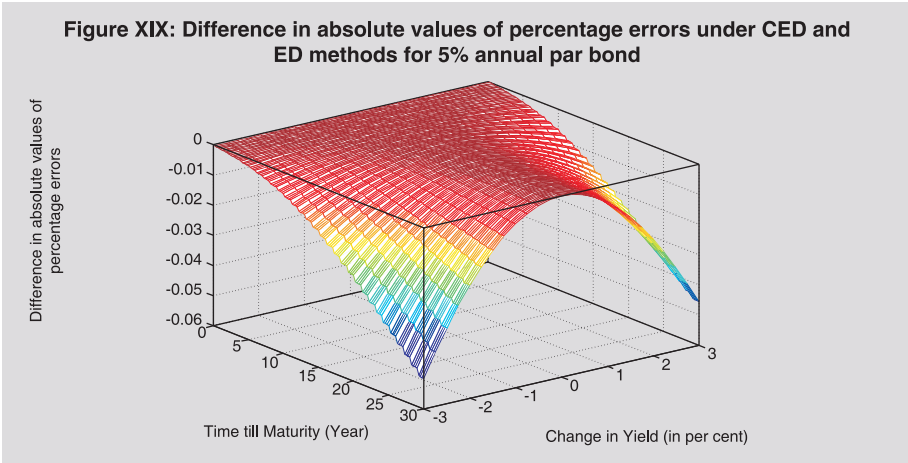ng-run equilibrium relationship amongst each other. These sectors also display strong long-run equilibrium relationship with one another in a bivariate framework. At the sub-sectoral level, existence of long-term equilibrium was found between 'trade, hotels, transport & communication' and 'manufacturing' sectors. Further, the financial sector activity in the 'banking & insurance' sector was found to be co-integrated with the 'manufacturing' and 'primary' sectors. The sectors, which displayed long-run equilibrium relationships, were re-estimated through state space model using Kalman filter. This also corroborated that variation in one sector influenced the other sector's performance over time. In view of the prevailing sectoral inter-relationships, the paper explores policy options so that positive growth impulses developing among the sectors are fostered.

*   Smt. Gunjeet Kaur is Director (Department of Economic Analysis and Policy, Mumbai), Shri Sanjib Bordoloi is Assistant Adviser (Department of Statistics and Information Management, Mumbai) and Shri Raj Rajesh is Research Officer (Department of Economic Analysis and Policy, Patna) in the Reserve Bank of India. Views expressed in the Paper are those of authors' alone and not of the institution to which they belong.

Introduction

The process of economic development in an economy results in distinct structural changes. As a country progresses and the gross domestic product (GDP) basket enlarges, a shift in economic activity occurs away from agriculture towards services and manufacturing sectors, owing to higher elasticity of the latter two sectors than that of former sector (Fisher, 1939 and Clark, 1940). The process in turn leads to structural shifts, and consequent diminishing significance of primary activities and growing dominance of secondary and tertiary activities. This process brings with it significant changes in the production process, consumption pattern and various other social indicators.

As per the standard literature on the subject, services sector experiences an accelerated growth only after a certain level of development has taken place in agriculture and industry. Experiences of the economies over-time, in this regard, have been varied. For instance, in most of the developed economies, economic development followed a sequence wherein sectors *viz.* agriculture, industry and services sector developed in that order. On the contrary, the experience of some of countries such as India bears out that subsequent to the development of the primary sector, tertiary sector developed without a successful transition to an industrialised economy.

From a traditional agro-economy till the 1970s, the Indian economy has transformed into a predominantly services-oriented economy, especially since the mid 1980s. Economic reforms initiated in the mid-eighties and their execution from early nineties has seen the share of services sector in GDP rising continuously for the Indian economy. The shift in composition of GDP has brought about substantial changes in the inter-sectoral production and demand linkages. Further, with the growing tertiarisation of the economy, there has been a phenomenal growth in distributive, communication, consumer and financial services, which, in turn, drives from increased demand from the commodity producing sectors. This brings to fore the issue as to how the tertiary sector is

linked up with the two commodity-producing sectors in the economy.

Investigation of structural relationships among the sectors becomes important from the policy perspective. It helps one understand not only the evolution and progression of such relationships but also the inter-sectoral adjustments over time. A clear perspective on the inter-sectoral dynamics could be useful in devising a conducive and appropriate development strategy. Further, sharp divergences in growth rates of different sectors are found to have serious implications for income distribution, inflation and current account deficit of an economy. A proper comprehension of the characteristics and trend of sectoral linkages also assumes importance in designing socially-just policies as also effective monetary/credit policies. The study of sectoral inter-linkages is all the more important for a developing country like India so that positive growth stimuli among sectors could be identified and fostered to sustain the economic growth momentum. This would go a long way in redressing various socio-economic problems such as poverty, unemployment and inequality.

In this backdrop, the present paper focuses on examining the inter-linkages among the sectors of the economy. Scheme of the paper is as follows: Section I documents the literature on inter-linkages among the sectors. Section II highlights some of growth attributes of the Indian economy. Section III analyses the framework of inter-linkages among various sectors based on Input-Output (I-O) table. Section IV outlines time period for the empirical analysis and the data sources. Section V examines the existence of long-run equilibrium and short-run dynamic relationship amongst primary, secondary and services sectors using co-integration and error correction mechanism. Estimates based on state-space model using Kalman filtre are discussed in Section VI. Section VII discusses some of policy implications emanating from the study. Finally, Section VIII marks concluding observations.

Section I
A Survey of Extant Literature

In an economy, the dynamics of inter-linkages among the sectors can, in general, be examined in three ways. First is through the I-O tables, which reveal the broad trends in structural shifts and at the same time provide valuable insights into the interdependence among the sectors. The second technique is purely statistical in nature and involves analysis of causality among the sectors. The third approach is based on econometric modeling exercises among various sectors of the economy.

In the context of Indian economy, a good deal of literature documents the sectoral inter-linkages. Researchers have attempted the aforementioned techniques extensively. Dhawan and Saxena (1992) and Hansda (2001) used the I-0 approach. Both causality tests and econometric models have been used by a plethora of researchers [Rangarajan, 1982; Ahluwalia and Rangarajan, 1989; Bhattacharya and Mitra, 1989, 1990 and 1997; Sastry *et al*, 2003; Bathla, 2003]. A brief summary of the some of the studies is presented below (Table 1).

Table 1: Literature survey relevant to present study

Study	Main findings
Rangarajan (1982)	➢ It established a strong degree of association between agriculture and industrial sectors. ➢ An important finding of the study is that the consumption linkages are much more powerful than production linkages. ➢ Another significant conclusion which emerged from the paper is that addition of one percent growth in the agricultural sector stimulates the industrial sector output to the extent of 0.5 per cent.
Bhattacharya and Mitra (1989)	➢ It found that the relationship between agriculture and industry depends on the relative growth of income and employment both in the industrial and the services sectors.
Bhattacharya and Mitra (1990)	➢ This paper concluded that though the share of the tertiary sector in total national income has been increasing, its share in total employment has been lower than the other two sectors, which along with an increasing deviation between the growth rates of the tertiary, primary and secondary sectors may have a negative impact on inflation, balance of payments and income distribution.
Bhattacharya and Mitra (1997)	➢ It found that many services activities are significantly associated with the agricultural and industrial sectors and this helps in employment generation.

Table 1: Literature Survey relevant to present study

Study	Main findings
Hansda (2001)	➢ In analysing the complementarity between industrial and services sectors, it conducted a detailed I-O analysis (using 1993-94 data) and found that linkages from services to industry were strong reflecting the use of services sector inputs in industry.
Banga and Goldar (2004)	➢ In order to assess the contribution of services sector to the industrial growth, it estimated a capital, labour, energy, material and services (KLEMS) production function for Indian manufacturing sector for the period 1980-81 to 1999-2000. ➢ Empirically, it found that the contribution of services to output growth increased substantially to 2.07 per cent per annum during the 1990s from a meager 0.06 per cent per annum during the 1980s. The relative contribution of services to output growth was about one per cent in the 1980s and increased significantly to about 25 per cent in the 1990s.
Sastry *et al* (2003)	➢ The inter-sectoral relationships and production linkages in the paper corroborate that in about a quarter of a century, agriculture modernized and this enhanced dependence of agriculture on the industry for inputs. ➢ As for the services sector, the paper shows movement of production linkages from late 1960s to early 1990s moderately in favour of agriculture and sharply in favour of services sector. ➢ On demand linkages, the paper asserts that a fall in agricultural income reduces demand for agricultural machinery and other industrial products, resulting in fall of aggregate demand and *vice-versa*. ➢ It found that dependence of industry on agriculture and services is presently much more than it used to be in the 1970s and the 1980s. Further, a fall in aggregate demand either in agriculture or services sector is likely to cause serious production constraints in the industrial sector, thereby affecting both demand and production linkages.
Bathla (2003)	➢ It carried out a comprehensive analysis of the inter-sectoral linkages in the Indian economy for the period 1950-51 to 2000-01. ➢ Under the granger causality framework, no evidence of relationship was found between primary and secondary sectors, while primary sector was found to have a unidirectional causation with 'trade, hotels, restaurants, communication services' and 'financing, insurance, real estate & business services' sectors. Further, the secondary sector was found to have bi-directional causality both with 'trade, hotels, restaurants, communication' and 'financing-insurance-real estate and business' services. ➢ Under the co-integration framework, strong evidence of existence of long-run equilibrium relationship was found among the primary, secondary and the specialised services sectors.

Section II
India's Growth Story: Some Attributes

Before analysing the inter-sectoral linkages in the Indian economy, it would be useful to review sectoral growth trends and altering sectoral composition of the GDP. To start with, decade-wise analysis reveals that the GDP accelerated remarkably to 5.6 per cent during the 1980s from 2.9 per cent during the 1970s (Table 2). The pick-up in GDP growth was supported by all the sectors with a marked acceleration. Since the eighties, the growth trend of industrial and services sectors have ratcheted upwards, while that of agriculture and allied activities has followed a downward trend.

Performance of services sector in the Indian economy has been exemplary. First, in contrast with agricultural and industrial sectors, except for the interregnum of the 1970s, the growth in services sector has trended upwards, accelerating from 4.0 per cent in 1950s to 8.8

Table 2: Sectoral Growth Trends - Average

(Per cent)

	1950s@	1960s	1970s	1980s	1990s*	2000-01 to 2007-08
1	2	3	4	5	6	7
Agriculture, forestry & fishing	**2.7**	**2.5**	**1.3**	**4.4**	**3.8**	**2.9**
Industry	**5.7**	**6.5**	**3.6**	**6.1**	**6.2**	**7.9**
Mining & Quarrying	4.6	6.2	3.1	8.9	4.9	5.2
Manufacturing	5.8	5.9	4.3	5.7	6.5	7.7
Electricity, Gas & Water Supply	10.7	11.4	6.9	8.3	7.0	4.6
Construction	5.8	7.2	2.0	5.5	6.0	10.6
Services	**4.0**	**4.8**	**4.4**	**6.4**	**7.6**	**8.8**
Trade, Hotels, Transport and Communication	5.0	5.4	4.8	5.9	8.0	10.7
Financing, Insurance, Real Estate & Business Services	3.1	3.2	4.3	8.4	7.7	8.8
Community, Social & Personal Services	3.5	5.2	4.1	5.8	6.9	5.6
GDP at factor cost	**3.6**	**4.0**	**2.9**	**5.6**	**6.2**	**7.3**

* : Excluding the crisis year 1991-92.
@ : Average for the growth during the 1950s is the average of nine years, *i.e.*, from 1951-52 to 1959-60.
Source : Central Statistical Organisation, Government of India.

per cent in 2000s (2000-01 to 2007-08). On the contrary, while the growth in primary sector remained volatile with no clear trend, growth in industrial sector in the 1980s and 1990s (6.1 per cent and 6.2 per cent, respectively) remained even lower than 6.5 per cent growth of the 1960s (3.6 per cent in 1970s).

Second, as measured by the coefficient of variation, services sector remained the least volatile sector of GDP as opposed to primary and secondary sectors (Table 3). Consistent and high growth of the services sector has added a dimension of stability to India's growth process through a decline in volatility of output (Rath and Rajesh, 2006).

In respect of comparison of sectoral shares in GDP since the 1950s, a skewed pattern emerges wherein the relative share of agriculture is declining over time, with industry remaining nearly

Table 3: Volatility in Growth as measured by Coefficient of Variation

(Per cent)

	1950s@	1960s	1970s	1980s	1990s*	2000-01 to 2007-08
1	2	3	4	5	6	7
Agriculture, forestry & fishing	**168.2**	**286.3**	**643.0**	**142.1**	**99.2**	**180.6**
Industry	**64.7**	**41.1**	**103.3**	**39.1**	**44.3**	**34.2**
Mining & Quarrying	72.2	78.2	154.4	58.5	81.7	58.3
Manufacturing	33.4	65.3	96.8	55.4	74.9	34.1
Electricity, Gas & Water Supply	32.9	27.3	62.8	20.9	16.8	42.5
Construction	172.3	57.7	363.6	92.5	62.3	41.7
Services	**22.9**	**23.8**	**31.7**	**20.1**	**23.0**	**22.6**
Trade, Hotels, Transport and Communication	36.7	37.4	59.1	16.8	29.9	18.2
Financing, Insurance, Real Estate & Business Services	34.4	30.8	62.2	33.3	33.7	37.4
Community, Social & Personal Services	22.1	21.9	35.9	34.1	42.2	22.4
GDP at factor cost	**73.2**	**92.5**	**142.0**	**40.9**	**18.2**	**32.1**

* : Excluding the crisis year 1991-92.
@ : Average for the growth during the 1950s is the average of nine years, *i.e*., from 1951-52 to 1959-60.
Source : Central Statistical Organisation, Government of India.

Chart 1: Sectoral Share in GDP
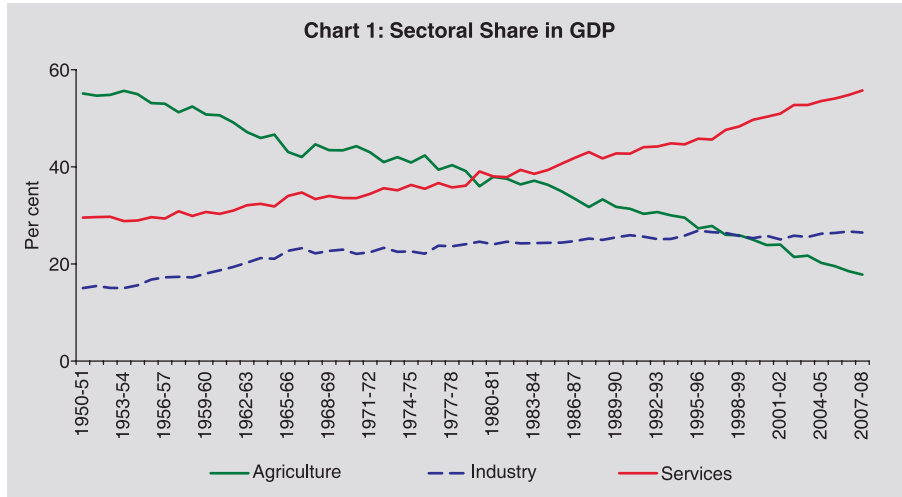
constant and services sector share rising in the GDP (Chart 1). Since the early 1950s, share of services sector in GDP exceeded that of the industrial sector, but the same remained smaller than that of the agricultural sector till the 1970s.

As per the components of services sector, it is found that 'community, social and personal services' (CSPS) and 'trade, hotel, transport & communication' (THTC) had almost the same share in GDP during the period from 1950-51 to 1954-55 (Chart 2). In 1955-56, THTC overtook the CSPS sector. The sector 'financing, insurance,

Chart 2: Share of Different Services Sectors in GDP
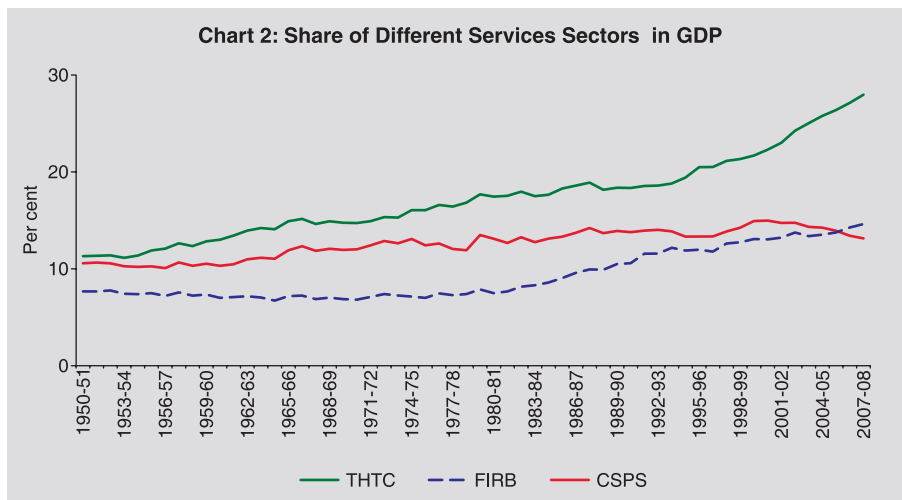
real estate and business services' (FIRB) has seen its share expanding sharply since the early 1980s and in 2006-07, its share in GDP has become almost equal to that of the CSPS. Nationalisation of banks and introduction of post office deposits along with the gradual liberalisation in the insurance sector may have contributed to financial deepening leading to a rise in the share of FIRB in the overall GDP.

Section III
Sectoral Linkages in the Indian Economy

Considering inter-dependence among the three sectors of an economy *viz.* agriculture & allied activities (primary), industry (secondary) and services (tertiary), it may be presumed that demand for one sector in a closed economy is a function of outputs generated in the other two sectors. In an open economy, however, the relationship can be captured by incorporating some other variables, which integrate the external economy.

To begin with, agriculture sector enjoys both production and demand linkages with industrial and services sectors. Agriculture sector has demand linkage with the industrial sector as it depends on the latter for agricultural implements and other inputs such as fertilizers and pesticides. Thus, a good harvest (in turn giving a boost to agricultural income) results in increased demand for industrial products. Similarly, a good agricultural year is also likely to raise demand for services like trade, transport, banking and insurance services. On the supply side, agricultural inputs are used in the production of various chemical and pharmaceutical products; consumer items, especially non-durable food products, *etc*. Thus, a fall in aggregate supply in agriculture sector is likely to cause a serious constraint in production of the industrial sector.

Similarly, there is a positive and significant association between manufacturing and services sectors, which becomes stronger at advanced stages of industrialisation. With the expansion of the economy, particularly in the manufacturing sector, demand for services like trade, transport, hotel, banking and social services such as education, hospitals and other infrastructure increases. In turn,

the service sector growth depends on the development of manufactured inputs. Given the high-income elasticity of demand for services, as the economy develops with rising per capita income, the growth linkages between manufacturing and services sectors become stronger through increased demand for each other's output. In recent years, there has been a phenomenal growth in respect of distributive, communication and financial services. Abetted liberalisation communication sector has been one of the fastest growing sectors, which has enhanced the productivity in the commodity producing sectors through sharing of recent and update knowledge about the current market and demand conditions. Financial services have consistently recorded double-digit growth in the last four years benefiting from substantial expansion in the economic activity. Transportation sector also witnessed substantial expansion and benefited from the burgeoning activity in commodity-producing sectors as well as growing external orientation of the Indian economy.

In the present study, we have relied upon both I-O approach and econometric modeling exercise using co-integration and state space models to study the inter-sectoral linkages in the Indian economy. I-O approach has been attempted to examine whether there have been some broad changes or shifts in the production and demand inter-linkages amongst the sectors over time. Co-integration analysis has been carried out to check long-run equilibrium relationship between and amongst the sectors. Having established co-integrating relationships, we have extended the estimation exercise by estimating state space model using Kalman filter. The basic objective behind this is to gauge the extent to which change in one sector(s) influences the other sector's performance over time.

III.1. Analysis based on the I-O Tables

An input-output table reflects inter-industry relations in an economy. It captures the dynamics of how output of one industry goes into another industry where it serves as an input, and thereby shows inter-dependence of the sectors, both as buyer of output and

as supplier of inputs. Each column of the I-O table reports monetary value of an industry's inputs, while each row represents value of an industry's outputs. Assuming that there are three industries in an economy, then column 1 reports value of inputs to industry 1 from industries 1, 2, and 3. Columns 2 and 3 do the same for respective industries. Row 1 reports value of outputs from industry 1 to industries 1, 2, and 3. Rows 2 and 3 do the same for the other industries. Hence, both production and demand linkages among the sectors can be examined from the I-O matrices. I-O tables also enable us to examine the nature and extent of changes in inter-dependence of various sectors over the years. Nevertheless, a major limitation of this approach is that it involves extensive data collection, which is generally not available on an annual basis. As a consequence, results based on these tables remain static and relate mainly to the reference period.

III.1.1. Production Linkages

Production linkages among various sectors of the Indian economy basically arise from inter-dependence of sectors for meeting their productive inputs needs. The production linkages between the sectors can be best illustrated through the available I-O tables for 1968-69, 1979-80, 1989-90, 1993-94, 1998-99 and 2003-04.

The sectoral share matrix (production linkage) based on the I-O table is presented in Table 4. The I-O table reveals that during 1968-69, to produce one unit of services output, it required 0.017 units of agricultural input, 0.132 unit of industrial input and 0.096 unit of services sector input itself. In 2003-04, one unit of services sector output required 0.029 unit of agricultural input, 0.213 unit of industrial input and 0.129 unit of services input. It is observed that input dependence of services sector is more aligned with the industrial sector than with agriculture sector. In respect of industry in 1968-69, input requirements for producing one unit of industrial sector output were 0.127 units from agriculture, 0.333 units from industry itself and 0.135 units from the services sector. Input dependence of

industrial sector remains the maximum with itself and this is found to be increasing from 0.333 during 1968-69 to 0.455 during 2003-04.

Coming to agriculture, it is observed that input usage from the industrial sector (such as agricultural implements) is increasing, though in 2003-04 it shows a slight decline from the 1998-99 level. Increased dependence of agriculture on Industry for inputs is suggestive of the growing mechanisation of Indian agriculture. In fact, input usage from the industrial sector has been showing an

Table 4: Sectoral Share Matrices (Production Linkages)

	Agriculture	Industry	Services
1	2	3	4
1968-69			
Agriculture	0.182	0.127	0.017
Industry	0.043	0.333	0.132
Services	0.016	0.135	0.096
1979-80			
Agriculture	0.160	0.130	0.039
Industry	0.068	0.345	0.105
Services	0.020	0.149	0.096
1989-90			
Agriculture	0.166	0.042	0.035
Industry	0.144	0.373	0.172
Services	0.047	0.188	0.185
1993-94			
Agriculture	0.146	0.038	0.037
Industry	0.144	0.422	0.231
Services	0.027	0.101	0.117
1998-99			
Agriculture	0.118	0.033	0.025
Industry	0.195	0.421	0.211
Services	0.029	0.101	0.132
2003-04			
Agriculture	0.196	0.028	0.029
Industry	0.180	0.455	0.216
Services	0.045	0.108	0.129

Note : Data upto 1993-94 have been taken from Sastry *et al* (2003). Data for 1998-99 and 2003-04 are based on authors' calculations.

Source : Sastry *et al* (2003) and Central Statistical Organisation.

increasing trend for all the three sectors, indicating the growing importance of industrial inputs for the other sectors, as the economy progresses.

III.1.2. *Demand Linkages*

In the preceding section, we examined production linkages using input-output coefficient matrix, say A, for each specific years. The matrix $[I — A]^{-1}$ can be used to examine the demand inter-linkages among the sectors. Such matrices for the years 1968-69, 1979-80, 1989-90, 1993-94, 1998-99 and 2003-04 are presented in Table 5.

Table 5: Sectoral Demand Matrices [$(I - A)^{-1}$] (Demand Linkages)

	Agriculture	Industry	Services
1	2	3	4
1968-69			
Agriculture	1.230	0.247	0.059
Industry	0.087	1.562	0.230
Services	0.035	0.237	1.141
1979-80			
Agriculture	1.214	0.260	0.083
Industry	0.135	1.601	0.191
Services	0.049	0.269	1.139
1989-90			
Agriculture	1.220	0.104	0.074
Industry	0.319	1.729	0.378
Services	0.144	0.404	1.318
1993-94			
Agriculture	1.189	0.091	0.074
Industry	0.326	1.838	0.495
Services	0.074	0.213	1.191
1998-99			
Agriculture	1.152	0.075	0.051
Industry	0.420	1.831	0.457
Services	0.087	0.216	1.207
2003-04			
Agriculture	1.265	0.077	0.061
Industry	0.466	1.958	0.501
Services	0.123	0.247	1.213

Note : Data upto 1993-94 have been taken from Sastry, *et al* (2003). Data for 1998-99 and 2003-04 are based on authors' calculations.
Source : Sastry, *et al* (2003) and Central Statistical Organisation.

I-O table (based on the matrix [I-A]$^{-1}$) for different years indicates major shifts in demand linkages. It is well established that an increase in agricultural income enhances the demand for industrial goods. Further, a good harvest year is also likely to raise the demand for various services such as the transport, *etc.* It is found that during 1968-69, a rise in demand in agriculture by one unit was likely to raise demand for industrial goods by 0.087 units and demand for services by 0.035 units. It is found that over the years, a rise in the income of agricultural households had made a positive impact on industrial and services sectors through the demand channel. The demand linkage of agricultural sector was found to be stronger with industrial sector than with services sector. Over the years, demand for industrial goods arising from agricultural sector has increased more than five-folds (from 0.087 in 1968-69 to 0.466 in 2003-04). Similarly, over the years a rise in agricultural income has increased the demand for services sector by more than three-folds (from 0.035 in 1968-69 to 0.123 in 2003-04).

During the same period, demand linkage of the industrial sector with the agriculture sector declined from 0.247 in 1968-69 to a mere 0.077 in 2003-04. On the contrary, demand linkage of industry with the services sector has remained intact, it increased initially from 0.237 in 1968-69 to 0.404 in 1989-90, and thereafter declined to 0.213 in 1993-94 before increasing to 0.247 in 2003-04. Demand linkage of services sector with industrial sector improved significantly from 0.230 in 1968-69 to 0.501 in 2003-04, indicating rising importance of industry for services sector, though it remained almost static in case of agriculture.

On the whole, I-O analysis reveals well-built production and demand linkages of services sector with industrial sector and of agriculture sector with industrial sector, respectively.

Section IV
Empirical Analysis and Data Sources

The empirical analysis in the paper focuses on the period since the mid-1980s. This is guided by two developments that

reinvigorated India's economic growth since the 1980s. First, a number of reforms, which were initiated in the 1980s, brought about the structural transformation in the economy to a certain extent. By the early 1980s, the Government had realised that licensing and other restrictions had limited the level of investment activity in the economy. It was felt that opening up the economy to foreign investment could enhance efficiency by bringing in superior technologies and better work practices. This changed the policy perspective and led to liberalisation in the Industrial Policy Statements of 1980 and 1982. For instance, foreign equity restrictions and licensing procedures for Monopolies and Restrictive Trade Practice (MRTP) companies were simplified. Furthermore, some of the industries earlier reserved exclusively for the small-scale industries (SSIs) were opened up for large and medium-scale industries. By 1983, import policies were also liberalised. Further, in 1985, establishment of four additional export-processing zones was announced with a view to attracting export-oriented foreign direct investment (FDI). In addition, by the mid-1980s, non-resident Indians (NRIs) were allowed to invest in Indian companies through equity participation. Second, as documented in Section III, growth trend in the Indian economy broke away from the past in the 1980s. This high growth phase of the economy since the 1980s was, by and large, led by the services sector, which being not a commodity producing sector depends on both industry and services sectors for its growth. This development is likely to have added a new dimension to the inter-sectoral linkages in the Indian economy.

As per the data sources, annual data from 1950-51 to 1999-00 on GDP along with its constituent sectors have been collected from 'National Accounts Statistics: Back Series 1950-51 to 1999-00' (CSO, 2007). For the subsequent periods the data have been taken from the web-site of the CSO. Data on rainfall are sourced from India Meteorological Department (IMD), Government of India. The US GDP data have been gathered from the website of Bureau of Economic Analysis, US Department of Commerce (http://www.bea.gov).

Section V
Co-integration Tests and Error Correction Model

Co-integration tests are conducted to examine the existence of long-run equilibrium relationship among a set of economic time series variables. Since co-integration can be done only with those variables that are integrated of the same order, initially we tested all the log-transformed variables for presence of unit roots or non-stationarity using Augmented Dickey-Fuller (ADF) test (Dickey and Fuller, 1979, 1981). The empirical results related to ADF test are presented in Table 6. All the variables, except the rainfall index, are found to be first difference stationary. Rainfall index is found to be stationary at level.

Mathematically, two or more variables are said to be co-integrated if they are individually integrated of the same order, say I(p), and a linear combination of the variables exists such that their linear combination is stationary, *i.e.* I(0). Generally, existence of co-

Table 6: Unit Root Test using Augmented Dickey Fuller (ADF) Test

Sector	Description	At Level		At First Difference		Conclusi-on
		Optimum Lag length	ADF test statistic	Optimum Lag length	ADF test statistic	
1	2	3	4	5	6	7
Primary Sector	PRI	1	-2.822	0	-12.360**	I(1)
Secondary Sector	SEC	0	-0.766	0	-5.684**	I(1)
Manufacturing	MFG	0	-2.341	0	-5.737**	I(1)
Tertiary Sector	TER	1	1.817	0	-4.855**	I(1)
Tertiary Sector excluding Community, Social & Personal Services	TER_EX_CSPS	0	2.743	0	-5.402**	I(1)
Trade, Hotels, Transport & Communication	THTC	1	1.652	0	-3.506**	I(1)
Banking and Insurance	BNKI	0	-1.273	0	-7.916**	I(1)
Gross Domestic Product (India)	GDP	0	0.447	0	-7.722**	I(1)
Rainfall Index	RAINFALL	0	-5.530**	–	–	I(0)
USA Gross Domestic Product	USGDP	0	-2.227	0	-7.200**	I(1)

Note : 1. The critical values for ADF test statistic are -4.122 (at 1%), -3.488 (at 5%) and -3.172 (at 10%) at level. Similarly, the critical values for ADF test statistic are -3.546 (at 1%), -2.912 (at 5%) and -2.593 (at 10%) at first difference.

2. ** indicates significance at 1% level of significance.

integration is examined by two alternative approaches, *viz.*, the Engle-Granger two step method proposed by Engel and Granger (1987) and Johansen-Juselius method proposed by Johansen (1988) and later expanded by Johansen and Juselius (1990). The Engle-Granger method is basically for tests for a unique co-integrating relationship, while the Johansen-Juselius method can be applied to test for existence of more than one co-integrating relationship. The number of co-integrating vectors based on Johansen-Juselius method is determined based on two test statistics, *viz.,* the Trace Statistic and the Maximal Eigenvalue Statistic. The Trace Statistic examines the null hypothesis that the number of distinct co-integrating vectors is less than or equal to 'r' against a general alternative. The Maximal Eigenvalue Statistic tests the null hypothesis that the number of co-integrating vectors is 'r' against the alternative of 'r+1' co-integrating vectors.

To begin with, as documented earlier, we would confine our analysis from mid-1980s onwards (from 1985-86 to 2007-08). Initially, we attempted to establish co-integrating relationship among the major sectors, *viz.*, primary, secondary and tertiary sectors and then tried to explore the relationship of certain sub-sectors of the secondary and tertiary sectors with other sectors. The empirical results of the co-integration tests based on Johansen-Juselius method are presented in Annex-I. Both the Trace Statistic and Maximum Eigenvalue Statistic indicate existence of co-integrating relationship among the sectors. In the process, we have made the following nine co-integrating relationships among various sectors and sub-sectors of the economy.

V.1. *Primary Sector and Secondary Sector*

At the outset, we attempted to explore the relationship between primary and secondary sectors. As the output of the primary sector in India depends heavily on rainfall, we have incorporated the rainfall index as an additional variable in the short-run dynamic equation. Both the Trace Statistic and Maximal Eigenvalue Statistic reject the null hypothesis of no cointegration.

The estimate of long-run equation along with short-run dynamic ECM equation for the period 1985-86 to 2007-08 is presented below. The estimated coefficient of the error term ECM_{t-1} indicates speed of adjustment of the primary sector towards the equilibrium state. The state corrects approximately 46 per cent of their error during one year.

Long-run Equation:

$$\log(PRI_t) = 1.430 + 0.510 \log(SEC_t)$$

ECM equation:

$$\Delta \log (PRI_t) = -0.46 ECM_{t-1} - 0.35 \Delta \log (PRI_{t-1}) - 0.18 \Delta \log$$
$$(PRI_{t-2}) - 0.04 \Delta \log (SEC_{t-1}) - 0.28 \Delta \log (SEC_{t-2})$$
$$+ 0.32 \log (RAINFALL_t)$$

Adjusted $R^2 = 0.83$

V.2. Primary Sector and Manufacturing Sector

We further attempted to explore for existence of relationship between the primary and manufacturing sectors. Both the Trace Statistic and Maximal Eigenvalue Statistic suggest existence of one cointegrating relationship. The ECM equation indicates that approximately 45 percent of previous year error is corrected in the current year. The estimates of both long-run as well as short-run ECM equations are presented below:

Long-run Equation:

$$\log(PRI_t) = 1.491 + 0.512 \log(MFG_t)$$

ECM equation:

$$\Delta \log (PRI_t) = -0.45 ECM_{t-1} - 0.32 \Delta \log (PRI_{t-1}) - 0.14 \Delta \log$$
$$(PRI_{t-2}) - 0.02 \Delta \log (MFG_{t-1}) - 0.32 \Delta \log (MFG_{t-2})$$
$$+ 0.33 \log (RAINFALL_t)$$

Adjusted $R^2 = 0.85$

V.3. *Primary Sector and Tertiary Sector*

Next, we explored for existence of long-run equilibrium relationship between the primary and tertiary sectors. The rainfall index has also been included as an additional variable in the short-run ECM equation. Both the Trace Statistic and Maximal Eigenvalue Statistic suggest existence of one cointegrating relationship.

The estimate short-run dynamic ECM equation indicates that approximately 33 percent of the error is being corrected during the current year. The estimates of both the equations are presented below.

Long-run Equation:

$$\log(PRI_t) = 0.90 + 0.45 \log(TER_t)$$

ECM equation:

$$\Delta \log (PRI_t) = -0.33 ECM_{t-1} - 0.44 \Delta \log (PRI_{t-1}) - 0.24 \Delta \log (PRI_{t-2}) - 0.08 \Delta \log (TER_{t-1}) - 0.39 \Delta \log (TER_{t-2}) + 0.36 \log (RAINFALL_t)$$

Adjusted R^2 = 0.83

V.4. *Primary Sector and Tertiary Sector (excluding CSPS)*

In line with above, we further attempted to explore for the existence of relationship between the primary and tertiary sector, excluding community, social & personal services. Both the Trace Statistic and Maximal Eigenvalue Statistic indicate the existence of one long-run equilibrium relationship. The estimate of both the equations is presented below.

Long-run Equation:

$$\log(PRI_t) = 1.430 + 0.447 \log(TER\_EX\_CSPS_t)$$

ECM equation:

$$\Delta \log (PRI_t) = -0.40 ECM_{t-1} - 0.38 \Delta \log (PRI_{t-1}) - 0.19 \Delta \log (PRI_{t-2}) - 0.35 \Delta \log (TER\_EX\_CSPS_{t-1}) - 0.54 \Delta \log (TER\_EX\_CSPS_{t-2}) + 0.35 \log (RAINFALL_t)$$

Adjusted R^2 = 0.84

V.5. Secondary Sector and Tertiary Sector

Next, an attempt was made to explore the relationship between the secondary and tertiary sector. Since the mid-1980s, the secondary and tertiary sectors display strong long-run equilibrium relationship with each other. The USGDP has also been added as an additional variable in the short-run dynamic equation. Both the Trace Statistic and Maximal Eigenvalue Statistic indicate the existence of one long-run equilibrium relationship.

The short-run dynamic ECM equation indicates that the state corrects approximately 40 percent of their error during one year.

Long-run Equation:

$$\log(SEC_t) = 0.33 + 0.90 \log(TER_t)$$

ECM equation:

$$\Delta \log (SEC_t) =- 0.40 ECM_{t-1} + 0.86 \Delta \log (SEC_{t-1}) + 0.10 \Delta \log (SEC_{t-2}) - 0.33 \Delta \log (TER_{t-1}) - 0.77 \Delta \log (TER_{t-2})$$
$$+ 0.02+ 0.94 \Delta \log (USGDP_t)$$

Adjusted R^2 =0.64.

V.6. Secondary Sector and Tertiary Sector (excluding CSPS)

Further, we tried to explore the relationship between secondary and tertiary sectors, after excluding the Community, Social & Personal Services (CSPS) from the tertiary sector. Since the mid-1980s, secondary and tertiary sectors (excluding CSPS) indicate strong long-run equilibrium relationship, as indicated by the Trace Statistic as well as by the Maximal Eigenvalue Statistic. Estimate of the long-run cointegrating relationship between the two sectors for the period 1985-86 to 2007-08 is as follows:

Long-run Equation:

$\log(SEC_t) = 0.84 + 0.85 \log(TER\_E\_CSPS_t)$

ECM equation:

$$\Delta \log (SEC_t) = -0.41 ECM_{t-1} + 0.88 \Delta \log (SEC_{t-1}) + 0.10 \Delta \log (SEC_{t-2}) - 0.28 \Delta \log (TER\_E\_CSPS_{t-1}) - 0.87 \Delta \log (TER\_E\_CSPS_{t-2}) + 0.75 \Delta \log (USGDP_t)$$

Adjusted $R^2 = 0.64$.

V.7. Primary Sector, Secondary Sector and Tertiary Sector

After establishing the existence of bivariate long-run relationship between different sectors, we further attempted to explore for existence of cointegration relationship among all the three major sectors, *viz.,* primary, secondary and tertiary sectors. Mathematically, both the Trace Statistic and Maximal Eigenvalue Statistic indicate existence of at most two cointegrating relation among the three sectors. The estimate of the long-run relationship is found to be

$\log(PRI_t) = 2.85 - 0.22 \log(SEC_t) + 0.68 \log(TER_t)$

Sign of the estimated coefficient in respect of the secondary sector is found to be negative, which suggests that the secondary sector and primary sector move in the opposite direction in the long-run. This finding is against the belief that all the sectors in an economy will move in the same direction, at least in the long-run.

Further, we explored for existence of long-run relationship among the three sectors, after excluding the CSPS sector from the tertiary sector. The rationale for exclusion of CSPS from the tertiary sector in our analysis emanates from the fact that a major part of the CSPS comprises wages and salaries of the Government administrative departments, which is policy driven and as such does not directly enter the productive activities of the economy. The Trace Statistic suggests the existence of at most two cointegrating relationship, while the Maximal Eigenvalue Statistic suggest existence of at most one cointegrating relationship among the three sectors, after excluding the CSPS sector from the tertiary sector. Thus, based on both the statistics,

we can infer for existence of long-run equilibrium relationship among the primary, secondary and tertiary sectors (excluding CSPS) for the period from 1985-86 to 2007-08. The short-run ECM equation includes USGDP and rainfall index as exogenous variables. The co-efficient for both these variables are found to be positive and significant. The positive sign in respect of rainfall index supports the assumption that a good monsoon plays a vital role in the agricultural growth of the Indian economy. Further, growth in the Indian economy is found to depend on the state of the US economy, which alone accounts for about a quarter of the global GDP. This is in sync with fact that though the export as well as import orientation of Indian economy is diversifying to other markets, the US continues to be one of its largest trading partners.

The estimate of the long-run cointegrating relationship among the three sectors is presented below. The ECM equation indicates that approximately 35 percent of the previous year error is corrected in the current year.

Long-run Equation:

$$\log(PRI_t) = 2.83 + 0.005 \log(SEC_t) + 0.19 \log(TER\_E\_CSPS_t)$$

ECM equation:

$$\Delta \log (PRI_t) = - 0.35ECM_{t-1} - 0.48\Delta \log (PRI_{t-1}) - 0.23\Delta \log$$
$$(PRI_{t-2}) + 0.38\Delta\log(SEC_{t-1}) + 0.15\Delta \log(SEC_{t-2})$$
$$- 0.30\Delta \log (TER\_E\_CSPS_{t-1})$$
$$- 0.34 \Delta \log (TER\_E\_CSPS_{t-2}) - 0.58$$
$$+ 0.32 \log (RAINFALL_t) + 0.37 \Delta \log (USGDP_t)$$

Adjusted R^2 =0.83

V.8. Banking & Insurance Sector, Manufacturing Sector and Primary Sector

Next we explored for existence of any long-run relationship among the banking & insurance, manufacturing and primary sectors. Though the Trace Statistic indicates existence of a single long-run cointegrating relationship, Maximal Eigenvalue Statistics suggests non-existence of

any cointegrating relationship among the three sectors. The ECM equation indicates that approximately 38 percent of previous year error is corrected in the current year.

Estimate of the long-run equation (as suggested based on the Trace Statistic) is found to be:

Long-run Equation:

$$\log(BNKI_t) = -9.60 + 0.22 \log(MFG_t) + 2.09 \log(PRI_t)$$

ECM equation:

$$\Delta \log (BNKI_t) = -0.38ECM_{t-1} + 0.16 \Delta \log (BNKI_{t-1})$$
$$+ 0.12 \Delta \log (BNKI_{t-2}) + 0.05 \Delta \log (MFG_{t-1})$$
$$+ 0.05 \Delta \log (MFG_{t-2}) - 0.03\Delta \log (PRI_{t-1})$$
$$- 0.42 \Delta \log (PRI_{t-2}) + 0.03$$

Adjusted $R^2 = 0.32$

V.9. *Trade, Hotels, Transport & Communication Sector and Manufacturing Sector*

Finally, we attempted to explore for the existence of long-run equilibrium relationship of 'trade, hotels, transport & communication' (THTC) sector with other sectors of the economy. Empirically, THTC sector is found to be cointegrated with the manufacturing sector, as suggested by both Trace Statistic and Maximal Eigenvalue Statistic. The USGDP is found to have a significant impact on India's trade growth in the short-run, which, in turn, is a testimony of the fact that the US is India's largest trade associate.

The estimate of the long-run equilibrium equation along with the short-run ECM equation is presented below. Co-efficient of the ECM term in the short-run equation is found to be 0.16. This indicates that, if the deviation in the long-run equation, *i.e.*, 'log(THTC) - 1.05 – 0.83 log(MFG)' is positive, then value added in the manufacturing sector will rise and the value added in the trade sector will fall. In case the deviation in the long-run equation is negative, then value

added in the manufacturing sector will fall and in the trade sector will rise.

Long-run Equation

$\log(THTC_t) = 1.05 + 0.83 \log(MFG_t)$

ECM equation:

$$\Delta\log(THTC_t) = 0.16ECM_{t-1} - 0.15\Delta\log(THTC_{t-1}) - 0.61\Delta\log(THTC_{t-2})$$
$$+ 0.38\Delta\log(MFG_{t-1}) + 0.14\Delta\log(MFG_{t-2})$$
$$+ 0.04 + 0.73\Delta\log(USGDP_t)$$

Adjusted $R^2 = 0.68$

Section VI
State Space Model Framework

Having established long-run equilibrium relationship among the variables, we extended our empirical exercise and made some estimations through the state space model using Kalman filter and test the stability of the model. The basic objective behind this exercise is to gauge the impact of changes in one sector(s) over the other sector over time. The estimates of state space model are obtained by maximising the log-likelihood function through a recursive algorithm (Annex– II). Towards this endeavor, we have considered the following seven frameworks, based on the cointegrating relationships as found in the preceding section. Formulation of the state space model is described in Annex – III.

VI.1.   *Primary Sector and Secondary Sector*

The first state-space model is premised on primary sector output being dependent only on the secondary sector output as also on the rainfall (Chart 3). The standard errors for the constant term as well as both for secondary sector and rainfall index are found to be quite small, implying stability in estimate of the parameters (Chart 3-B, Chart 3-D and Chart 3-F). The coefficient of the constant term shows an increasing trend (Chart 3-A) suggesting possibly that productivity in agriculture sector might have increased over the years. The coefficient of the manufacturing sector shows a declining trend in the last decade or so,

Chart 3: Plot of the Estimates and Standard Errors of Parameters (state series) for PRI = f(SEC, RAINFALL)

Plot of the Coefficient estimates of Parameters

Plot of the Standard Errors of Parameters
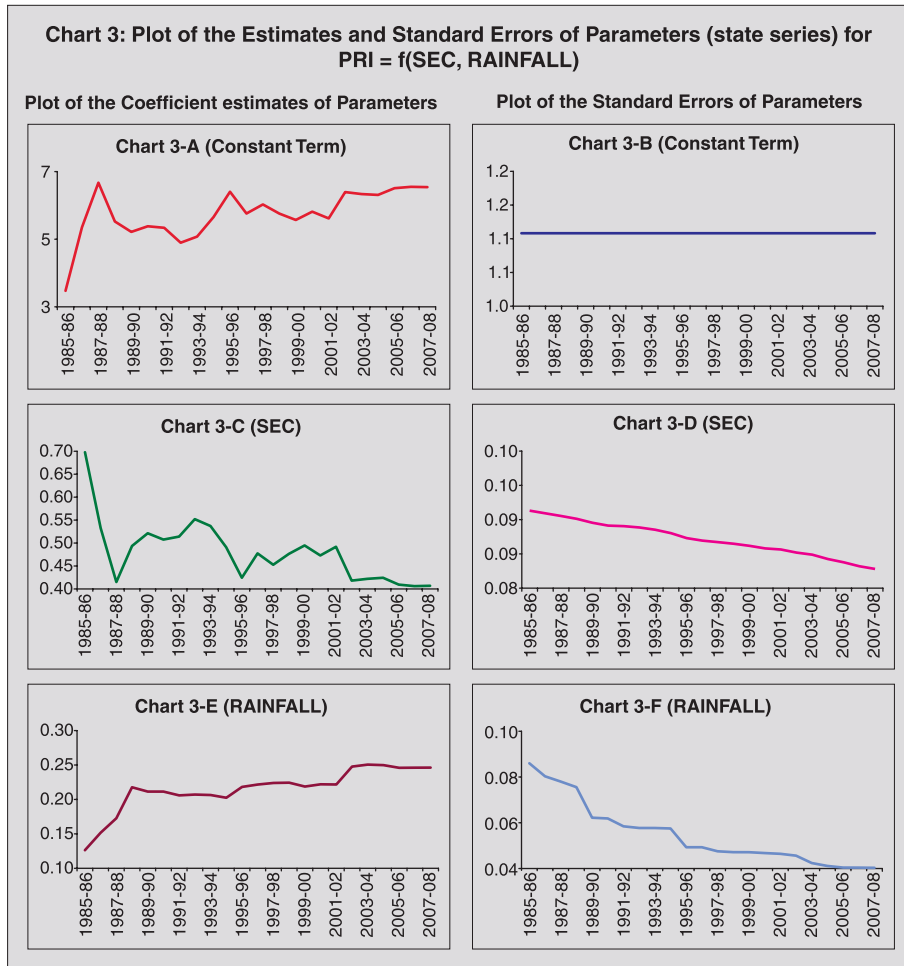
indicating the lower dependence of the agriculture and allied sector on the manufacturing sector. Interestingly, this fact is to an extent supported by the I-O Table (Table 3) also, wherein one unit agricultural sector output required 0.195 unit of industrial inputs in 1998-99, which subsequently declined to 0.180 units in 2003-04. The coefficient of rainfall index shows a rising trend indicating a stronger influence of the rainfall still on agricultural and allied sector output.

VI.2.   *Primary Sector and Tertiary Sector:*

The second state-space model formulates the primary sector on tertiary sector. Further, the primary sector is assumed to be

dependent on rainfall also. Estimates of the coefficient along with the standard errors of parameters are presented in Chart 4. The estimate of near zero standard errors for all the parameters indicates stability in the estimate of the co-efficient. Coefficient of the constant term is showing an increasing trend (Chart 4-A), which supports the empirical finding obtained in the previous section. The coefficient of the tertiary sector shows a declining trend in the last decade or so, which is suggestive of the fact that of late the dependence of the agriculture & allied activities on tertiary sector has declined (Chart 4-C).

Chart 4: Plot of the Estimates and Standard Errors of Parameters (state series) for PRI = f(TER, RAINFALL)
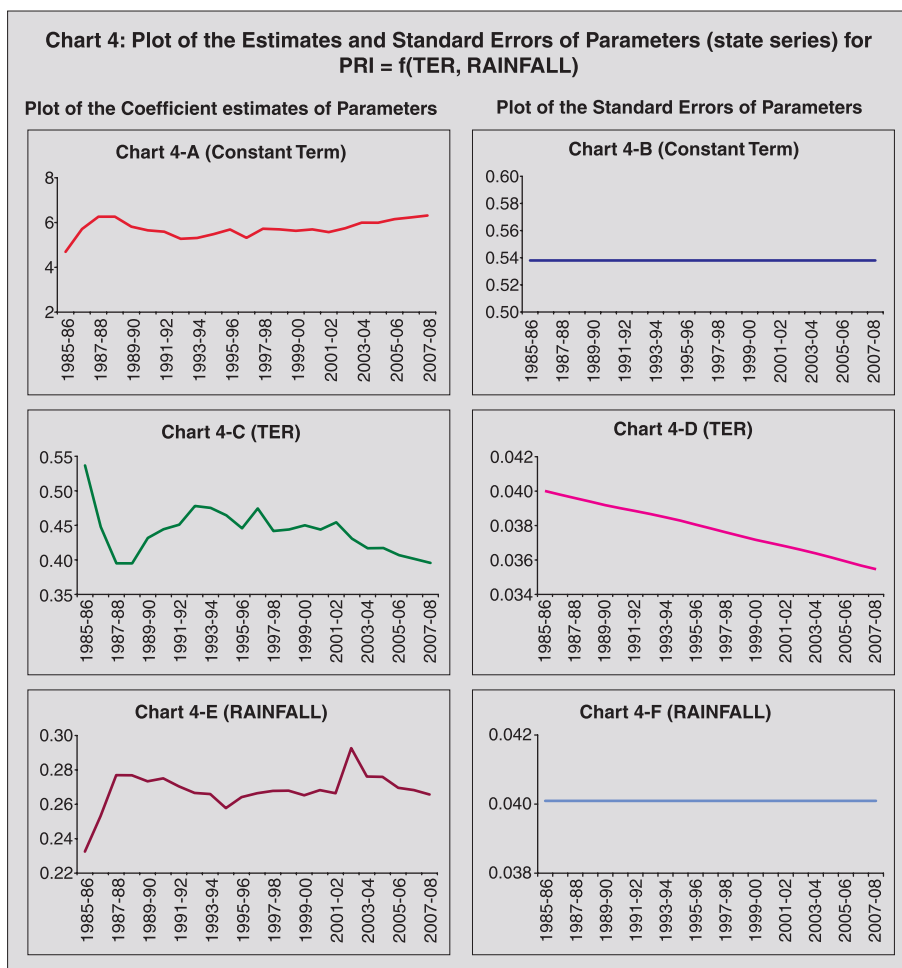
VI.3.   *Secondary Sector and Tertiary Sector:*

In the third analysis, secondary sector output is considered to be a function of the tertiary sector. Further, the USGDP has also been considered as an additional explanatory variable in the model. Estimates of the coefficient of the parameters along with the standard errors over the period are presented in Chart 5. Estimates of standard errors for all the parameters are found to be small indicating stability of estimates of the parameters. Coefficient of the tertiary sector is showing an increasing trend since the early 2000s, suggesting that tertiary sector, of late, has been abetting the secondary sector output. Further, the I-O Table (Table 3) also supports

Chart 5: Plot of the Estimates and Standard Errors of Parameters (state series) for SEC = f(TER, USGDP)
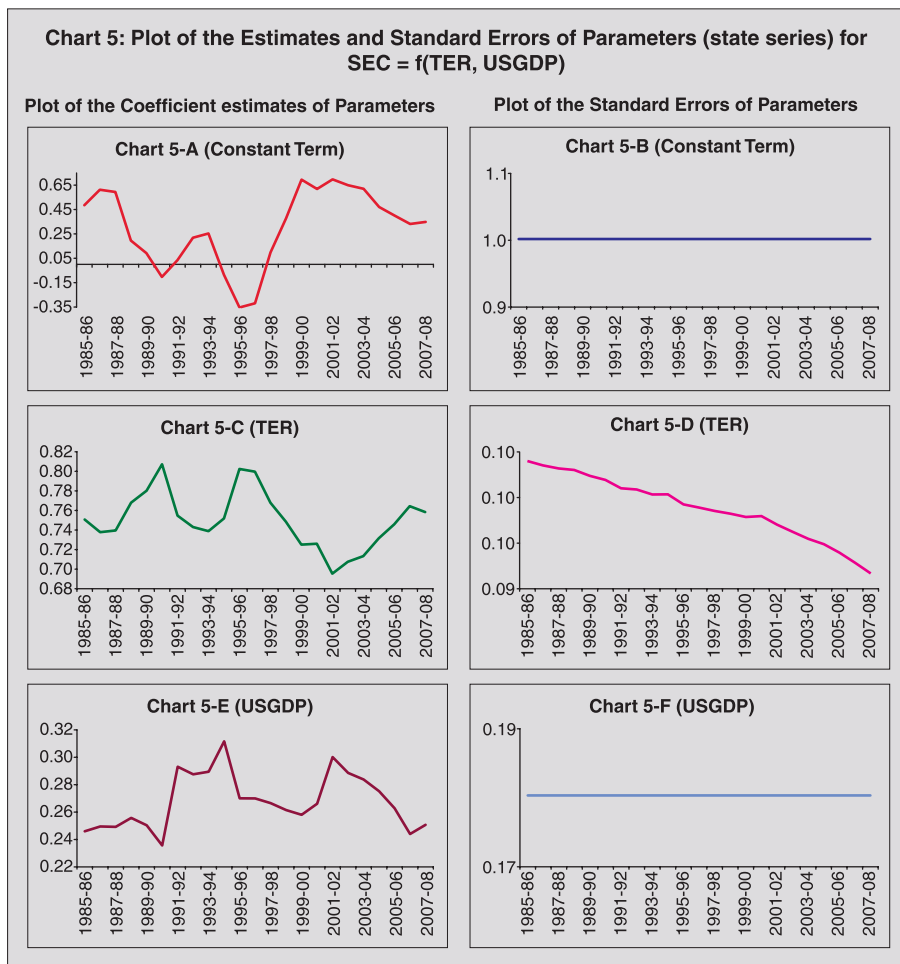
this finding, wherein one unit of industrial sector output required 0.421 units of services inputs in 1998-99, which increased to 0.455 units in 2003-04. The coefficient of USGDP shows a declining trend in the recent period, thereby suggesting declining influence of the USGDP on the secondary sector's performance (Chart 5-E). The diversification in the of India's exports to other destinations in the last couple of years may be a potential cause for this decline.

VI.4.   *Primary Sector, Secondary Sector and Tertiary Sector*

In the fourth analysis, primary sector output is considered to be a function of secondary sector, tertiary sector and rainfall index. The near zero estimate of the standard error over the time period for all the parameters indicate the tendency towards stability in estimate of the coefficients. Coefficient of the constant term shows a rising trend (Chart 6-A). Coefficient of the secondary sector shows a declining trend thereby suggesting its declining influence on the primary sector performance (Chart 6-C). Coefficient of the rainfall index shows a

Chart 6: Plot of the Estimates and Standard Errors of Parameters (state series) for PRI =f(SEC, TER, RAINFALL)

Chart 6-E (TER)

Chart 6-F (TER)

Chart 6-G (RAINFALL)

Chart 6-H (RAINFALL)
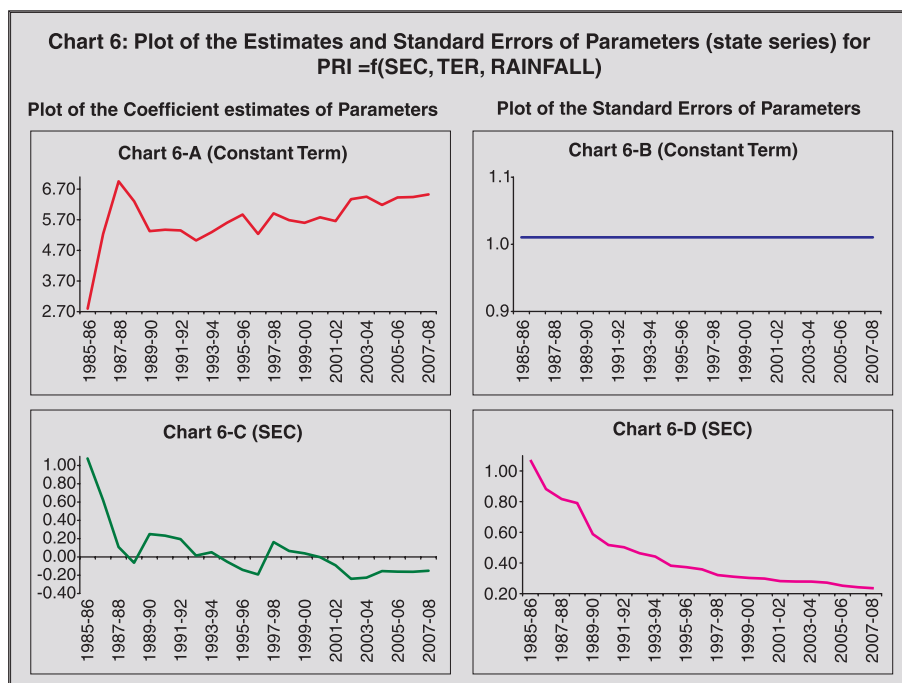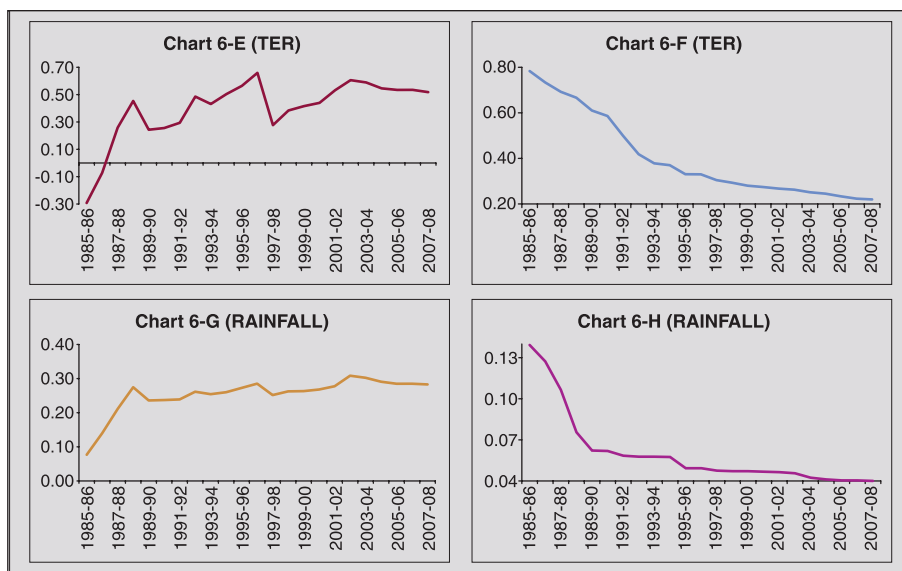
declining trend since 2000-01 suggesting that the impact of rainfall on the agricultural production has decelerated in the recent period.

It is offered that the agricultural sector in India, even after six decades since independence is, by and large, dependent on the monsoon rainfall. About 43.0 per cent of gross sown area remained irrigated in 2005-06, while a large chunk of close to 57.0 per cent of gross cropped area remained reliant on rainfall (Chart 7).

Chart 7: Trend in Gross Irrigated Area as a % of Gross Sown Area

Per cent

Source: Ministry of Agriculture, GOI
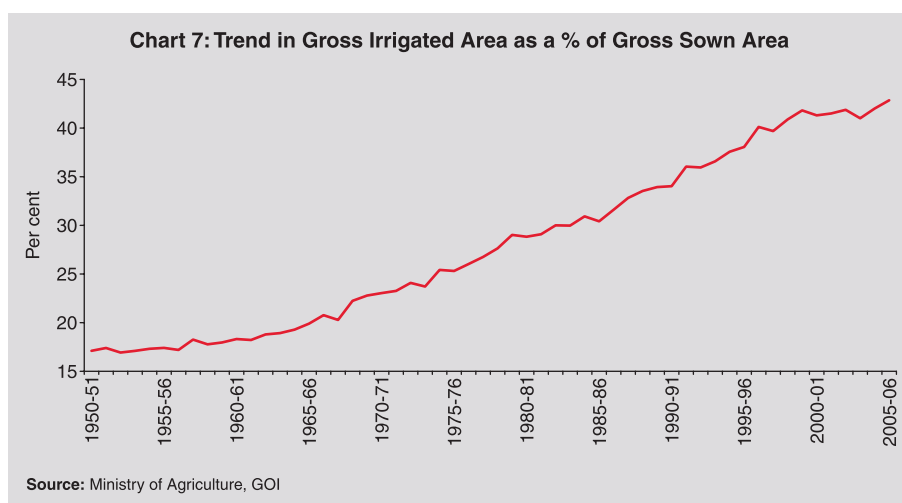
VI.5.   *Primary Sector, Secondary Sector and Tertiary Sector (excluding CSPS)*

The fifth state-space model is estimated based on the relationship among the primary, secondary and the tertiary sectors (excluding CSPS). Small values of the estimated standard error over the time period for all the parameters indicate the tendency towards stability in the estimate of coefficients. Coefficient of the constant term shows a rising trend (Chart 8-A). Coefficient of the secondary sector shows a declining trend, thereby suggesting its declining influence on the primary sector performance (Chart 8 C).

VI.6.   *Banking & Insurance Sector, Manufacturing Sector and Primary Sector:*

We further attempted to explore the relationship among Banking & Insurance Sector (BNKI), manufacturing sector[1] and

Chart 8: Plot of the Estimates and Standard Errors of Parameters (state series) for PRI =f(SEC, TER_EX_CSPS, RAINFALL)

---
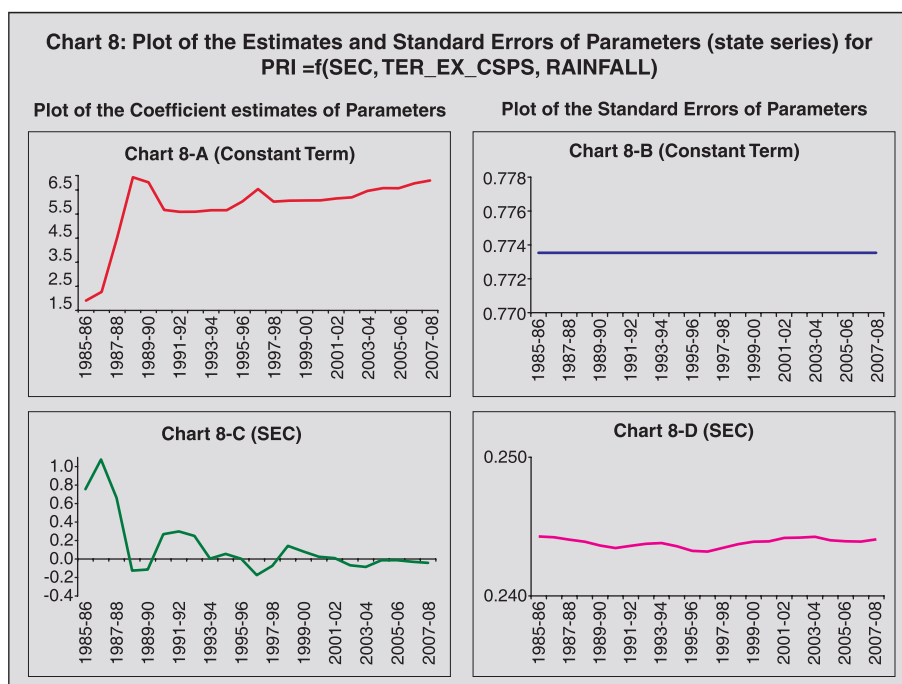
[1]   The empirical estimates using the secondary sector was not found to be consistent.

Chart 8-E (TER_EX_CSPS)

Chart 8-F (TER_EX_CSPS)

Chart 8-G (RAINFALL)

Chart 8-H (RAINFALL)
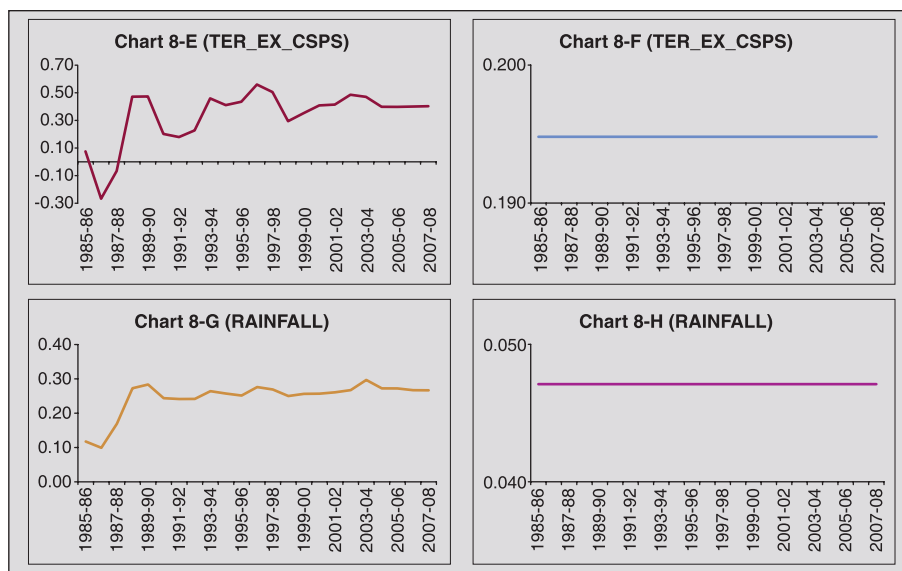
the primary sector (Chart 9). The standard errors for the constant term, and the coefficients of the manufacturing sector and primary sector indicate the stability in the estimate of the parameters. The coefficient of the manufacturing sector shows a declining trend from 1989-90 to 2004-05, and thereafter an increasing trend. The increase in the coefficient of the manufacturing sector on BNKI may be attributed to the rise in the banking and insurance activities corresponding to the rise in the manufacturing sector activities during the expansionary phase observed in the Indian economy from 2005-06 onwards. The coefficient of the primary sector output also shows a slowly increasing trend since 1992-93.

VI.7. *Trade, Hotels, Transport & Communication Sector and Manufacturing Sector*

In the ultimate analysis, THTC sector output is considered to be a function of manufacturing sector and the USGDP. Time plot of the estimated standard errors indicates the stability in the estimate of all the parameters. The coefficient of the manufacturing sector shows a rising trend since 2000-01, suggesting that manufacturing sector plays

Chart 9: Plot of the Estimates and Standard Errors of Parameters (state series) for BNKI = f(MFG, PRI)

Plot of the Coefficient estimates of Parameters   Plot of the Standard Errors of Parameters

Chart 9-A (Constant Term)   Chart 9-B (Constant Term)

Chart 9-C (MFG)   Chart 9-D (MFG)

Chart 9-E (PRI)   Chart 9-F (PRI)
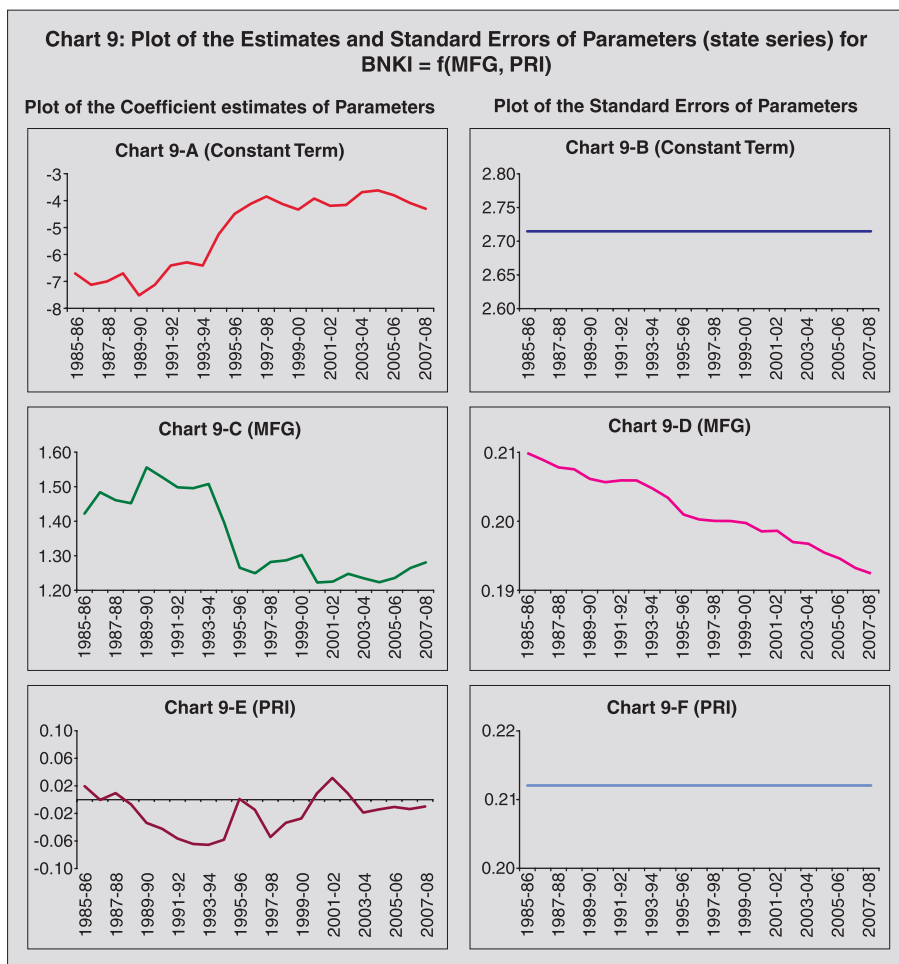
a vital role in influencing THTC (Chart 10). Similarly, coefficient of the USGDP shows a declining trend since 2000-01, possibly indicating trade diversification of India's external sector to the non-US countries.

Section VII
Policy Implications emanating from the Study

Though services sector has emerged as the growth driver of the economy over the period of the analysis, possible negative implications of the same are agenda for active debate in the growth literature. It is argued that to the extent to which the services sector is not commodity producing in nature, a wide disparity between

Chart 10: Plot of the Estimates and Standard Errors of Parameters (state series) for THTC = f(MFG, USGDP)

Plot of the Coefficient estimates of Parameters   **Plot of the Standard Errors of Parameters**

Chart 10-A (Constant Term)   **Chart 10-B (Constant Term)**

Chart 10-C (MFG)   **Chart 10-D (MFG)**

Chart 10-E (USGDP)   **Chart 10-F (USGDP)**

sectoral incomes would widen the demand-supply gap of the commodities, which would result in inflation, high import demand and balance of payment (BoP) problems in a closed economy (Bhattacharya and Mitra, 1990). The decade of the 1990s marked the opening up of the Indian economy. Contrary to a section of the literature, which vouches for the aforementioned conclusions, India's experience in the post-reform period suggests that despite higher growth of services sector in relation to other commodity producing sectors, the country has not confronted any significant inflationary pressures and BoP problems. In fact, rising flow of services invisibles have aided in keeping the current account deficit of the country at a

manageable level. Nevertheless, this pattern of India's growth needs a more careful re-examination for its sustainability and other macroeconomic and distributive implications. *Prima facie*, it appears reasonable to argue for a more synchronised sectoral growth of the Indian economy since this would create/expand the market of commodities and services produced by each sector. Growth of agriculture is critical for raising the income levels of the people engaged therein, while manufacturing sector needs to grow faster for ensuring macroeconomic balance and overcome supply constraints, and thereby ensure price stability and trade balance. Above all, it needs to grow faster to generate employment opportunities, as among the three sectors, manufacturing has a reasonably high and growing employment intensity.

The foregoing co-integration analysis highlights that services sector maintained long-term equilibrium relationship both with agricultural and industrial sectors. As per I-O relationship, however, services activity was found to have strong linkages with the industrial sector, while a great degree of association was evident between the agriculture and the industrial sector. Over the years, the services sector has remained in the forefront of the economic progress, while the growth of agriculture sector has not only remained significantly lower, but also volatile. This seems to indicate that the growth synergy between agriculture and services sectors has remained weak. This may be attributable to the fact that reforms in the agricultural sector have lagged significantly behind reforms in the industry and services sectors. This indisputably is a concern area since it is desirable that the leading sector (*i.e.* services sector) in the economy should share its positive growth impulses with rest all sectors, if an economy were to realize its true growth potential. Bathla (2003) argues that if liberalised measures were directed simultaneously at all the three sectors, it would go a long way in expanding the markets for goods and services produced in the economy. In view of this, policy measures need to foster agricultural growth by unleashing the export potential of agro-products. Consequently, this would stimulate demand for specialised infrastructure services such as warehouses,

cold storage, refrigerated vans, ports, transportation, communication, finance, insurance and the like, thereby reinvigorating the inter-sectoral synergy, especially between agriculture and the services sectors. Further, promotion of export of agri-products by attending to agro-processing industries would further reinforce the growth linkages between agriculture and industry.

In India, the share of 'banking and insurance' in GDP has increased from about one per cent in 1950-51 to about seven per cent in recent years, reflecting growing financial sector activity. In our empirical analysis, 'banking and insurance' sector was found to be cointegrated with both the manufacturing and agricultural sectors. This is in sync with experiences of a number of countries, where finance and growth have been found to move in tandem. There is a need to foster this association further by extending the reach of financial sector to the unorganised sector, thereby facilitating better financial inclusion. Ironically, though the size of unorganised sector in India continues to remain enormously large, the missing links deprive this segment of the potential benefits from the 'banking and insurance' sector. In this regard, public policy needs to focus on encasing the unorganised sector within the financial sphere so that its latent growth potential could be fully unleashed. The motivation behind public policy interventions here emanate from the fact that the financial sector initiatives in India in terms of their outreach have, by and large, been State led.

Section VIII
Concluding Observations

The present study has endeavored to examine and analyse inter-sectoral linkages in the Indian economy following both the I-O approach and the econometric exercises using co-integration and state-space models. The analysis of I-O tables from the production side reveals that input demand of the services sector is industry intensive rather than being farm (denoting agriculture) intensive. Further, that the farm sector is significantly reliant on industry for inputs. The demand linkage examination amply demonstrates that the agricultural sector exhibits strong association with the industrial

sector, while the converse connection in terms of demand linkages of industry with the agricultural sector have weakened in the last two decades or so. Demand linkages of the services sector were observed to have strengthened *vis-à-vis* the industrial sector overtime.

The cointegration analysis (covering the period since mid-1980s) at the broad sectoral level supports the assessment that the three broad sectors *viz.*, primary, secondary and tertiary (excluding CSPS) demonstrate strong long-run equilibrium amongst themselves. In bivariate framework also, these sectors confirm robust long-term equilibrium relationship with one another. At the sub-sectoral level, existence of long-term equilibrium was observed between 'trade, hotels, transport & communication' and the 'manufacturing' sectors. Further, the financial sector activity in the 'banking & insurance' sector was noticed to be cointegrated with the 'manufacturing' and 'primary' sectors. Our analysis based on state space model using Kalman filter also corroborates the outcome of the cointegration analysis, as the results capture variations in one sector influencing the other sector's performance over time.

As per the policy implications of the study, it is found that relatively stronger growth of the services sector in India *vis-a-vis* other sectors does not appear to be desirable and calls for a correction in terms of enhancing the growth synergies among sectors. This is likely to give a stimulus to the dormant growth potential. Towards this end, reforms in the agriculture sector which lagged behind that of the industrial and services sectors deserve policy consideration to be able to harness the export potential of agro-products. Creation of specialised infrastructure services for promoting agri-exports would strengthen the agriculture-services relationship. Finally, the public policy needs to be geared towards encasing the unorganised sector in the ambit of banking and insurance so that the latent growth potential of the sector could be fully realised.

Annex-I

Table : Empirical Results of the Co-integration Tests based on Johansen-Juselius method

Variables in the system		Eigenvalue	Trace Statistic	Maximal Eigenvalue Statistic	Conclusion
1	2	3	4	5	6
PRI, SEC	None	0.775	36.636 (0.000)	35.820 (0.000)	One co-integrating relationship exists.
	At Most 1	0.033	0.816 (0.972)	0.816 (0.972)	
PRI, MFG	None	0.783	37.199 (0.000)	36.699 (0.000)	One co-integrating relationship exists.
	At Most 1	0.021	0.500 (0.995)	0.500 (0.995)	
PRI, TER	None	0.797	42.298 (0.000)	38.280 (0.000)	One co-integrating relationship exists.
	At Most 1	0.154	4.018 (0.409)	4.018 (0.409)	
PRI, TER_EX_CSPS	None	0.818	45.853 (0.000)	40.870 (0.000)	One co-integrating relationship exists.
	At Most 1	0.188	4.984 (0.285)	4.984 (0.285)	
SEC, TER	None	0.488	21.491 (0.006)	16.059 (0.026)	One co-integrating relationship exists.
	At Most 1	0.203	5.432 (0.020)	5.432 (0.020)	
SEC, TER_EX_CSPS	None	0.497	21.375 (0.035)	16.508 (0.040)	One co-integrating relationship exists.
	At Most 1	0.184	4.867 (0.298)	4.867 (0.298)	
PRI, TER_EX_CSPS	None	0.818	45.853 (0.000)	40.870 (0.000)	One co-integrating relationship exists.
	At Most 1	0.188	4.984 (0.285)	4.984 (0.285)	
PRI, SEC, TER	None	0.684	44.894 (0.001)	27.648 (0.005)	At most Two co-integrating relationship exist.
	At Most 1	0.453	17.246 (0.027)	14.499 (0.046)	
	At Most 2	0.108	2.747 (0.098)	2.747 (0.098)	
PRI, SEC, TER_EX_CSPS	None	0.714	46.417 (0.000)	30.017 (0.002)	At most one co-integrating relationship exists.
	At Most 1	0.421	16.400 (0.037)	13.131 (0.075)	
	At Most 2	0.127	3.269 (0.071)	3.269 (0.071)	
BNKI, MFG, PRI	None	0.579	31.607 (0.031)	19.917 (0.073)	One co-integrating relationship exists (by Trace Statistic).
	At Most 1	0.398	11.691 (0.172)	11.688 (0.123)	
	At Most 2	0.0001	0.002 (0.959)	0.002 (0.959)	
TRADE, MFG	None	0.483	18.753 (0.016)	15.826 (0.028)	One co-integrating relationship exists.
	At Most 1	0.115	2.927 (0.087)	2.927 (0.087)	

<div align="right">**Annex - II**</div>

Methodology of Time Varying Parameter approach using Kalman filter algorithm

The time varying parameter approach is based on the assumption that parameters are assumed to follow some underlying processes over time. These time varying parameters are modeled and estimated using the Kalman filter algorithm (Kalman, 1960). Kalman filter is an estimation method, which is used to estimate state-space models. The general form of the Kalman filter model comprises of two equations – the measurement and transition equations.

The measurement equation is given by –

$$A_t = B\alpha_t + e_t, \qquad\qquad \text{var}(e_t) = R \qquad\qquad \text{(II.I)}$$

and the transition equation is given by –

$$\alpha_t = T\alpha_{t-1} + v_t, \qquad\qquad \text{var}(v_t) = Q \qquad\qquad \text{(II.2)}$$

The measurement equation (7.1) is an ordinary regression equation with time-varying parameters, α_t, while the transition equation (7.2), defines the evolution of the parameters over time. Here A_t represents the *(nx1)* vector of n- observable variables and α_t is a *(rx1)* vector of r unobservable components. B and T represent matrices of order *(nxr)* and *(rxr)* respectively. e_t and v_t are Gaussian error vectors of order *(nx1)* and *(rx1)* respectively.

If one has an estimate of α_{t-1} and its mean square error p_{t-1}, then the updated estimate of α_t, given A_t and B_t, is estimated by the following Kalman-filter algorithm:

$$\left.\begin{array}{l} S_t = TP_{t-1}T' + Q \\ P_t = S_t - K_t BS_t \\ \alpha_t = T\alpha_{t-1} - K_t(A - B\alpha_{t-1}) \end{array}\right\} \qquad\qquad \text{(II.3)}$$

The matrix K_t, referred as the Kalman gain matrix, is defined as,

$$K_t = S_t B'(BS_t B' + R)^{-1} \qquad\qquad \text{(II.4)}$$

The problem is to develop appropriate estimates for the four unknown parameters of the model $\beta = \{B,T,R,Q\}$ and make inference about the state vector α_t.

For implementation of the Kalman filter, one has to specify initial values for the state vector α_0, its mean squared error P_0, and the parameters $\beta^{(0)} = \{B_0,T_0,R_0,Q_0\}$. Given these initial values, the sequence of state vector α and the mean square error P is computed using Kalman filter. These are then used to evaluate the Gaussian log-likelihood function,

$$\log L(\beta) = -\frac{nm}{2} \log(2\pi) - \frac{1}{2} \sum_t \log | BP_tB' + R |$$
$$- \frac{1}{2} \sum_t e_t'(BP_tB'+R)^{-1} e_t$$

(II.5)

and find the next set of parameters $\beta^{(1)}$ and this completes one iteration. The next iteration starts with initial values α_0, P_0 and $\beta^{(1)}$ to obtain $\beta^{(2)}$ and so on, until convergence is achieved. In equation (II.5), 'm' represents the number of observations.

<div align="right">**Annex – III**</div>

Formulation of the State Space Model

Let's consider a three-sector framework consisting of sectors X, Y and Z, wherein sector X depends on the other two sectors. The specification of the model under the state-space form can be formulated as:

$$\log(X_t) = b_{0t} + b_{1t} \log(Y_t) + b_{2t} \log(Z_t) + e_t \tag{III.1}$$
$$b_{0t} + b_{0t-1} + u_{0t} \tag{III.2}$$
$$b_{1t} + b_{1t-1} + u_{1t} \tag{III.3}$$
$$b_{2t} + b_{2t-1} + u_{2t} \tag{III.4}$$

In the above specification, equation (III.1) is known as the measurement equation, which states that the output of the sector X depends on the output on the other two sectors Y and Z. Equations (III.2) through (III.3) are known as transition equation.

The measurement equation (III.1) can be written in the matrix form as,

$$\log(X_t) = \begin{pmatrix} 1 & \log(Y_t) & \log(Z_t) \end{pmatrix} \begin{pmatrix} b_{0t} \\ b_{1t} \\ b_{2t} \end{pmatrix} + e_t \tag{III.5}$$

and the corresponding *transition* equation, takes the form,

$$\begin{pmatrix} b_{0t} \\ b_{1t} \\ b_{2t} \end{pmatrix} = \begin{pmatrix} 1 & 1 & 1 \end{pmatrix} \begin{pmatrix} b_{0,t-1} \\ b_{1,t-1} \\ b_{2,t-1} \end{pmatrix} + \begin{pmatrix} u_{0t} \\ u_{1t} \\ u_{2t} \end{pmatrix} \tag{III.6}$$

The matrices, as defined in (III.5) and (III.6) may be represented as,

$$\left.\begin{aligned} A_t &= B\alpha_t + e_t \\ \alpha_t &= T\alpha_{t-1} + v_t \end{aligned}\right\} \tag{III.7}$$

where

$$A_t = \log(X_t), \quad B = \begin{pmatrix} 1 & \log(Y_t) & \log(Z_t) \end{pmatrix}, \quad \alpha_t = \begin{pmatrix} b_{0t} \\ b_{1t} \\ b_{2t} \end{pmatrix}, T = \begin{pmatrix} 1 & 1 & 1 \end{pmatrix}, v_t = \begin{pmatrix} u_{0t} \\ u_{1t} \\ u_{2t} \end{pmatrix}$$

The model, as presented in (III.7), can be estimated by using the Kalman filter and maximum likelihood, as described in Appendix-II.

References

Ahluwalia, U.J.; Rangarajan, C. (1989), 'A Study of Linkages between Agriculture and Industry: The Indian Experience', in Williamson, J .G and Panchamukhi, V.R. (Edt.). *The Balance Between Industry and Agriculture in Economic Development*. Vol. 2 (Sector Proportions), MacMillan Press, London, 305-319.

Banga, R. and Goldar, B.N. (2004), 'Contribution of Services to Output Growth and Productivity in Indian Manufacturing: Pre and Post Reform', *ICRIER Working Papers,* No.139, Indian Council for Research on International Economic Relations, New Delhi, India.

Bathla, S. (2003), 'Inter-Sectoral Growth Linkages in India: Implications for Policy and Liberalized Reforms', *Institute of Economic Growth Discussion Papers,* No.77, Institute of Economic Growth, Delhi, India.

Bhattacharya, B.B. and Mitra, A. (1989), 'Industry-Agriculture Growth Rates: Widening Disparity: An Explanation', *Economic and Political Weekly*, August 26, Vol. XXIV, 1963-70.

_____. (1990), 'Excess growth of Tertiary Sector in Indian Economy: Issues and implications', *Economic and Political Weekly*, November 3, Vol. XXV, 2445-50.

_____. (1997), 'Changing Composition of Employment in Tertiary Sector: A Cross-Country analysis', *Economic and Political Weekly*, March 15-21, Vol. XXXII, 529-34.

Central Statistical Organisation (2007), 'National Accounts Statistics: Back Series 1950-51 to 1999-00'.

Chowdhury, K. and Chowdhury, M.B. (1995), 'Sectoral Linkages and Economic Growth in Asia: Evidence from Granger Causality Test', *The Indian Economic Journal*, Vol. 42(4), 59-75.

Clark, C. (1940), 'The Conditions of Economic Progress', Macmillan Publishing Co., London.

Dhawan, S. and Saxena, K.K. (1992), 'Sectoral Linkages and Key Sectors of the Indian Economy', *Indian Economic Review,* Vol. XXVII (2), 195-210.

Dickey D.A. and Fuller W.A. (1979), 'Distribution of the Estimators for Autoregressive Time Series with a Unit Root', *Journal of the American Statistical Association*, Vol. 74, 427-31.

Dickey D.A. and Fuller W.A. (1981), 'Likelihood Ratio Statistics for Auto-regressive Time Series with Unit Root', *Econometrica*, Vol. 89(4), 1052-72.

Engle, R.F. and Granger, C.W.J. (1987), 'Co-integration and Error-Correction: Representation, Estimation and Testing', *Econometrica*, Vol.55, 251-76.

Fisher, A. (1939), 'Production: Primary, Secondary and Tertiary', *Economic Record*, Vol. 15, (June), 24-38.

Hansda S. (2001), 'Sustainability of Services-Led Growth: An Input-Output Analysis of the Indian Economy', *Reserve Bank of India Occasional Papers*, Vol. 22(1, 2 & 3), 73-118.

Johansen, S. (1988), 'Statistical Analysis of Cointegration Vectors', *Journal of Economic Dynamics and Control*, Vol. 12, 231-254.

Johansen, S. and Juselius, K. (1990), 'Maximum Likelihood Estimation and Inference on Co-integration with Application to Demand for Money', *Oxford Bulletin of Economics and Statistics*, Vol.52, 169-210.

Kalman, R.E. (1960), 'A New Approach to Linear Filtering and Prediction Problem', *Journal of Basic Engineering*, Vol. 82(D), 35-45.

Pani, P.K. (1984), 'A Macro Model of Indian economy with Special Reference to Output, Demand and Prices', *Reserve Bank of India Occasional Papers,* Vol. 5(2), 113- 239.

Palanivel T. and Klein, L. (1999), 'An Econometric Model for India with Emphasis on the Monetary Sector', *The Developing Economies*, Vol. XXXVII-3, September, 275–336.

Rangarajan, C. (1982), 'Agricultural Growth and Industrial Performance in India', Research Report No. 33, International Food Policy Research Institute, Washington D.C.

Rath, D. P. and Raj Rajesh (2006), 'Analytics and Implications of Services Sector Growth in Indian Economy', *The Journal of Income and Wealth*, Vol.28 (1)**,** 47-62.

Sastry, D.V.S.; Singh, B.; Bhattacharya, K. and Unnikrishnan, N.K. (2003), 'Sectoral Linkages and Growth: Prospects Reflection on the Indian Economy', *Economic and Political Weekly, June 14,* Vol. XXXVIII (24), 2390-97.

Hedonic Quality Adjustments for Real Estate Prices in India

Abhiman Das, Manjusha Senapati and Joice John*

Measurement of house price at an aggregate level poses several challenges. House prices vary significantly with associated quality attributes and in order to capture the true price change, the effect of quality of house should be adjusted appropriately. In this context, hedonic price index principle is a widely accepted method for quality adjustment. This paper attempts to construct hedonic price index by two different hedonic methods, viz., Time Dummy Method and Characteristics Price Index method, using survey data on rent and sale/resale prices of residential properties in Mumbai for the period January 2004 to November 2007. The results reveal that impact of quality adjustment is sizable and hedonic house price indices are much lower than traditional median weighted average price indices.

Introduction

House is a basic necessity of our life. Besides providing shelter, it is a major form of individual wealth. Understanding its price movements is important for a number of reasons. Changes in its value may influence consumer spending and saving decisions, which in turn affect overall economic activity. Changes in housing prices impact and reflect the health of the residential investment sector, a major source of employment. More importantly, many fundamental factors that shape the market's expectations of future supply and demand relating to house price movements are not directly observable. As a result, it is difficult to ascertain whether rapid shifts in house prices are reflecting changes in the underlying fundamentals or not.

* Dr. Abhiman Das is Assistant Advisor and Smt. Manjusha Senapati and Shri Joice John are Research Officers in the Department of Statistics and Information Management. The views expressed in the paper are strictly personal.

When the expectations turn out to be wrong or get revised as new information becomes available, real estate market witnesses dramatic adjustments in prices and this raises concern that prices have lost touch with the underlying fundamentals (Plosser, 2007). Therefore, from the Central Banks' point of view, monitoring of house price movements is important for maintaining financial stability. In this context, it is essential to have accurate measure of aggregate housing prices.

As with many economic statistics, measurement of house prices also poses conceptual and practical problems. It is not easy to define 'a house' uniquely. Each house is associated with many quality attributes and thus making price comparison is difficult across units. Thus, standard index number theory is not applicable directly. The computation of a price index requires reliable data and a rigorous and robust methodology. The methodological problems associated with compilation of a housing price index are somewhat different from that of any standard price index: how is pure price evolution to be separated from changes in the quality of houses? First, for example, two houses are never exactly the same, because they have many characteristics, the unique combination of which translates into a particular housing service. Second, frequency of exchange of houses is much less than the other goods. These features lead to the problem of understanding the price evolution of a house or of a given group of dwellings, when very few prices are observed at each period. The observed transactions are few, and are a non-random sample of the housing stock. On the other hand, the housing stock itself is not fixed: it keeps changing through destruction, deterioration, improvement, new construction, extension, etc. Should the housing stock be perfectly fixed, transactions would have to be a large enough random sample of the housing stock to be validly used to compute price evolution. In addition, market does discount the age factor of the house in arriving at a price. Ideally the average price index should be a weighted average of prices of different ages and other characteristics. Thus the comparison of average sale prices is a mixture of true price evolution and change in the quality of the sample of transactions drawn from the stock. Further, house prices vary

significantly with associated quality attributes like location, floor, facing side and many other facilities directly linked to standard of living. These are like add-on items; for every add-on item, there is an additional price. For all these reasons, the use of econometric techniques cannot be avoided. In the face of such challenges, different methodologies have been followed to measure aggregate price of housing. This paper attempts to estimate hedonic price index by two different methods using the data on sale/resale prices of residential properties in Mumbai based on a survey undertaken by Reserve Bank of India (RBI).

The paper is organised as follows. Section II presents a brief literature review, section III gives different methodologies of compilation of housing price index and section IV presents hedonic price index model used in the present study. Section V provides issues relating to house price measurement in India and presents a brief account of the overall residential property price movements in Mumbai based on the RBI survey results. Estimation and analysis is presented in section VI. Concluding remarks follow.

Section II
Literature Review

A price index intends to measure the effects of price changes over time while keeping other economic factors constant. Quality changes that take place over time in a rapid phase pose a fundamental problem in constructing a robust price index that measures only the pure price change over time. Separating pure price change and the quality change components from the total price change is a major challenge for the price index producer. Traditionally, several methods are available for quality adjustments. These include overlap pricing, direct quality adjustment using information from producers, and linking methods. But all these methods potentially suffer from subjective biases in selecting newly appeared products that most closely resemble the old ones.

Waugh (1928) and Court (1939) first used hedonic method to explain the relationship between price and quality characteristics. A

more objective way of dealing with quality change as compared with these methods was recommended by the Price Statistics Review Committee (US) in 1961. This committee suggested that statistical agencies explore hedonic methods, referring to the major study on hedonic price index method and its application by Griliches (1961). Works of Griliches (1961) and Chow (1967) received much attention in the potential use of hedonics which were further supported by Lancaster (1971) and Rosen (1974). Triplett and McDonald (1977) studied hedonic quality adjustments to replacement items in the refrigerator price index. Diewert (2001) developed a consumer theory approach to hedonic regression as a simplification of Rosen's (1974) theory.

Several European countries and countries like U.S. and Japan, have adopted hedonic regression methodology in their CPI quality control, particularly in areas where quality adjustment is proved to be difficult using traditional methods. The result has been quite successful in some areas like housing, electronic goods, computers, clothing and cars (Pakes, 2001; Bascher and Lacroix, 1999; Liegey and Shepler, 1999; Shiratsuka, 1999; Fixler et al, 1999; Okamoto and Sato, 2001).

As mentioned earlier, houses have various idiosyncratic characteristics, including location, size, number of rooms, occupancy, age, etc. This heterogeneity translates into different sub-markets, various turnover rates, and prices. It leads to difficulties in analysing housing prices which are less frequently observable. As between two sales, the value of a house, in the economic sense, cannot be given. It has to be estimated from a model of price. To estimate the value of the reference stock, econometric models are used relating prices (the log of the price per square metre) to the characteristics of the dwellings. Sutton (2002) studied the joint behaviour of house prices, national incomes, real interest rates and stock prices within the context of a simple empirical model. He identified the typical response of house prices to changes in a small set of key determinants.

Among official house price series, the Halifax House Price Index is the UK's longest running monthly house price series with data

covering the whole country going back to January 1983. The methodology is based on the hedonic approach to price measurement characterised by valuing goods for the attributes. In the case of housing, prices are supposed to reflect the valuation placed by a purchaser on the particular set of physical and locational attributes possessed by the property they wish to buy. Prices are disaggregated into their constituent parts using multivariate regression analysis. This permits the estimation of the change in average price from one period to another on a standardised basis. An obvious analogy can be drawn with the standard basket of goods used for calculating the retail price index.

The US Office of Federal Housing Enterprise Oversight (OFHEO) publishes the OFHEO HPI, a quarterly broad measure of the movement of single-family house prices. The HPI is a weighted, repeat-sales index, meaning that it measures average price changes in repeat sales or refinancing on the same properties. This information is obtained by reviewing repeat mortgage transactions on single-family properties whose mortgages have been purchased or securitized by Fannie Mae or Freddie Mac since January 1975. The HPI was developed in conjunction with OFHEO's responsibilities as a regulator of Fannie Mae and Freddie Mac. It is used to measure the adequacy of their capital against the value of their assets, which are primarily home mortgages.

Section III
Methodology for Compilation of House Price Index

Like any other price index, house price index also captures the relative price movement of houses over two time periods. Methodology of compilation of housing price index for major developed countries is summarized in Table 1. There are mainly 4 different methods of price measurements, as discussed is the following section.

III.1 Median/mean transactions price:

The simplest measures of house prices use some indicator of central tendency from the distribution of prices for houses sold during

a period. Since house price distributions are generally positively skewed (predominantly reflecting the heterogeneous nature of housing, the positive skew in income distributions and the zero lower bound on transaction prices), the median is typically used rather than the mean. Further, as no data on housing characteristics, other than the size of house or location of the house are required to calculate a median or mean, a price series can be easily compiled.

Table 1: Housing Price Series in Selected Countries

	Methodology and Background
Australia	a. *Medians*: produced by the Real Estate Institute of Australia and the Commonwealth Bank of Australia. b. *Mix-adjusted*: produced by the Australian Bureau of Statistics (groups houses mostly according to region) and Australian Property Monitors (groups houses and apartments according to the long-run average price of the suburb). c. *Repeat-sales*: produced by Residex.
Canada	a. *Means*: produced by the Canadian Real Estate Organization. b. *Mix-adjusted*: published by the Bank of Canada/Royal Le Page (groups transactions by region and dwelling type).
Europe	a. *Median and means*: produced in most countries, with some countries making a rudimentary adjustment for quality by measuring prices in per square metre terms. b. *Mix-adjusted*: produced by Deutsche Bundesbank/Bulwien AG in Germany and Ministerio de Formento in Spain. Transactions tend to be grouped by region and dwelling type. c. *Hedonic*: produced by the National Statistical Institute of France.
New Zealand	a. *Medians*: published by the Real Estate Institute of New Zealand.
United Kingdom	a. *Medians*: produced by the Land Registry. b. *Mix-adjusted*: produced by Hometrack and Rightmove (both group transactions according to dwelling type and region) and the Office of the Deputy Prime Minister (where a hedonic regression is used to calculate a price for each group). c. *Hedonic*: produced using loan approvals data from Halifax and Nationwide. In the recent past, Bank of England was involved in the house price survey of Halifax and Nationwide.
United States	a. *Medians and means*: published by the National Association of Realtors. b. *Repeat-sales*: produced using mortgage lenders data by the Office of Federal Housing Enterprise Oversight and Freddie Mac.

The main problem with median and mean prices is that they are subject to distortion by 'compositional' factors. Compositional factors include the volume of property sales within specific price bands. For example, if mainly low value properties in an area are sold in a month (and few of the superior properties in that area) then this can indicate a drop in the median or average. However, in the next month most sales in that area may be in superior properties (i.e., higher values) and this would then show that the median and average house price had increased when in fact overall values may have fallen. Median prices are affected by compositional change and seasonality. Hence, samples of observed transactions cannot be considered to be random. While median prices are widely used, alternative methodologies are employed in a number of countries to deal with the problem of compositional change and to obtain improved measures of housing prices.

III.2 Mix-adjusted

One means of controlling for changes in the mix of properties sold is to use the technique of stratification to construct a mix-adjusted measure of house prices. This is the methodology used by the Australian Bureau of Statistics (ABS) in its indices for established house prices. Mix-adjusted measures have also been used in a number of other countries including Canada, Germany and the United Kingdom, although there are differences between the approaches used in each country reflecting the diverse nature of housing markets across regions. In this method, typically, small geographic regions (e.g., suburbs) are clustered into larger geographic regions and then a weighted average of price changes in those larger regions is taken. Another approach along these lines uses price-based stratification, based on the evidence of marked compositional change between lower- and higher-priced suburbs. This appears to be highly effective in reducing the influence of compositional change. In particular, houses and societies sold in any period can be divided into groups (or strata) according to the long-run median price of their respective suburbs. The mix-adjusted measure of the city-wide average price change is then calculated as the average of the change in the medians for each group.

III.3 Repeat-sales

Rather than focusing on the price *level* in each transaction, this approach relies on the observed changes in price for those properties that have been sold more than once. It seeks to identify the common component in price changes over time. One limitation of a pure repeat-sales approach is that it uses only the data from those transactions involving properties for which there is a record of an earlier sale. An additional factor is that estimates of price changes in any quarter will generally continue to be revised based on sales that occur in subsequent quarters.

III.4 Hedonic method

In addition to repeat sales method, hedonic regression-based approaches have also been used by researchers and are used in the official measures produced in some countries, including the United Kingdom and United States. This method attempts to explain the price in each transaction by a range of property attributes, such as the location, type and size of a property, as well as the period in which it was sold. The resulting index of house prices can be thought of as the average price level of the transactions that occurred in each period, after controlling for the observable attributes of the properties that were sold. Hence, a hedonic approach can take account of shifts in the composition of transactions in each period. In principle, it can also control for quality improvements, although the ability to do so in practice depends on the comprehensiveness of data on housing characteristics.

Section IV
Hedonic Regression Model Specification

The hedonic method is basically a regression technique used to estimate the prices of qualities of an object. A hedonic price index is a price index that uses a hedonic function in some way. Four major methods, viz., time dummy variable method, characteristics price index method, hedonic price imputation method and hedonic quality

adjustment method for calculating hedonic price indexes have been developed. Each of these four hedonic price index methods uses a different kind of information from the hedonic function. The first two methods (the time dummy variable method and the characteristics price index method) have sometimes been referred to as "direct" methods, because all their price information comes from the hedonic function; no prices come from an alternative source. Direct methods require that a hedonic function be estimated for each period for which a price index is needed. The next two hedonic price index methods (viz., the hedonic price imputation method and the hedonic quality adjustment method) have been described as "indirect" or "composite" methods. They are often called "imputation" methods, because the hedonic function is used only to impute prices or to adjust for quality changes in the sample in cases where matched comparisons break down. The rest of the index is computed according to conventional matched-model methods, using the prices that are collected in the usual sample.

In this paper, we use two direct methods, viz. Time Dummy Variable Index method and the Characristics Price Index method for constructing the house price index. These two methods are described in the following sections.

IV.1 Time dummy variable index method

A time dummy hedonic regression model is specified with the characteristics as independent variables and the natural log of the collected price as the dependent variable. Model specification for the time dummy method looks like this:

$$\ln(p_{it}) = \alpha + \sum_{k=1}^{K} \beta_k z_{ik} + \delta_t D_t + \varepsilon_{it} \tag{1}$$

For k set of observations and time period t; and not all houses appearing in all periods; p_{it} is the price of ith observation in t^{th} time period expressed in natural logarithmic scale. α is the constant term, β_k is the regression coefficient or implicit hedonic price, z_{ik} is the

value of the characteristics, δ_t is the regression coefficient for time dummy, D_t is the time dummy variable with a value of 1 in period t and 0 otherwise and ε_{it}, error term.

The quality-adjusted price index can be calculated directly by taking the exponential of the time-dummy coefficients of interest after estimating the regression coefficients. In other words, *Index = exp (δ_t)*, where δ_t is the regression coefficient of the time dummy when the hedonic functional form is semi-log. When we compare the relative price of a house, between period t and period t-1, for any given quality specification, then this ratio is equal to the relative exponential of the time dummy variables (Melser, 2005). This is the simplest and most common approach. Many statistical agencies world-wide use this method to calculate price indexes.

Whenever an item replacement takes place between the base and reference periods, quality change potentially occurs. The change in quality due to item replacement is taken care of by the associated characteristics, and the pure price change will be captured by the regression coefficient of the time dummy variable. The disadvantage of the time dummy variable index is that it is sensitive to specification bias and multi-collinearity.

IV.2 Characteristics price index method

An alternative approach for a comparison between price of houses in period t and t+1 is to estimate a hedonic regression for period t+1, and insert the values of the characteristics of modal house in period t into the period t+1 regression. This would generate predictions of the price of modal house existing in period t, at period t+1 shadow or implicit prices. This price can be compared with the price of the modal house in period t obtained from regression for period t.

Similarly another set of implicit prices could be generated by inserting the characteristics of modal house of period t+1 into the period t regression coefficients. This price is then compared with the price of the same modal house in period t+1 obtained from regression equation for period t+1.

The geometric mean of these two indexes gives us the desired characteristics price index. Let the regression equation for the period t be given as

$$\ln p_{it} = \beta_{0t} + \sum_{i=1}^{k} \beta_{it} x_{it} + \varepsilon_{it} \tag{2}$$

where x_{it} = variable for characteristics i and β_0, β_i are the regression coefficients.

Substituting in regression equations of t and t+1, specification of modal house $\overline{X_{it}}$ in the period t, we have

$$\ln \overline{p_{it}} = \beta_{0t} + \sum_{i=1}^{k} \beta_{it} \overline{X_{it}} + \varepsilon_{it} \quad \text{and}$$

$$\ln \overline{p_{it+1}} = \beta_{0t+1} + \sum_{i=1}^{k} \beta_{it+1} \overline{X_{it}} + \varepsilon_{it+1}$$

The hedonic index specification in period t $= \overline{p_{it+1}} / \overline{p_{it}}$ $\tag{3}$

Similarly, substituting average specification $\overline{X_{it+1}}$ in the period t+1 for variables in regression equations of t and t+1, we have

$$\ln p_{it}^{'} = \beta_{0t} + \sum_{i=1}^{k} \beta_{it} \overline{X_{it+1}} + \varepsilon_{it} \quad \text{and}$$

$$\ln p_{it+1}^{'} = \beta_{0t+1} + \sum_{i=1}^{k} \beta_{it+1} \overline{X_{it+1}} + \varepsilon_{it+1}$$

The hedonic index specification in period t $= \dfrac{p_{it+1}^{'}}{p_{it}^{'}}$ $\tag{4}$

and the final hedonic index is the geometric mean of (3) and (4).

Geometric mean of (3) and (4) $= \sqrt{\left(\dfrac{\overline{p_{it+1}}}{\overline{p_{it}}} \right) * \left(\dfrac{p_{it+1}^{'}}{p_{it}^{'}} \right)}$ $\tag{5}$

In other words, this is nothing but the valuation of the typical base period (t) house by the current period's implicit prices, obtained from the current period's hedonic function, and compared with the same valuation for the base period. This is analogous to the Laspeyres type price index. Similarly the alternative index is the comparison of typical current period's price with the hedonic function of the base period. The geometric mean of these two indexes would give the desired characteristics price index (Okamoto and Sato, 2001; Triplett, 2001).

Section V
House Price Measures in India

Until recently, India had no official system of collection and monitoring of real estate price movement. A proxy indicator in the form of rent is collected as a part of consumer price index. Both CPI(UNME) and CPI(IW) capture house rent price movements at half-yearly intervals. For CPI(UNME), apart from the middle class price collection data, a representative sample of rented dwelling occupied by non-manual employee families, the middle class house rent and middle class off-take are canvassed under the house rent and off take survey at the interval of six months for collection of comparable house rent data. For CPI(IW), the change in rent and related charges, which constitute a single item under housing group, is captured through repeat house rent surveys, which are conducted in the form of six-monthly rounds. This survey is conducted on a sub-sample of dwellings covered during the main income & expenditure survey in 1999-2000. The index is calculated once in every six months and is kept constant for the entire six months on account of the tendency of house rent to remain more or less stable over short periods. Under the house rent survey, three types of dwellings, viz. rented, rent free and self-owned are covered uniformly across all the centres. As the names suggest, both these indices capture house rent price movements for specific target population. Therefore, rent price movements based on these indices do not necessarily reflect true rent price movement of a city as a whole.

National Housing Bank, a government agency brought out an index of real estate price movements called *Residex*. It was developed

based on a pilot study for five cities viz., Bangalore, Bhopal, Delhi, Kolkata and Mumbai for five years 2001-2005 (with 2001 as base). Later, *Residex* was extended to cover 15 cities and was updated up to (January-June) 2009 with base year as 2007. In terms of coverage, this index in the present form excludes price movements of commercial properties. Many private organisations also bring out synoptic view of real estate property price of selected cities in India.

To capture the data on rent and sale/resale price movements of residential as well commercial properties, the Reserve Bank of India conducted a pilot survey on real estate price movements of Mumbai as on January 2004, January 2005, January 2006, January 2007, May 2007 and November 2007. The weighted average price index of rent and sale/resale of houses in Mumbai, estimated from the price movements of individual transactions are presented in Table 2. The rent and sale/resale prices of residential properties in Mumbai have shown an unprecedented increasing trend over the years from 2004 to 2007. Monthly rent prices of residential properties in Mumbai had more than doubled during this period. During January 2004 to November 2007, median sale/resale price per sq. ft. of a standard apartment (500-1000 sq. ft.) showed an increase of 123.3 per cent and the same for large size apartment (>1000 sq. ft.) went up by 142.7 per cent. The price index of commercial sale/resale prices per sq. ft. had increased from 100 in January 2004 to 176 in November 2007. Intra-city variations in property prices in Mumbai were also found to be too large.

Table 2: Rent and Sale/Resale Real Estate Price Index for Mumbai

Property	Transaction	Size (in sq. ft.)	Jan-04	Jan-05	Jan-06	Jan-07	May-07	Nov-07
1	2	3	4	5	6	7	8	9
Residential	Rent	500-1000	100.0	108.7	138.6	211.9	224.3	228.8
	(monthly)	>1000	100.0	133.8	164.9	188.5	219.2	240.7
	Sale/Resale	500-1000	100.0	118.7	144.9	177.0	194.9	223.3
	(per sq. ft.)	>1000	100.0	122.2	149.6	189.0	222.7	242.7
Commercial	Sale/Resale							
	(per sq. ft.)	100-500	100.0	107.0	128.0	164.1	175.8	175.9

In the present paper, using the same data, we develop the hedonic price index for residential properties in Mumbai.

Section VI
Estimation and Analysis of Hedonic Regression

As indicated earlier, hedonic regression was estimated based on the data obtained from the RBI pilot survey conducted in 25 areas of Greater Mumbai during January 2004-November 2007 covering both residential and commercial properties. The actual transaction price, inclusive of land but exclusive of registration fee, stamp duty, brokerage fee, etc., was taken as the purchase price. The selection of sample in Mumbai was based on the municipal administrative zones. Six urban municipal administrative zones and six municipalities constituted the strata for selection of areas. In all 25 representative areas with high number of transactions were selected across the 12 areas (six zones + six municipalities) on the basis of their share in the total areas in zones. For proper representation, a total of 20 transactions per year in each of the 25 areas were captured. Thus, a sample of 500 transactions was collected as on January 2004, January 2005, January 2006, January 2007, May 2007 and November 2007. The information for each transaction within a particular area was classified according to whether it is a residential property or a commercial property. Within the residential and commercial property selected, the transactions were further classified into whether the property is used for rental purposes or is subjected to sale/resale in the time period under consideration.

Six quality attributes associated with price variations are considered in the hedonic model. These are: floor (F) in which house is situated; floor space area (FSA), number of rooms (R), number of bath rooms (B), whether it is sale or resale (S) and availability of lift (L). Classifications of these attributes are presented in Table 3. In the hedonic regression model, all the categories are represented by dummy variables. Apart from these attributes, dummy variables are used to represent separate areas (corresponding to 6 zones in Greater Mumbai, indicated by zone Z1 to Z6, and 6 municipalities,) and 6

Table 3: Quality attributes of selected real estate properties

Sl. No	Attribute	Category
1	2	3
1.	Floors(F)	$1 = 0 \leq F \leq 1$
		$2 = 1 < F \leq 3$
		$3 = 3 < F \leq 5$
		$4 = F > 5$
2.	Floor Space Area (FSA)(in sq. ft.)	$1 = 0 \leq FSA = 600$
		$2 = 600 < FSA < 1000$
		$3 = FSA \geq 1000$
3.	Number of rooms (R)	$1 = 1R$
		$2 = 2R$
		$3 = R \geq 3$
4.	Number of bathrooms (B)	$1 = 1B$
		$2 = 2B$
		$3 = B \geq 3$
5.	Sale or Resale (S)	$1 = $ Sale
		$0 = $ Resale
6.	Availability of lift(L)	$1 = $ Lift
		$0 = $ No Lift

time periods (T). The list of the areas under each zone and municipality is given in Table D1 in the Annex. As expected, there exists a large price disparity across zones. For example, the per square feet price in Malabar Hill, which comes under the zone 1, is expected to be much higher than any of the areas in the suburbs. Among the different zones in suburbs also, the house prices are expected to be heterogenous. Results of the hedonic regression method are presented separately for time dummy method and characteristics price method.

VI.1 Hedonic Index for Residential Properties: Time Dummy Method

VI.1.1. Rent

For obtaining the hedonic index using this method, the dependent variable is natural logarithm of per square feet rent. The regression coefficients obtained are presented in the Table A of *Annex*. It can be

seen that all zones are having significantly higher rent compared to the average rent for zone 5. Further the rent of zone 1 is 7.3 times (exp(1.99)) than that of zone 5. Further, higher floors are found to have more rent, as coefficients corresponding to all floor categories are found to be significantly positive. As expected, larger floor space area leads to higher rent. The rent of two room houses is not significantly different from one room house. This can be viewed as the number of rooms being insignificant when considered independent of the floor space area. However, for the three room houses, rent is significantly higher. Rent in case of three bathroom house is also significantly different from one bathroom house.

The quality-adjusted index is calculated directly by taking the exponential of the time-dummy coefficient. The Table 4 gives price index for rented residential properties in Greater Mumbai with January 2004 as base. The hedonic rent index, taking into account the changes in attributes of residential properties was increasing on an average at the rate of 20 per cent per annum (Table 4). The index registered highest growth during January 2006 - January 2007 of 30.4 per cent. Afterwards, it decelerated. Chart 1 shows the house rent index using Time Dummy method for different areas of Greater Mumbai.

VI.1.2. Sale/Resale

Regression coefficients obtained are presented in Table B in *Annex.* Zones 1, 2, and 3 are having significantly higher price compared to the

**Table 4: Hedonic Rent Index for Greater Mumbai
- Time Dummy Method**

Time Period	Hedonic Index for Rent (using Time Dummy Method)	Annual Growth Rate (in %)
1	2	3
Jan-04	100.0	
Jan-05	106.2	6.2
Jan-06	131.5	23.8
Jan-07	171.5	30.4
May-07	193.0	12.5 *
Nov-07	215.1	25.4 *

* : Over Jan 2007.

Chart 1: House Rent Index for Greater Mumbai – Time Dummy Method
House Rent Index -Time Dummy - GM

	Jan 04	Jan 05	Jan 06	Jan 07	May 07	Nov 07
HRI	100.0	106.2	131.5	171.5	193.0	215.1
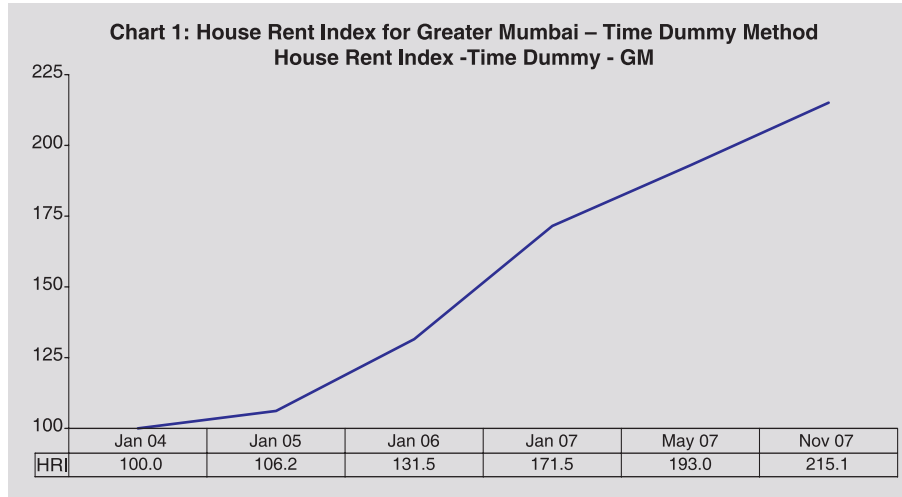
average price of zone 6. Further the price of zone 1 is 4.5 times (exp(1.50)) than that of zone 6. The zone 4 and zone 6 are found to be have no significant difference in their average house price. The price of zone 5 is found to be significantly lower than that of zone 6. As expected the first hand sale is priced significantly more than that of resale price. It is found that the higher floors are priced significantly more than that of ground floor. The larger area, as expected, is significantly priced more. It is found that number of rooms is related negatively to price and it is found to be significant for more than 3 rooms category. It can viewed as less price for more number of rooms for a given floor space area. Table 5 shows zone wise hedonic price indices for sale/resale of residential

Table 5: Hedonic Index using Sale/resale prices of Residential Properties in Greater Mumbai (Time Dummy Method)

Zones	Jan-04	Jan-05	Jan-06	Jan-07	May-07	Nov-07
1	2	3	4	5	6	7
Zone 1	100.0	111.7	154.8	205.8	268.3	311.3
Zone 2	100.0	117.4	134.6	165.3	164.6	175.3
Zone 3	100.0	124.0	161.8	172.0	202.2	222.9
Zone 4	100.0	136.2	158.0	189.8	200.6	208.5
Zone 5	100.0	118.2	147.7	179.6	201.6	218.0
Zone 6	100.0	119.3	131.8	163.6	163.8	160.5
Greater Mumbai	100.0	121.9	147.8	177.5	194.3	209.6

properties using time dummy method. During the four year period, viz., 2004-07, the index grew at an average rate of 18 per cent per annum. The growth rate of the index for zone 1 area was the highest (25 per cent per annum) whereas, for zone 6 area, it was the lowest (13 per cent). For zone 2 to zone 5, the price increase was in the range of 15-19 per cent per annum.

Table 6 shows hedonic index of sale/resale prices of residential properties in adjacent municipalities of Mumbai using time dummy method. The average rate of growth of index was highest in Badlapur (40 per cent) whereas it was lowest in Thane (9 per cent). Table C in *Annex* presents regression results for adjacent municipalities.

V.2 Hedonic Price Index for Residential Properties: Characteristics Price Index Method

For calculating the index based on the characteristics price index method, we first identified the modal houses for different zones and different time periods. The modal values of the characteristics, viz., number of bathrooms, rooms, availability of lift, etc., are taken as the characteristics of the representative modal house in each zone for different time periods (Table E in *Annex*). The modal house is the most frequently transacted attribute of different characteristics in different zones during a particular period. The price movement of Mumbai city is estimated as the weighted average prices of 6 major

Table 6: Hedonic Index using Sale/resale prices of Residential Properties in Adjacent Municipalities of Greater Mumbai (Time Dummy Method)

Municipalities	Jan-04	Jan-05	Jan-06	Jan-07	May-07	Nov-07
1	2	3	4	5	6	7
Navi Mumbai	100.0	138.9	166.1	203.8	210.4	246.9
Thane	100.0	111.1	128.3	146.5	213.3	202.1
Kalyan	100.0	151.8	180.2	232.2	238.7	240.3
Mira Road/ Bhyander	100.0	160.9	227.5	299.8	321.3	310.0
Virar/ Vasai	100.0	159.1	241.8	292.4	303.7	337.0
Badlapur	100.0	162.7	281.4	338.8	340.7	351.5

tax zones (excluding municipalities), weights being the proportion of house stocks of the tax zones (Table D2 in *Annex*). The regression coefficients obtained are given in Table F of *Annex*. The relative price of zone 1, 2 and 3 with respect to zone 6 had been increasing steadily over the time points considered. This indicates the widening housing price gap between southern areas of Mumbai and its suburbs. The coefficients of zones 4 and 5 which are found to be negative in 2004 and 2005 became significantly positive in November 2007. This indicates that the price in zone 4 and 5 were less than zone 6 in 2004 and 2005, which had appreciated more and overtook zone 6 in 2007.

The Table 7 gives hedonic price index for residential properties in Mumbai using characteristics price index method. For residential properties of Mumbai using characteristic price index method, the average growth rate of index was around 17 per cent annum. Growth rate of house prices was highest for zone 1 areas (27 per cent) whereas it was lowest for zone 6 areas (9 per cent). For other areas of greater Mumbai, the growth rate was in the range of 12-20 per cent.

Table G in *Annex* gives regression results obtained for adjacent municipalities. In contrast to the coefficients of the zones in Greater Mumbai, the coefficients of adjacent municipalities tend to fall. This shows that the difference in house prices in the surrounding part of Greater Mumbai was decreasing. The Table 8 shows the price index for residential properties in adjacent municipalities of Mumbai using

Table 7: Hedonic price Index using sale/resale prices of Residential Properties in Mumbai - Characteristics Price Index Method

Zones	Jan-04	Jan-05	Jan-06	Jan-07	May-07	Nov-07
1	2	3	4	5	6	7
Zone1	100.0	109.9	166.0	215.3	258.1	304.2
Zone2	100.0	114.7	126.1	153.1	154.4	157.5
Zone3	100.0	120.1	152.8	162.8	187.3	211.8
Zone4	100.0	129.6	147.1	199.2	198.9	203.8
Zone5	100.0	118.4	140.8	176.2	197.8	219.0
Zone6	100.0	118.0	122.5	151.4	161.6	146.3
Greater Mumbai	100.0	118.9	142.1	173.7	189.5	202.9

Table 8: Hedonic Index using Sale/resale Prices of Residential Properties in Adjacent Municipalities - Characteristics Price Index Method

Municipalities	Jan-04	Jan-05	Jan-06	Jan-07	May-07	Nov-07
1	2	3	4	5	6	7
Navi Mumbai	100.0	161.8	245.8	302.6	308.8	301.1
Thane	100.0	161.2	259.3	265.3	317.6	301.1
Kalyan	100.0	214.4	304.0	317.0	337.2	255.1
Mira Road/Bhayander	100.0	170.0	271.7	346.2	325.4	323.0
Virar/Vashi	100.0	170.0	283.7	346.2	345.3	341.0
Badlapur	100.0	171.4	305.5	383.5	359.7	363.4

Characteristics Price Index method. The prices in adjacent areas of municipalities were growing at a higher rate than in the Greater Mumbai area. Growth rate in Badlapur municipality was the highest (44 per cent) whereas it was lowest in Thane (30 per cent).

Chart 2 gives comparison of price indexes obtained from the four different methods. The hedonic price indices are less as compared to other indices for the period under consideration. That is, price increase is subdued once the effect of quality attribute is controlled. This indicates that in order to asses the price movements of housing sector, quality attribute must be considered. The price indexes for

Chart 2: Comparison of the Price Indexes obtained from the four methods

WA : Weighed Average.
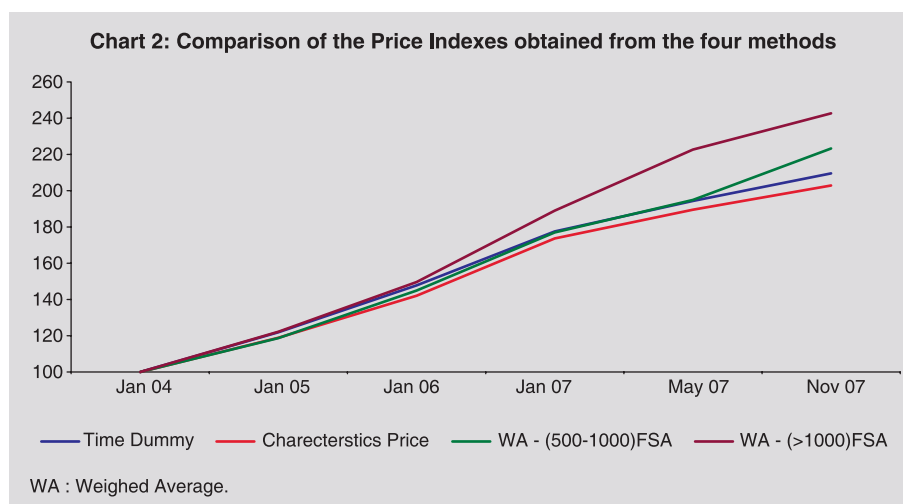
greater Mumbai obtained from two hedonic methods, viz., time dummy and characteristic price method were moving together till January 2007. However, the index obtained from characteristic price method was moving slowly as compared to time dummy after January 2007.

Section VII
Conclusion

House is a major form of individual wealth. Understanding its price changes is important as changes in its value may influence consumer spending and saving decisions, and thus affect overall economic activity. From the Central Banks' point of view, these are particularly important for maintaining financial stability. While it is important to have accurate measure of aggregate housing prices, its measurement poses significant conceptual and practical problems as each house is associated with many quality attributes which makes price comparisons difficult across units. Different methodologies have been followed to measure aggregate price of housing. This paper attempts to construct hedonic price index by two different methods, viz., Time Dummy Method and Characteristics Price Index method using the data on rent and sale/resale prices of residential properties in Mumbai for the period from January 2004 to November 2007. Results reveal that the price indices for Greater Mumbai obtained from the above-mentioned two methods were moving together till January 2007. However, the index obtained from characteristic price method moved slowly as compared to time dummy method after January 2007. The hedonic price indices are less as compared to other indices for the period under consideration. That is, price increase is subdued once the effect of quality attribute is controlled. This indicates that in order to asses the price movements of housing sector, effect of quality attributes must be considered.

References:

Bascher, J. and Lacroix T. (1999), "Dishwashers and PCs in the French CPI: Hedonic Modelling from Design to Practice", presented at the F*ifth meeting of the International Working Group on Price Indexes*, Reykjavik, Iceland, August, 1999.

Chow, G.C. (1967), "Technological Change and the Demand for Computers", *American Economic Review* **57**, pp. 1117–1130.

Court, A. (1939), "Hedonic Price Indexes with Automotive Examples", *The Dynamics of Automobile Demand*, pp.99-117, General Motors Corporation.

Diewert W.E. (2001), "Hedonic Regressions: A Consumer Theory Approach", *Discussion Paper, Department of Economics, University of British Columbia*.

Fixler, D., Fortuna, C., Greenlees, J. and Wlater, L . (1999), "The Use of Hedonic Regressions to Handle Quality Change: The Experience in the US CPI", paper presented at th*e Fifth Meeting of the International Working group of Price Indexes*, Reykjavik, Iceland, August 1999.

Griliches, Z. (1961), "Hedonic Price Indexes for Automobiles: An Econometric Analysis of Quality Change", The Price Statistics of Federal Government, New York, *National Bureau of Economic Research*.

Lancaster, K. (1971), "Consumer Demand: A New Approach", *Columbia University Press*, New York.

Liegey, P.R. and Shepler, N. (1999), "Adjusting VCR Prices for Quality Change: A Study Using Hedonic Method", *Monthly Labour Review*.

Melser, D. (2005), "The Hedonic Regression Time-Dummy Method And The Monotonicity Axioms", *Journal of Business & Economic Statistics*, 23(4): 485-492.

Okamoto, M. and Sato, T. (2001), "Comparison of Hedonic Method and Matched Models Methods using Scanner Data: The Case of PCs, TVs and Digital Cameras", Paper presented at the *Sixth Meeting of the International Working Group on Price Indexes*, Canberra, Australia, 2-6 April 2001.

Pakes, A. (2001), "A Reconsideration of Hedonic Price Indexes with an Application to PC's", *NBER working paper* 8715, Cambridge MA.

Plosser, C. I. (2007), "House Prices and Monetary Policy", Speech by the President, Federal Reserve Bank of Philadelphia, *European Economics and Financial Centre, Distinguished Speakers Series*.

Rosen, S. (1974), "Hedonic Prices and Implicit markets: Product Differentiation and Pure Competition", *Journal of Political Economy*, 82, 34-49.

Shiratsuka, S. (1999), "Asset Price Fluctuation and Price Indices", Monetary and Economic Studies.

Sutton, G. (2002), "Explaining Changes in House Prices", *BIS Quarterly Review*.

Triplett, J. E (2001), Handbook on Quality Adjustment of Price Indexes for Information and Communication Technology Product*s*, Paris: OECD.

Triplett, J.E., and McDonald R.J. (1977), "Assessing the Quality Error in Output Measures: The Case of Refrigerators", *The Review of Income and Wealth*, 23, 137-156.

Waugh, Frederick, V. (1928): "Quality Factors Influencing Vegetable Prices", *Journal of Farm Economics*, 10,185-196.

Annex

Table A: Regression coefficients –
Time Dummy Hedonic for Greater Mumbai - Rent

Con	Lift	z01	z02	z03	z04	t02	t03	t04	t05
1	2	3	4	5	6	7	8	9	10
1.98* (0.2)	0.02 (0.08)	1.99* (0.07)	0.52* (0.07)	0.37* (0.07)	0.16* (0.07)	0.06 (0.05)	0.27* (0.06)	0.54* (0.06)	0.66* (0.05)

t06	f02	f03	f04	a02	a03	r02	r03	b02	b03
11	12	13	14	15	16	17	18	19	20
0.77* (0.06)	0.09** (0.05)	0.14* (0.06)	0.14* (0.06)	0.14* (0.05)	0.33* (0.09)	0.07 (0.16)	0.29* (0.20)	0.00 (0.10)	0.32** (0.17)

Figures in parenthesis are SE; * Significant at 5 per cent level ; **Significant at 10 per cent level;

Note : The regression equation is formulated in a semi-log form with logarithm of house rent as the dependent variable. The data corresponding to zone 6 were very few in number. So those were not taken into account while calculating the rent price index for Greater Mumbai. The coefficients corresponding to the attributes of houses in zone 5 in January 2004 with FSA in the range of 0 to 600 sq. ft and having one bedroom and one bathroom house are set to zero.

Table B: Regression coefficients –
Time Dummy Hedonic for Greater Mumbai – Sale/Resale

Con	S	L	z01	z02	z03	z04	z05	t02	t03	t04
1	2	3	4	5	6	7	8	9	10	11
8.18* (0.08)	0.40* (0.04)	0.03 (0.03)	1.50* (0.04)	0.75* (0.03)	0.54* (0.03)	0.00 (0.03)	-0.07* (0.03)	0.20* (0.02)	0.39* (0.02)	0.57* (0.02)

t05	t06	f02	f03	f04	a02	a03	r02	r03	b02	b03
12	13	14	15	16	17	18	19	20	21	22
0.66* (0.02)	0.74* (0.02)	0.06* (0.02)	0.09* (0.02)	0.11* (0.03)	0.09* (0.02)	0.15* (0.03)	-0.07 (0.07)	-0.13** (0.07)	0.03 (0.04)	0.09** (0.05)

Figures in parenthesis are SE ; *Significant at 5 per cent level; **Significant at 10 per cent level;

Note : The regression equation is attempted with logarithm of house price as the dependent variable. The coefficients corresponding to the attributes zone 6, time period corresponding to January 2004, floor space area in the range 0 to 600 square feet, one bed room house and one bathroom house are set to zero. Thus the coefficients corresponding to other attributes of that variable are interpreted in relation to that attribute which is set to zero.

Table C : Regression coefficients – Time Dummy Hedonic for Greater Mumbai (Zone-wise) and Adjacent Municipalities- Price

Area	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Navi Mumbai	Thane	Kalyan	Mira Road/ Bhaya-nder	Virar/ Vasai	Badla-pur
1	2	3	4	5	6	7	8	9	10	11	12	13
Con	9.18* (0.16)	8.55* (0.13)	8.18* (0.57)	7.71* (0.16)	7.35* (0.26)	8.38* (0.04)	7.33* (0.16)	7.01* (0.45)	7.82* (0.04)	7.04* (0.12)	6.93* (0.05)	5.73* (0.04)
S	@	0.04 (0.11)	0.07 (0.24)	0.10 (0.08)	0.23 (0.14)	0.52* (0.02)	0.18* (0.08)	0.08 (0.11)	0.58* (0.03)	0.20* (0.05)	0.36* (0.03)	@
L	0.05 (0.15)	0.21* (0.03)	0.31 (0.47)	0.1* (0.03)	0.00 (0.19)	0.01 (0.02)	0.05 (0.1)	0.10 (0.29)	0.00 (0.03)	@	-0.03 (0.02)	0.03 (0.03)
t02	0.11* (0.04)	0.16* (0.04)	0.21* (0.1)	0.31* (0.04)	0.17* (0.03)	0.18* (0.02)	0.34* (0.05)	0.09 (0.11)	0.42* (0.02)	0.48* (0.05)	0.47* (0.04)	0.49* (0.03)
t03	0.44* (0.05)	0.3* (0.04)	0.48* (0.09)	0.46* (0.04)	0.39* (0.03)	0.28* (0.02)	0.52 (0.04)	0.25* (0.1)	0.59 (0.02)	0.82* (0.05)	0.89* (0.04)	1.03* (0.03)
t04	0.72* (0.04)	0.5* (0.04)	0.54* (0.09)	0.64* (0.04)	0.59* (0.03)	0.49* (0.02)	0.72* (0.05)	0.38* (0.11)	0.84 (0.02)	1.1* (0.05)	1.08* (0.04)	1.22* (0.03)
t05	0.99* (0.05)	0.5* (0.04)	0.7* (0.1)	0.7* (0.04)	0.7* (0.03)	0.49* (0.02)	0.75* (0.05)	0.76* (0.11)	0.87 (0.02)	1.17* (0.05)	1.11* (0.04)	1.23* (0.03)
t06	1.14* (0.04)	0.56* (0.04)	0.8* (0.09)	0.73* (0.04)	0.78* (0.03)	0.47* (0.02)	0.92* (0.05)	0.7* (0.12)	0.88 (0.02)	1.13* (0.05)	1.22* (0.04)	1.26* (0.03)
f02	-0.05 (0.05)	0.06 (0.04)	0.28* (0.09)	-0.01 (0.03)	0.00 (0.03)	0.00 (0.01)	0.01 (0.04)	0.07 (0.1)	-0.01 (0.01)	-0.06 (0.11)	0.01 (0.04)	-0.01 (0.02)
f03	0 (0.05)	0.17* (0.04)	0.17 (0.09)	-0.01 (0.04)	0.01 (0.03)	0 (0.03)	0.01 (0.05)	-0.01 (0.11)	0.00 (0.02)	-0.04 (0.11)	0.02 (0.05)	-0.05 (0.06)
f04	0.01 (0.04)	0.2* (-0.05)	0.18 (0.1)	0.09 (0.04)	0.04 (0.04)	-0.03 (0.06)	0.04 (0.06)	0.11 (0.12)	@	@	0.08 (0.11)	@
a02	0.04 (0.06)	0.15* (0.03)	-0.13 (0.11)	0.03 (0.04)	0.00 (0.05)	-0.02 (0.02)	-0.15* (0.07)	0.13 (0.14)	0.02 (0.02)	-0.03 (0.03)	0.00 (0.02)	0.04 (0.03)
a03	0.12 (0.08)	0.14* (0.08)	-0.04 (0.14)	0.19* (0.05)	-0.01 (0.06)	-0.02 (0.04)	-0.11 (0.08)	0.27 (0.19)	@	@	0.03 (0.15)	0.01 (0.05)
r02	0.04 (0.07)	-0.12* (0.06)	-0.28 (0.15)	0.23 (0.13)	0.14* (0.1)	0.03 (0.04)	-0.17 (0.12)	0.00 (0.22)	0.01 (0.03)	0.08* (0.04)	-0.03 (0.02)	0.00 (0.03)
r03	@	-0.4* (0.08)	@	0.12 (0.13)	@	0.1 (0.04)	0.21 (0.23)	@	@	@	@	@
b02	-0.03 (0.04)	0.02 (0.05)	-0.1 (0.09)	0.1* (0.05)	0.27* (0.1)	-0.05 (0.02)	-0.18 (0.19)	0.14 (0.17)	0.00 (0.03)	-0.06 (0.07)	0.00 (0.04)	-0.05 (0.03)
b03	@	0 (0.11)	@	0.09 (0.07)	0.35* (0.11)	@	-0.20 (0.19)	@	@	@	@	@

@ Not Estimable due to insufficient data ; Figures in parenthesis are SE; * Significant at 5 per cent level

Note : The regression equations are attempted with logarithm of house price as the dependent variable. The coefficients corresponding to the attributes of houses in January 2004 with FSA in the range of 0 to 600 sq. ft and having one bedroom and one bathroom house are set to zero in all the regression equations.

Table D1. Distribution of Sample Colonies by Administrative Zones

Administrative zones	Area
Zone 1 (z01)	1. Cuffe Parade 2. Malabar Hill
Zone 2 (z02)	3. Lower Parel 4. Matunga East 5. Mahim West
Zone 3 (z03)	6. Bandra West 7. Andheri East 8. Oshivara
Zone 4 (z04)	9. Kurla East 10. Tungwa/ Chandivali 11. Chembur
Zone 5 (z05)	12. Malad 13. Borivali/Kandivali 14. Dahisar 15. Goregoan
Zone 6 (z06)	16. Bhandup 17. Mulund
Municipalities	
Navi Mumbai (z07)	18. Vashi 19. Khargarh Road
Thane (z08)	20. Pokaran Road 1&2
Kalyan (z09)	21. Near Railway Station
Mira Road/Bhyander (z10)	22. Mira Road
Virar/Vasai (z11)	23. Virar 24. Nala Sopara
Other Municipalities (z12)	25. Badlapur

Table D2: Housing Stock Distribution

Zone	No. of House Holds	Population (as per Census-2001)
1	2	3
1	270644	1377578
2	406519	1960453
3	513317	2428908
4	371736	1675679
5	372291	1867118
6	351499	1640978

Table E: Modal Houses

Time	Zone	S (whether sale/ resale)	L (availability of lift)	F (floor)	A (area)	R (no. of rooms)	B (no. of bath- rooms)
1	2	3	4	5	6	7	8
Jan-04	1	Sale	Lift	> 5 F	>1000 SF	>2R	2B
Jan-04	2	Sale	Lift	4-5 F	600-1000 SF	2R	1B
Jan-04	3	Sale	Lift	2-3 F	600-1000 SF	>2R	2B
Jan-04	4	Sale	Lift	2-3 F	< 600 SF	2R	1B
Jan-04	5	Sale	Lift	2-3 F	< 600 SF	2R	1B
Jan-04	6	Sale	Lift	2-3 F	600-1000 SF	2R	1B
Jan-05	1	Sale	Lift	> 5 F	>1000 SF	>2R	2B
Jan-05	2	Sale	Lift	4-5 F	600-1000 SF	2R	1B
Jan-05	3	Sale	Lift	2-3 F	< 600 SF	>2R	2B
Jan-05	4	Sale	Lift	2-3 F	600-1000 SF	2R	1B
Jan-05	5	Sale	Lift	2-3 F	< 600 SF	2R	1B
Jan-05	6	Sale	Lift	2-3 F	600-1000 SF	2R	1B
Jan-06	1	Sale	Lift	> 5 F	>1000 SF	>2R	2B
Jan-06	2	Sale	Lift	2-3 F	< 600 SF	2R	1B
Jan-06	3	Sale	Lift	2-3 F	600-1000 SF	>2R	1B
Jan-06	4	Sale	Lift	2-3 F	600-1000 SF	>2R	2B
Jan-06	5	Sale	Lift	2-3 F	< 600 SF	2R	1B
Jan-06	6	Sale	Lift	2-3 F	600-1000 SF	>2R	2B
Jan-07	1	Sale	Lift	> 5 F	>1000 SF	>2R	2B
Jan-07	2	Sale	Lift	4-5 F	< 600 SF	2R	1B
Jan-07	3	Sale	Lift	2-3 F	>1000 SF	>2R	2B
Jan-07	4	Sale	Lift	> 5 F	600-1000 SF	>2R	2B
Jan-07	5	Sale	Lift	2-3 F	< 600 SF	2R	1B
Jan-07	6	Sale	Lift	0-1 F	600-1000 SF	>2R	2B
May-07	1	Sale	Lift	2-3 F	>1000 SF	>2R	2B
May-07	2	Sale	Lift	2-3 F	< 600 SF	2R	1B
May-07	3	Sale	Lift	2-3 F	>1000 SF	>2R	2B
May-07	4	Sale	Lift	2-3 F	< 600 SF	>2R	2B
May-07	5	Sale	Lift	2-3 F	< 600 SF	2R	1B
May-07	6	Resale	Lift	2-3 F	600-1000 SF	>2R	1B
Nov-07	1	Sale	Lift	> 5 F	>1000 SF	>2R	2B
Nov-07	2	Sale	Lift	4-5 F	< 600 SF	2R	1B
Nov-07	3	Sale	Lift	2-3 F	>1000 SF	>2R	2B
Nov-07	4	Sale	Lift	2-3 F	600-1000 SF	>2R	2B
Nov-07	5	Sale	Lift	2-3 F	< 600 SF	>2R	1B
Nov-07	6	Sale	Lift	0-1 F	600-1000 SF	>2R	2B

Table F: Regression coefficients –
Characteristic Price for Greater Mumbai

Time	Con	S	L	z01	z02	z03	z04	z05	f02
1	2	3	4	5	6	7	8	9	10
Jan-04	8.28*	0.32*	0.19*	1.24*	0.75*	0.38*	-0.15	-0.19*	0.08
	(0.16)	(0.09)	(0.07)	(0.10)	(0.08)	(0.08)	(0.08)	(0.08)	(0.05)
Jan-05	8.29*	0.34*	0.04	1.16*	0.68*	0.42*	-0.07	-0.23*	0.05
	(0.17)	(0.10)	(0.06)	(0.10)	(0.08)	(0.08)	(0.08)	(0.08)	(0.06)
Jan-06	8.36*	0.39*	0.07	1.38*	0.74*	0.58*	0.01	-0.09	-0.02
	(0.28)	(0.08)	(0.06)	(0.09)	(0.08)	(0.07)	(0.07)	(0.07)	(0.05)
Jan-07	8.99*	0.46*	-0.03	1.55*	0.76*	0.52*	0.04	-0.04	0.04
	(0.19)	(0.08)	(0.06)	(0.09)	(0.08)	(0.07)	(0.08)	(0.07)	(0.05)
May-07	8.70*	0.39*	-0.05	1.68*	0.72*	0.54*	-0.02	-0.02	0.09
	(0.15)	(0.09)	(0.07)	(0.10)	(0.08)	(0.08)	(0.08)	(0.08)	(0.05)
Nov-07	9.07*	0.50*	-0.03	1.99*	0.83*	0.81*	0.16*	0.18*	0.04
	(0.22)	(0.09)	(0.07)	(0.10)	(0.09)	(0.08)	(0.08)	(0.08)	(0.05)

Time	f03	f04	a02	a03	r02	r03	b02	b03
1	11	12	13	14	15	16	17	18
Jan-04	0.08	0.02	0.14*	0.27*	-0.30*	-0.42	0.08	-0.08
	(0.05)	(0.07)	(0.05)	(0.09)	(0.14)	(0.19)	(0.13)	(0.17)
Jan-05	0.10	0.13	0.10*	0.13	0.10	0.00	0.02	0.17
	(0.06)	(0.07)	(0.05)	(0.08)	(0.15)	(0.18)	(0.11)	(0.13)
Jan-06	0.04	0.09	0.08	0.17*	0.14	0.06	0.09	0.07
	(0.06)	(0.06)	(0.05)	(0.08)	(0.28)	(0.29)	(0.08)	(0.11)
Jan-07	0.06	0.15*	0.10*	0.09	-0.20	-0.13	-0.07	-0.10
	(0.06)	(0.06)	(0.05)	(0.07)	(0.18)	(0.17)	(0.14)	(0.15)
May-07	0.14*	0.14*	0.01	0.11	0.07	0.10	0.04	0.17
	(0.06)	(0.07)	(0.06)	(0.09)	(0.13)	(0.14)	(0.08)	(0.11)
Nov-07	0.02	0.06	0.05	0.08	-0.21	-0.39	0.16	0.24
	(0.06)	(0.07)	(0.07)	(0.09)	(0.20)	(0.24)	(0.12)	(0.14)

Figures in parenthesis are SE; * Significant at 5 per cent level

Note: The regression equations are estimated with logarithm of house price as the dependent variable. The coefficients corresponding to the attributes for zone 6, floor space area in the range 0 to 600 square feet, one bed room house and one bathroom house are set to zero. Thus the coefficients corresponding to other attributes of that variable are interpreted in relation to the attribute which is set to zero.

Table G: Regression coefficients –
Characteristic Price for adjacent municipalities

Time	cons	Sale	lift	z07	z08	z09	z10	z11	f02
1	2	3	4	5	6	7	8	9	10
Jan-04	5.74*	0.12	0.09	1.62*	1.55*	1.88*	1.10*	0.94*	-0.02
	(0.11)	(0.06)	(0.06)	(0.07)	(0.08)	(0.10)	(0.09)	(0.08)	(0.05)
Jan-05	6.51*	0.39*	0.11	1.42*	1.11*	1.46*	1.03*	0.80*	-0.01
	(0.09)	(0.06)	(0.06)	(0.08)	(0.09)	(0.09)	(0.09)	(0.07)	(0.05)
Jan-06	7.08*	0.32*	-0.04	1.19*	0.89*	1.33*	0.93*	0.69*	0.02
	(0.11)	(0.09)	(0.05)	(0.07)	(0.07)	(0.11)	(0.08)	(0.07)	(0.05)
Jan-07	7.14*	0.21*	-0.06	1.22*	0.87*	1.54*	1.04*	0.71*	0.06
	(0.10)	(0.07)	(0.05)	(0.07)	(0.08)	(0.11)	(0.09)	(0.07)	(0.05)
May-07	7.19*	0.22*	-0.03	1.24*	1.14*	1.52*	1.09*	0.75*	-0.05
	(0.09)	(0.06)	(0.05)	(0.07)	(0.08)	(0.10)	(0.08)	(0.07)	(0.05)
Nov-07	7.07*	0.06	0.11	1.43*	1.17*	1.70*	1.04*	0.83*	0.05
	(0.10)	(0.06)	(0.06)	(0.07)	(0.08)	(0.10)	(0.09)	(0.07)	(0.05)

Time	f03	f04	a02	a03	r02	r03	b02	b03
1	11	12	13	14	15	16	17	18
Jan-04	0.02	0.05	-0.07	-0.04	0.07	0.24*	-0.03	0.10
	(0.07)	(0.09)	(0.04)	(0.09)	(0.05)	(0.12)	(0.09)	(0.22)
Jan-05	-0.01	-0.05	-0.07	-0.13	0.08	0.14	0.12	0.28
	(0.06)	(0.10)	(0.05)	(0.11)	(0.06)	(0.13)	(0.09)	(0.18)
Jan-06	0.01	0.09	0.02	0.11	-0.03	0.03	-0.02	-0.07
	(0.06)	(0.13)	(0.04)	(0.10)	(0.05)	(0.11)	(0.08)	(0.13)
Jan-07	-0.01	-0.05	0.09*	0.30*	-0.08	0.00	-0.06	-0.38*
	(0.06)	(0.09)	(0.05)	(0.09)	(0.06)	(0.11)	(0.07)	(0.11)
May-07	-0.07	0.01	0.00	0.09	0.01	0.05	-0.01	-0.13
	(0.06)	(0.07)	(0.04)	(0.09)	(0.05)	(0.10)	(0.07)	(0.11)
Nov-07	0.06	0.07	0.01	-0.05	-0.07	-0.04	0.00	0.16
	(0.05)	(0.09)	(0.05)	(0.09)	(0.05)	(0.10)	(0.07)	(0.12)

Figures in parenthesis are SE;   * Significant at 5 per cent level.

Note: The regression equations are estimated with logarithm of house price as the dependent variable. The coefficients corresponding to the attributes for Badalapur, floor space area in the range 0 to 600 square feet, one bed room house and one bathroom house are set to zero. Thus the coefficients corresponding to other attributes of that variable are interpreted in relation to the attribute which is set to zero.

Evolution of Global Private Equity Market: Lessons, Implications and Prospects for India

R. K. Jain and Indrani Manna*

Venture capital and private equity industry has emerged as a potential source of capital for the corporate sector. They have been facilitating the productive use of existing assets and resources, usually by identifying companies with untapped potential and reorganizing their operations in ways that increase their value. Over the years, they have made their presence felt in the Indian economy too. Given their rising prominence in the financial sector, there have been concerns about their regulation, of late. This paper takes stock of the evolution of private equity market in the world and analyses its prospects and implications for India.

Introduction

Financial globalization and increasing risk appetite among global investors has given birth to a new genre of financial intermediaries such as the private equity (PE). Growth in savings, abundant liquidity propelled by petrodollars, sovereign wealth funds as well as hedge funds and an accommodative monetary policy that enabled a low interest rate environment accelerated this process further. Moreover, regulatory changes such as pension fund reforms and financial innovations like securitization motivated the growth of alternative asset classes like private equity and more particularly, the leveraged buyout industry since 2000.

* Shri R.K. Jain is Director and Ms Indrani Manna is Research Officer in the Department of Economic Analysis and Policy. The authors are grateful to Shri B.M. Misra, Advisor, DEAP for his valuable suggestions. The views expressed in the paper are those of the authors and not of the institution to which they belong.

However, the rapid growth of the private equity industry, of late, has raised concerns relating to the regulation of the sector. The secretive nature of private equity firm activity, limited research and dearth of regulatory control on the industry has raised several questions about the quality of the capital flowing in, the activities of private equity funds, impact on the firms' fundamentals and possibility of systemic risks emerging from the operations of private equity funds. Although, there is a rich literature illuminating the impact of venture capital financing on the firm's earnings, management, financial reporting practices, post IPO performance, *etc.,* due to institutional differences between venture capital firms and PE sponsors, the findings of such research cannot be completely extrapolated to assess the impact of private equity on the fundamentals of the firm. For example, while venture capital firms invest in early stage, low profitable firms and rarely use bank debt, PE sponsors, generally, buy mature, profitable businesses *via* leveraged/management buyout transactions, finance the transactions with large portion of bank debt and assume control of board of directors but are less likely to assume operational control. Further, these studies look into firm specific effects. Hence, the questions pertaining to private equity impact on the economic fundamentals, its benefits and systemic risks has remained more or less unanswered. This study makes an attempt to look into these aspects.

The paper has been organized into seven sections. Section II reviews the literature in this area. Section III gives an overview of the global private equity market including its historical background, definition and characteristics, benefits from PE and need for regulating the industry. Section IV describes evolution of private equity in India. Section V discusses implications of private equity market for India. Section VI elaborates on the prospects of the industry and Section VII concludes.

Section II
Review of Literature

Despite growing interest in the subject, academic studies and analyses of private equity finance has been relatively less. The main

reason for this is that private equity has been a secretive economic sector and has been able to do so because it operates privately and does not have to provide accounts of what it does and how it is done. The available literature on private equity so far has covered a range of issues including the spread of the industry, risk-return characteristics, operation of economies of scale, demand-supply functions of a typical private equity firm, benefits from private equity and regulatory aspects of private equity.

Ljungqvist and Richardson (2003) produced one of the first analysis of private equity returns based on actual cash flows of venture and buyout capital funds. The study measures the timing and magnitude of investment decisions, how quickly capital is returned to investors and overall performance of private equity as a function of various characteristics. The author has found that it takes over three and six years, respectively, to invest 56.9 per cent and 90.5 per cent of the capital committed, and over eight and ten years, respectively, for internal rates of returns to turn positive and eventually exceed public equity returns. Further, private equity generates excess returns to the order of five to eight per cent per annum relative to the aggregate public equity market. Some other studies have found evidence that internal rate of return on realized investments of PE firms are high under syndication, incentive compatible financial instruments and strong legal environment.

Weidig and Mathonet (2004) analysed the risk profiles and estimated the risk-return characteristics of different private equity investment vehicles such as direct investment, funds and fund-of-funds. The study elaborates that calculation of risk as volatility of a time series of market price in different private equity investment vehicles is hampered by the lack of public and efficient market to price the product. Therefore, the risk is measured as the standard deviation around average return. The return is expressed as a measure, typically the internal rate of return or the multiple (the sum of all cash flows of an investment divided by the capital invested). The study concludes that there is a clear diversification benefit for funds,

fund-of-funds, portfolio of funds and direct investments. The distribution of multiples of a direct investment is extremely skewed. About 30.0 per cent of all direct investments are total failure and all capital invested is lost. However, the distributions have very long, slowly decreasing and fat tails with extreme profits above multiple of 10. The multiple distribution of a fund-of-funds is nearly normally distributed with rapidly decreasing tails. Hence a fund-of-funds has a small probability of any loss.

Katz (2008) analyses how the ownership structure of a firm – that is PE-backed and non PE-backed firms - affects their financial reporting practices, financial performance and stock returns in the years preceeding and following an IPO. In other words, the author has attempted to analyse whether the alleged opportunistic behaviour of PE-backed firms coupled with their tighter monitoring and reputational considerations affect earnings management, conservatism and post-IPO performance as compared to non-PE-backed firms owned and controlled by their management teams. The author finds that presence of and monitoring by sophisticated PE-sponsors restrains upward earnings management and induces a higher frequency of timely loss recognition, both pre and post IPO. Further, majority ownership by a PE sponsor is associated with better stock price performance relative to management owned firms. Larger PE sponsor size is positively associated with both better long term financial and stock price performance when firm goes public.

Some studies have also brought out the economies of scale operating within the constituents of private equity industry – the buyout funds as opposed to venture capital (VC) funds. Metric and Yasuda (2008) have shown that the crucial difference between buyout and venture capital funds derives from the fact that a buyout manager's skill can add value to extremely large companies, whereas a venture capital manager's skills can only add value generally to small companies. It has been observed that a key feature of a buyout business is that once a buyout manager is successful in managing a US$ 100 million company, the same skills can be applied to handle a US$ 1 billion company. This scalability allows buyout funds to

sharply increase the size of the fund while keeping the number of companies per partner and per professional fairly constant. On the other hand, venture capital skills that are critical in helping firms in their developmental infancy are not applicable to more mature firms that are ten times larger and already in possession of core management skills. So when successful VC firms increase the size of their fund, they cannot just scale up the size of each firm they invest in without dissipating their source of rent.

Cumming and Johan (2007) have analysed how the dearth of regulations in private equity has affected the Dutch institutional investor's participation in the private equity market and how regulatory harmonization may facilitate the investment in private equity. The author has concluded that low disclosure standards raise the screening, search, governance and monitoring costs of private equity investment, which in turn requires specialized skills on the part of the institutions to participate in the private equity class. Therefore, institutions that perceive the comparative dearth of regulations in private equity to be more important for their investment allocation decisions are essentially ranking the potential agency problems as being more pronounced and are less likely to invest in private equity. In particular, the study has found that an increase in the ranking of the importance of a comparative dearth of regulations in private equity by 1 on a scale of 1 (lowest importance) to 5 (highest importance) reduces the probability that the institutional investor will invest in private equity by up to 30 per cent, and reduces the amount invested by up to 0.8 per cent of the institution's total assets. The study has also shown that harmonization of existing regulations affecting institutional investors facilitates investment in private equity through enabling different type of institutional investors in different countries to act as limited partners for the same private equity fund.

Cumming and Walz (2007) analysed the drivers behind institutional investors investment in private equity firms. They conclude that institutional investors are inclined to invest in PE firms in economies which have strong disclosure standards, congenial legal environment, stable economy and robust financial markets. The

authors are of the view that institutional investors face information asymmetries as PE fund holds illiquid assets in the form of portfolio firms that do not have a market value until disposition or a realization event. PE managers have an incentive to overvalue unrealized investments in order to attract capital from other institutional investors to raise follow-up funds. Further, in economies with unstable market conditions and less stringent regulatory standards, institutional investors are faced with an added difficulty of ascertaining whether a change in reported value of unrealized investment is a result of adverse changes in market conditions or overvaluation in reporting. The study finds that less experienced PE managers and those involved in early stage investments are more inclined to overvalue. Further, less stringent accounting rules and weak legal systems facilitate overvaluation.

Among the prominent Indian studies is the analysis of leveraged buyouts in India by Chokshi (2007). The study elaborates the major factors hindering the growth of leveraged buyouts in India such as the restrictions on foreign investments in India, limited availability of control transactions and professional management, underdeveloped corporate debt market, restrictions on bank lending, *etc.*

This paper attempts to add to the limited literature in private equity in Indian context. It takes stock of the PE industry including its inception, definitional issues, performance and regulatory issues and derives therefrom lessons, implications and prospects for India.

Section III
Evolution of the Global Private Equity Market

III.1. The Concept of PE and its Characteristics

III.1.1 Definition

There is no universally agreed definition of private equity. Different academic studies and private equity associations in various economies have defined private equity differently depending on the activities they engage in those economies. Lerner (1999) broadly defines private equity organization as partnerships specializing in venture capital, leveraged buyouts (LBOs), mezzanine investments,

build-ups, distressed debt and other related investments. Fenn, Liang and Prowse (1995) have described them as 'financial sponsors' acquiring large ownership stakes and taking an active role in monitoring and advising portfolio companies. Ljungqvist and Richardson (2003) describes private equity as an illiquid investment since there is no active secondary market for such investments, investors have little control over how capital is invested and the investment profile covers a long horizon. The European Venture Capital Association defines private equity as the provision of equity capital by financial investors – over the medium or long-term – to non-quoted companies with high growth potential. It is also called 'patient capital' as it seeks to profit from long term capital gains rather than short term regular reimbursements. Similarly, the International Financial Services, London calls any type of equity investment in an asset in which the equity is not freely tradable on a public stock market as private equity. Private equities are generally less liquid than publicly traded stocks and are thought of as a long-term investment.

III. 1.2 *Difference between Private Equity, Venture Capital and Hedge Funds*

Presently there is lot of ambiguity surrounding the concepts of private equity and alternative investment channels like venture capital and hedge funds. Venture capital is a subset of private equity and refers to equity investments made for the launch, early development, or expansion of a business. It has a particular emphasis on entrepreneurial undertakings rather than on mature businesses. In fact, in most of the literature on private equity and venture capital, these two concepts are used interchangeably. Hedge Funds differ from private equity firms in terms of their time-to-hold, liquidity, leverage and strategic direction of investments which in turn dictates differences in their exit strategy, risk tolerance and desired rate of return of the two types of funds. Hedge funds seek a quick flip of their investments with the average length of their investments being 6-18 months, whereas private equity firms stay invested for around 3-5 years. Hedge funds are also inclined towards volatile withdrawal

of investments as opposed to private equity firms which are focussed on long term returns. However, of late, it has been observed that the arena of activities of such institutional investors are not mutually exclusive. Many private equity groups own hedge funds and make long term investments in hedge funds. Further, attracted by the significant returns in buyout deals, many hedge funds have joined hands with private equity players to make large buyout deals. Given the differences in activities and risk tolerance of the two players coupled with the absence of any public reporting norms of their activities, the synergy between the two players has raised regulatory concerns, of recent.

III.1.3 Nature of Private Equity Firm

Virtually, all private equity firms are organized as limited partnerships where private equity firms serve as general partners and large institutional investors and high net worth individuals providing bulk of the capital serve as limited partners (Metrick & Yasuda; 2008). Typically such partnerships last for 10 years and partnership agreements signed at the funds inception clearly define the expected payments to general partners.

III.1.4 Market Structure and Activities of PE

Pratt (1981) has tried to categorise types of private equity activities in terms of the stages of corporate development, where PE financing is called for.

1. *Seed Financing*: Providing small sums of capital necessary to develop a business idea.

2. *Start-up financing*: Providing capital required for product development and initial marketing activities.

3. *First-stage*: Financing the commercialization and production of products.

4. *Second-stage*: Providing working capital funding and required financing for young firms during growth period.

5. *Third-stage*: Financing the expansion of growth companies.

6. *Bridge financing*: Last financing round prior to an initial public offering of a company.

7. *PIPE deals:* A private investment in public equity, often called a PIPE deal, involves the selling of publicly traded common shares or some form of preferred stock or convertible security to private investors. In the U.S., a PIPE offering may be registered with the Securities and Exchange Commission on a Registration Statement or may be completed as an unregistered private placement.

8. *Leveraged Buyout (LBO):* It entails the purchase of a company by a small group of investors, especially buyout specialists, largely financed by debt.

9. *Management Buyout (MBO):* It is a subset of LBO whereby incumbent management is included in the buying group and key executives perform an important role in the LBO transactions.

Fenn (1995) tried to further this idea by classifying the stages of corporate development in terms of revenues generated and the corresponding growth potential, finance requirement and access to various sources of finance of the firm. For example, an early stages new venture company is visualized as a firm generating revenues between zero and US$ 15 million, having a high growth potential with limited access to bank credit and greater dependence on alternative sources of finance such as the private equity. Private equity investments in firms in financial distress includes firms which are over-leveraged or suffer from operating problems with very limited access to other financial markets and the objective is to effect a turnaround.

III.1.5 Players in the Private Equity Market

Povaly (2007) has identified three major participants in a private equity market namely

i.   *Issuers* or firms where private equities invest in. As private equity is an expensive form of finance, issuers are generally firms that do not have recourse to an alternative source of financing such as a bank loan, private placement or the public equity market (IFSL Research, 2008). These firms vary in their size and reasons for raising capital. Firms seeking venture capital include young firms that are expected to show high growth rates, early stage capital for companies that have commenced trading but have not moved into profitability as well as later stage investments where the product or service is widely available but capital is required for further growth. Non-venture private equity investments include middle-market companies that raise private equity finance for expansion or change in their capital structure.

ii.   *Intermediaries* which are private equity funds themselves. These are mostly organized as limited partnerships where investors who contribute to the fund's capital are limited partners, while the professional managers running the fund serve as the general partners. About four fifths of the private equity investments flow through specialized intermediaries, while the remainder is invested directly in firms through co-investments (IFSL Research; 2008).

iii. *Investors* who are contributing capital to private equity firms. These may include public and corporate pension funds, endowments, foundations, bank holding companies, investment banks, insurance companies and wealthy families and individuals. Most institutional investors contribute capital to private equity funds because they expect the risk-adjusted returns in private equity to be higher than the risk-adjusted returns on other investments and because of the potential benefits of diversification (Povaly; 2007).

III.1.6 Business Cycle of Private Equity

A private equity business cycle consists of four stages. The first stage of a private equity business cycle is to establish investment funds that collect capital from investors or limited partners. Limited

partners include pension and provident funds, hedge funds, sovereign wealth funds, multilateral development banks like the Asian Development Bank and bilateral development financial institutions. These institutions, with the exception of hedge funds, do not have the professional staff nor the expertise to make such investments themselves and hence channel capital to private equity funds.

The partners commit funds for a set period (on average 10 years). The fund raising period lasts for six months to one year. There can be three types of private equity funds *viz.,* Independent, Captive and Semi-captive funds. Independent private equity funds are those in which third parties are the main source of capital and in which no one shareholder holds a majority stake. In a captive fund, one shareholder contributes most of the capital.

At the second stage, the capital thus raised is used to buy equity stakes in high-potential companies following a clearly defined strategy. The private equity management team makes investments essentially in the first five years of the fund (EVCA; 2007). A private equity investment takes place through one of the four investment vehicles *viz.*, direct investments, funds, fund-of-funds and more exotic products like collateralized fund obligations (CFOs), publicly quoted entities or mixed portfolios. Under direct investments, venture capital funds and informal private equity investors align interests with the founders or early round investors to avoid adverse selection and opportunistic behaviour. A private equity fund, on the other hand, collects capital from investors to choose and manage about 10 to 20 direct investments on their behalf. Investors decide to pool in funds based on due diligence including the quality of the management team, its track record, investment strategy and fund structure. Capital is drawn down as needed in order to pay set-up costs and management fees (typically 2.5 per cent p.a.) and to invest in a number of companies over an investment period of 4-5 years. Over the following years, the companies in the portfolio are further financed and managed for exit *via* trade sales, public offerings or secondary markets. Under the fund of funds, capital is collected from investors to invest in 20 or more funds on their behalf. They typically charge a management

fee of around 0.5 per cent per year and participate in the profits upto 5 per cent to 10 per cent. Collateralised fund obligations are effectively securitization of mainly private equity fund-of-funds. Publicly traded products refer to those entities that raise capital from the public market like mutual funds and invest into private equity. Their net asset value is published regularly and the market price reflects the market's judgement on their fair value. These include listed companies whose core business is private equity such as 3i, quoted investment funds and specially structured investment vehicles (Weidig and Mathonet; 2004).

Private equity funds generally do not intend to maintain indefinite control of the target company. Instead they seek to acquire control of companies, implement value adding changes and then realize the resulting capital gain by disposing of their investment within a relatively short time frame which is generally 3-5 years. Hence the penultimate stage of a private equity business cycle is to exit the investment. They require timely and profitable exits not only to redeem capital and returns to their investors and themselves but also to establish and maintain their reputation, which in turn enable them to raise capital again for future funds from existing and new limited partners. Hence it is extremely important that there exists a smooth and functional public issues market where they can divest and capitalize their gains.

Finally, the capital recovered from the exit is redistributed to original investors on a pro-rata basis depending on the size of their initial investment. These reimbursements along with the capital gains, allow the institutional investors to honour their insurance contracts, pensions and savings deposits. This completes one private equity business cycle. When all the capital collected from the investors has been invested and when certain investments have already been exited, the fund managers may launch a second fund. Their credibility in attracting new investors depends on their historical performance because they will be in competition with other managers in the asset management market (EVCA; 2007). Successful private equity firms stay in business by raising a new fund every 3 to 5 years.

III.1.7 Risk Profile of Private Equity Investment

Private equity is regarded as a risky asset given the amount of leverage involved in the deals. However, private equity investments are not necessarily risky (Weidig and Mathonet; 2004). The risk profiles of private equity investment varies with the investment vehicle used in the process. For example, a direct investment has a 30.0 per cent probability of total loss whereas a fund has a very small probability of total loss.

In sum, private equity originally evolved as a conduit to finance young entrepreneurial firms which require substantial capital to drive growth and innovation. These enterprises are characterized by significant intangible but limited tangible assets, expect a period of negative earnings and have uncertain prospects which makes debt financing difficult (Povaly; 2007). Similarly, private equity organizations finance firms trapped in troubled waters which typically find it difficult to raise debt finance. Private equity organizations finance these high risk situations and expect high rewards in return. They protect the value of their equity investments by conducting careful and extensive due diligence before making an investment regarding business, financial, regulatory and environmental issues relevant for the company in question.

III.2. Benefits of Private Equity Finance

Private equity finance has become popular in recent times as it confers various benefits on the companies concerned, as well as the industry, economy and society at large. KPMG survey of 119 PE-sponsored firms in Asia has found that most private equities conceptualise 'provision of capital' as their most important contribution to growth of business followed by optimizing company's financing structure, general management guidance at the board level, ability to recruit the best managers to run the business, improve corporate governance and improvement of business processes. Host companies also benefit from international network of contracts, injection of international know-how, *etc.* Several studies have also

documented that private equity/venture capitalists speed up product commercialization (Hellman and Puri; 2000), adoption of human resource development policies and strengthens companies commercialization strategies (Gans, Hsu, Stern; 2002; Hsu, 2006).

Private equity also provide 'venture capital' and therefore PE funds are looked upon as 'company builders'. They favour build-up of absorptive capacity preparing firms with the ability to identify, evaluate and absorb internally different forms of know-how which have been generated outside the firm. By investing in the build-up of absorptive capacity through in-house R&D, companies may therefore increase their ability to generate future innovations by remaining actively tuned on what others are doing and ready to exploit opportunities that scientific and technological advances create. In fact, a survey of firms receiving private equity investments in Australia in 2006 has shown that PE investors encourage collaboration with universities in R&D. They shape portfolio companies innovative strategies by investing at the right time and making them public at the right moment (Rin and Penas; 2007) and thus freeing of capital to reinvest it in new ventures (Michelacci and Suarez; 2004). Incentivisation of management coupled with control function of debt are prone to making executives rethink existing business models and inspire new ideas. They stimulate management for add-on acquisitions or for launch of new higher margin products or markets.

Private equity helps companies to perform better in several ways. Kaplan (1989) examined the post-buyout operating performance of 48 LBOs completed during 1980 to 1986. His results show that in comparison with the year before the buyout, operating income has increased by 42 per cent over a 3-year period after the buyout. Most of the studies have indicated that the pressure of servicing a debt load coupled with changes in incentive, monitoring and governance structure of firm also lead to improved performance. It has also been found that post-IPO, majority ownership by a PE-sponsor is associated with better long-term stock performance. A survey of PE-firms in Asia-Pacific by KPMG has shown that in India, the average share price of PE-sponsored companies trading for 501-616 days rose by

195 per cent, while non-PE sponsored companies' stock gained only 99 per cent.

Besides, PE-firms are said to extend several social benefits such as improving environment, building infrastructure, encouraging R&D and upgrading human capital. The survey of Australian PE firms has shown that investee companies are contributing to productivity improvements and ongoing Australian R&D. IFSL Research estimates that in UK, the companies that have received private equity backing, accounted for the employment of approximately 3 million people in 2007. This is equivalent to 16 per cent of UK's private sector employees. According to Venture Intelligence, the growth in employment in private equity firms (8 per cent) is greater than in other private sector firms (less than one per cent in FTSE 100 companies). A survey of Indian PE firms has also shown that PE-backed firms have shown higher annual wage growth of around 32 per cent as compared with 6 per cent growth in non-PE backed firms. Annual sales grew by over 22 per cent in PE-backed firms as compared with 10 per cent in non-PE backed firms. Private equity catalyzes innovation in the economy as is evident from the comparatively higher growth in research and development in PE-backed firms than non-PE backed firms. Many of the investee companies appear to be consistently environmentally aware and responsible. Private equity also benefits the economy at large by incentivising capital formation, optimizing allocation of resources, encouraging competition and thereby raising social welfare of the economy as a whole.

Above all, private equity firms are known as natural system stabilizers (Persaud: 2008). During a systemic crisis, while those with short term funding may indulge in risk trading, private equity firms can balance the system by being a risk trader because of their long term funding requirements. Private equity firms get the bulk of their funds from long term investors like pension funds and invest in illiquid assets.

In the same letter and spirit, the role of private equity in developing countries like India may broadly be described as 'enabling

capital' given the potential support it can provide to capital starved sectors such as SMEs and infrastructure, emerging sectors like realty, telecom, IT, *etc*., restructuring of loss making companies as well as the high value agriculture sector. With policy support, private equity can revolutionise the disinvestment process in India. This will require policy support such as relaxation of archaic labour laws and land legislations that have hitherto disabled transfer of capital and other resources into more productive pursuits.

III.3. Country Experiences

The PE industry developed simultaneously in US and Europe soon after World War II. However, the degree and pace of development since then varied significantly on the two continents (Povaly; 2007). The first formal PE firm, ARD was established after World War II in 1946 in the US. Although the industry grew steadily since then, it experienced rapid growth after the 1970s post amendment to the so-called 'prudent man' rule governing the pension fund investments and lowering of capital gains tax rates in 1978. Private equity funds were raised specifically as venture capital funds or buy-out mezzanine funds. Initially, buyout funds raised around four-fifths of the money going to private equity, leaving around one fifth to be raised by venture capital. However, with the technology boom, the venture capital funds overtook buyout funds in terms of total mobilisation. Between 1979 and 1988, the US private buyout market expanded from less than US$ 1 billion to a peak of more than US$ 60 billion. This was largely facilitated by the creation of high yield junk bonds market. The industry used this high yield debt to finance huge corporate takeovers including that of RJR Nabisco, Inc by Kohlberg Kravis Roberts & Co. (KKR) for US$ 31.4 billion in 1988 (McKinsey, 2006). Together with the growing capital inflows, the number of private equity firms proliferated dramatically and firms began to specialize in the various aspects of private equity such as early stage venture capital, leveraged buyouts or mezzanine financing. However, the culmination of the Leveraged Buyout (LBO) wave was associated with many bankruptcies and fierce public and political resistance (anti-takeover legislation) such that PE activity slowed down abruptly to US$ 4

billion in late 80s (Renneboog, Simons and Wright, 2007). However, the market recovered by mid 90s due to strong public equity market environment and exit of many inexperienced venture capitalists. The revival was aided by cut in capital gains tax in 1994 on investments in smaller firms and opening of NASDAQ stock exchange which expanded exit perspectives for portfolio firms. The US market is today the biggest and most developed private equity market in the world. The number and value of US private buyout-related deals rose from 12 transactions in 1970, involving less than US\$ 13 million in direct capital raised and invested, to 2,474 deals involving US\$ 70 billion in 2007. The private equity investments in US amounted to US\$ 105.7 billion or 0.8 per cent of GDP in 2007 (PwC, 2008).

The Canadian venture capital and private equity industry grew with the blessings of the Government of Canada. The growth of the indigenous venture capital industry was facilitated through the provision of subsidies to a particular group of venture capital funds better known as labour sponsored venture capital corporations. Under this program, investors received 15 per cent tax credit from the federal Government on their investments which is equivalent to 15 per cent subsidy on such funds. In addition, some provincial Governments added an additional tax credit, typically 15 per cent, making the total effective subsidy 30 per cent (Brander, Egan and Hellman, 2008). One of the major reasons for the tremendous growth in Canada's private equity market is the mounting demand for risk financing from established middle market firms in case of buyout/mezzanine activity and emerging technology firms in case of venture capital. Further, proximity to the massive and highly sophisticated private equity markets in the USA coupled with access to volume of assets of institutional investors has added fillip to the growth of the market. Private Equity investments in Canada rose to US\$ 1.4 billion or 0.1 per cent of GDP in 2007 (PwC, 2008).

Till 1980's, the growth of the UK PE industry was constrained by a multitude of factors, including political environment where mainly socialist governments had created harsh entrepreneurial climate, cultural impediments such as higher risk averseness and lack

of liquid stock exchange for small and mid-sized businesses (Povaly; 2007). Discouraging fiscal and legal rules of game added muscle to the stagnation of the industry. It was only in the mid 80's that the State took progressive steps to promote venture capital industry including development of missing markets, rationalization of marginal tax rates, *etc*. The establishment of the Unlisted Securities Market (USM) in early 80's proved advantageous for the exit of small firms because of relatively easier listing requirements. Private Equity investments in UK increased to US$ 40.1 billion or 1.5 per cent of GDP in 2007 (PwC, 2008).

In Latin America, private equity industry flourished in Brazil. The private equity industry in Brazil which developed in the early 90's did not receive much direct support from the Government at its preamble. Between 1992-94, there was only one player in the market. The focus of the industry was exclusively on buyouts and no venture capital was raised. The industry largely gained from deregulation of previously protected sectors like telecom, energy and utilities. Subsequently, many large regional funds came up and fund raising recorded a 343 per cent rise to US$ 3.7 billion. The industry troughed between 2000 and 2002 after Brazilian currency devaluation, crisis in Argentina, international macro-economic uncertainties and extended regulatory transition of local pension funds industry (Holman et al, 2006).

The private equity industry in Mexico originated in the early 1990's through foreign direct investment rather than as a result of organic growth (Holman et al., 2006). Between 1992-1996, many US-based funds made a foray into Mexico and initial investments were made in manufacturing, telecom and entertainment sector by firms like Chase Capital Partners, Blackstone Group and Banc of America Equity Partners. In the second wave of PE investment during 1997-98, several new sectors witnessed interest namely, retail, food, power and utilities. Between 1999-2001, private equity in Mexico was negatively impacted by Brazilian devaluation of 1999, Russian default in 1998 and the burst of the telecom bubble in 2000 and Argentine economic collapse of 2001. This led to withdrawal of

investments from telecom and IT sector. The industry recovered in 2002 with a structural shift away from foreign investors to emergence of local funds. The latter sourced bulk of their capital from foreign institutional investors as well as indigenous high net worth individuals. The Mexican Government was also directly involved in financing private equity. Since early 1990's, Nacional Financiera (NAFIN), a branch of the Mexican Development Bank, has adopted an institutional strategy of direct and indirect financing. Under direct investment, NAFIN makes equity contributions, monitors and advises specific firms. Indirect investment refers to matching-fund equity investments in venture capital funds known as SINCAS and private equity funds. PE investment has been attracted by Mexico's relative economic and political stability, abundant workforce and economic integration brought about by North American Free Trade Agreement. The current fund size averages to US$ 100 million. Today, Mexico is the second largest private equity destination after Brazil. However, the penetration of the market remains thin at 0.04 per cent of GDP as on 2008 (EMPEA, 2009).

Just like in developed countries, the import and indigenous development of private equity in emerging markets like Malaysia and Singapore was aided by the growth enabling policies of the State as well as inflow of money from public sources. The growth of the private equity industry in Singapore, for example, was facilitated by institutional support from the Government of Singapore. In 1985, the Economic Development Board (EDB), an institution established to act as a facilitator to develop self-sustaining enterprises, created its own venture capital fund. The inflow of private equity got further boost and thrust after the exit possibilities were enhanced on the establishment of the Stock Exchange of Singapore Dealing and Automated Quotation System (SESDAQ) with less stringent norms for listing, which became useful for small and new companies.

The private equity industry in Malaysia developed under the tutelage of the Malaysian Government and support from the more advanced venture capital firms in Singapore. The first venture capital company, 'Malaysian Ventures' was established in 1984 by Singapore-

based South East Asian Venture Investment (SEAVI). The Malaysian Government earmarked resources during the five yearly plans for developing the indigenous venture capital industry. The Government granted several tax incentives in addition to liberalizing equity ownership for venture capital corporations and venture capital management corporations. The Malaysian Venture Capital Development Council (MVCDC) was established in January 2005 to facilitate the development of the venture capital industry by co-ordinating Government initiatives and incentives towards charting the industry's strategic direction. Further, the Government also established its own venture capital companies to infuse resources into certain strategic sectors of the economy. As at end-2007, Malaysia had 98 venture capital companies and venture capital management companies registered with Securities Commission with total of RM3.3 billion committed funds under management (MVCA, 2008).

III.4 Performance of Global Private Equity Market

III.4.1 Growth of Private Equity Market

Private equity organizations specialize in the business of pooling funds from institutional investors and high net worth individuals and channelise capital and know how to unlisted start-up companies through buying of majority stake or partial/complete buyout of growth promising firms. According to an OECD report[1], approximately 3,000 private equity funds are currently operating worldwide managing over US$ 1.5 trillion. The assets under management and average annual returns of private equity firms compare favourably with other alternative investments such as global hedge funds thus making them popular asset classes (Table 1).

According to the Emerging Markets Private Equity Fund Association (EMPEA), global private equity fund raisings reached a peak of US$ 545 billion in 2007 with buyout funds constituting about half of the money committed**.** In the same letter and spirit, global

---

[1] The Implications of Alternate Investment Vehicles for Corporate Governance', OECD, July 2007.

Table 1: Comparative figures for Private Equity and Global Hedge Funds (2007)

	Assets under Management (US$ trillion)	Average Annual Return (%)
1	2	3
Private Equity	1.5	12.3*
Hedge Funds	2.3	11.6**

*: In US; **: Global Hedge Fund Index.
Source : IFSL, CBS Hedge Funds, 2008.

private equity investments increased to US$ 303 billion in 2007 from just US$ 112 billion in 2001, recording a growth of over 170.0 per cent. During 2008, at the height of the US financial crisis, although global fund raisings moderated to US$ 444 billion, global PE investments recorded a growth of over 14.0 per cent to US$ 348 billion (Chart 1).

The global private equity industry is dominated by United States. United States accounted for around 65.0 per cent of total global fund raisings and more than 58.0 per cent of global PE investments in 2008. Western Europe, on the other hand, raised more than 18.0 per cent of total global PE funds and accounted for 22.7 per cent of total global PE investments in 2008 (Tables 2 and 3).
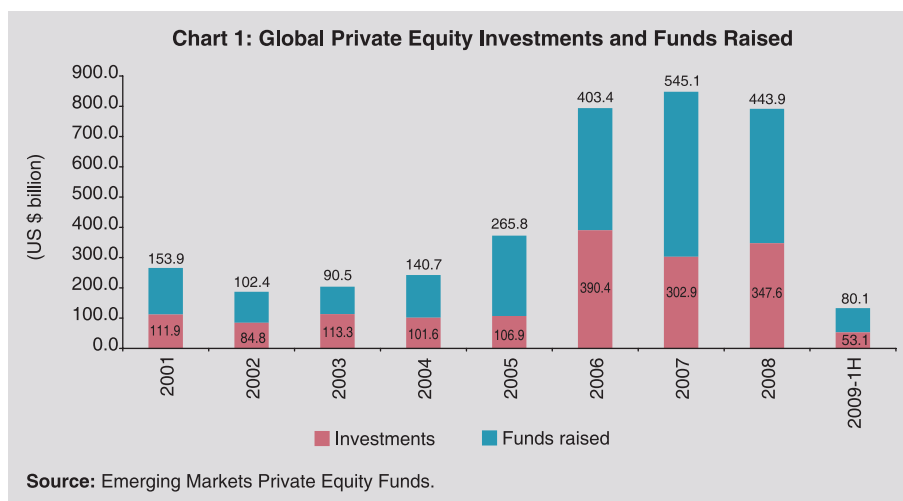
Chart 1: Global Private Equity Investments and Funds Raised

Year	Investments	Funds raised (top label)
2001	111.9	153.9
2002	84.8	102.4
2003	113.3	90.5
2004	101.6	140.7
2005	106.9	265.8
2006	390.4	403.4
2007	302.9	545.1
2008	347.6	443.9
2009-1H	53.1	80.1

(US $ billion)

■ Investments ■ Funds raised

Source: Emerging Markets Private Equity Funds.

Table 2: Global Private Equity Fundraising

(US $ billion)

	2007	**2008**	**2009-H1**
1	2	3	4
United States	325.8	287.5	55.0
Western Europe	152.0	82.7	8.3
Developed Asia	8.1	7.2	0.6
Emerging Asia	28.7	39.7	11.1
CEE/CIS	14.6	5.6	1.8
Latin America	4.4	4.5	0.9
Sub-Saharan Africa	2.0	2.2	1.0
Global Total	545.1	443.9	80.1

Note   : Developed Asia includes Japan, Australia and New Zealand.
                 Emerging Asia excludes Japan, Australia and New Zealand.
Source : EM PE Industry Statistics, EMPEA, September, 2009.

The emerging markets have also become substantially important in terms of both private equity fundraisings and investments over the years. While fundraisings have increased by over ten times from US$ 6.5 billion in 2001 to US $ 66.5 billion in 2008, PE investments in emerging markets have grown thirteen fold during the same period from US$ 3.7 billion in 2001 to US$ 47.8 billion in 2008. During 2008, emerging market economies accounted for 15.0 per cent and 13.8

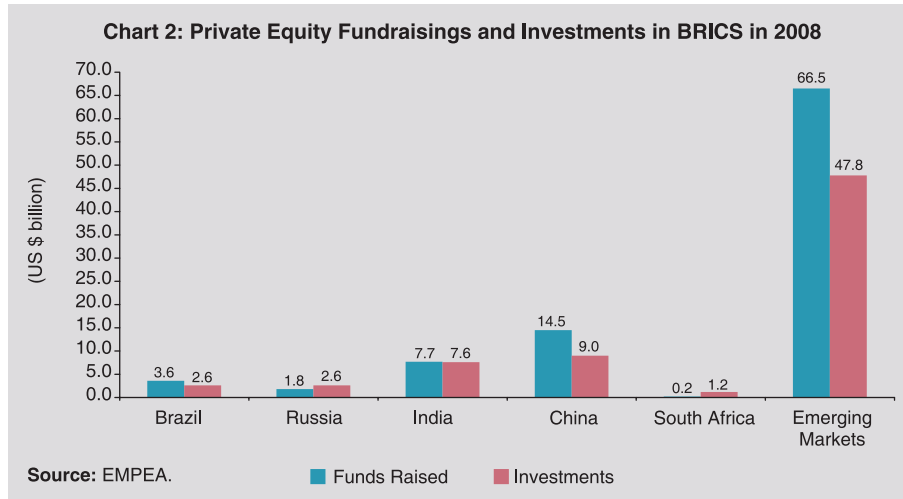**Table 3: Global Private Equity Investment**

(US $ billion)

	2007	**2008**	**2009-H1**
1	2	3	4
United States	105.7	204.4	26.0
Western Europe	132.6	78.9	12.1
Developed Asia	11.0	16.4	2.3
Emerging Asia	30.4	28.3	10.5
CEE/CIS	8.3	6.3	0.5
Latin America	8.0	7.0	0.5
Sub-Saharan Africa	3.4	2.9	0.6
Global Total	302.9	347.6	53.1

Note   : Developed Asia includes Japan, Australia and New Zealand.
                 Emerging Asia excludes Japan, Australia and New Zealand.
Source : EM PE Industry Statistics, EMPEA, September, 2009.

Chart 2: Private Equity Fundraisings and Investments in BRICS in 2008

per cent of total global private equity funds raised and investments, respectively. Among the EMEs, emerging Asia contributed 60.0 per cent of the total funds raised in the region and around 59.2 per cent of the total PE investments are from emerging markets (Chart 2). In the wake of the global financial crisis in 2008, however, private equity investments in emerging markets declined by 10.8 per cent over the previous year. Investment activity slowed particularly during the second half of the year as investors abstained from buyouts in view of the collapse of major equity markets in the world.

III.4.2 Structure of Investments

The structure of investments have undergone a sea change from 2000 to 2007. Around 89.0 per cent of the investments were in the form of buyouts in 2007 as opposed to 21.0 per cent in 2000. On the other hand, investments in early and expansionary stage have declined significantly (Table 4).

**Table 4: Investments by financing stage**

(Per cent share)

	Early stage	**Expansion**	**Buyouts**
1	2	3	4
2000	33.0	46.0	21.0
2007	2.0	9.0	89.0

Source: IFSL, 2008.

III.4.3 Return on Private Equity Investments

Private Equity returns in US and Europe have been displaying a characteristic cycle. The returns witnessed a steady rise from 1985 to 1989, followed by a decline till 1995. The returns picked up thereafter and continued to rise to an average of 22.8 per cent till 2000 after which there was a steep decline probably due to the bursting of the dot-com bubble. The industry appears to have revived in 2006 with the average returns in US and Europe during the two years rising to 9.1 per cent and 8.0 per cent, respectively (Chart 3).

The year 2008, although marked by extreme volatilities, witnessed strong commitments from institutional investors investing in private equity funds. In 2008, 339 limited partners made 449 fund allocations, representing moderate increases of 7.2 per cent and 5.9 per cent, respectively, compared to those for 2007. In 2008, China was the most active player with fund allocations registering a rise of 68.1 per cent over 2007. On the other hand, institutional investments from USA witnessed a decline of 43.8 per cent in number of fund allocations during 2008. Government related agencies were the most active investor group. During 2008, US$ 46.3 billion in deal value have been transacted from 789 transactions as compared with US$ 46.9 billion from 907 transactions in 2007. The average deal size has increased to US$ 66.4 million during 2008 from US$ 57.6 million in 2007 (APER; 2008).

Chart 3: Private Equity 5-year Returns (1985-2007)
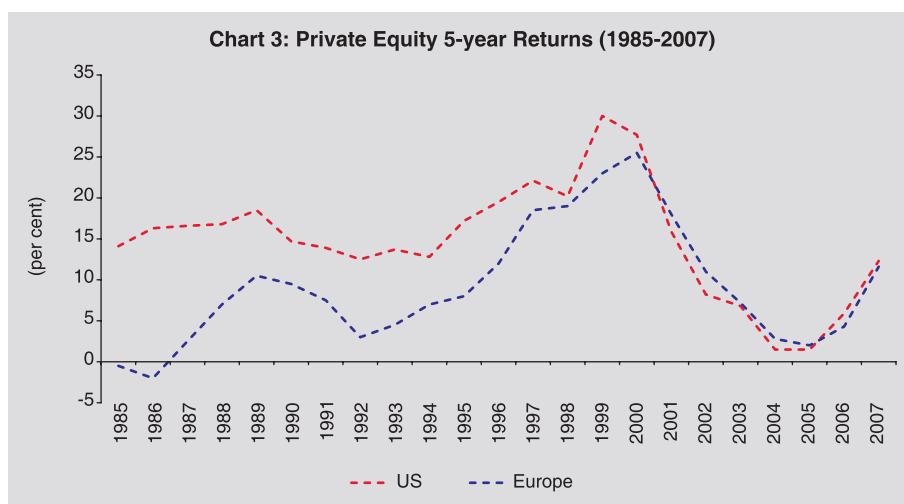
III.5 Regulation of Private Equity Market

III.5.1 Motivation behind Regulation

Private Equity firms' role as an intermediary for other institutions in leveraged investments along with the growth in size of buyout transactions and the involvement of banks has raised concerns about economy's vulnerability to a systemic financial market event if a large firm, or a series of firms purchased in highly leveraged buyout or a major private equity firm should suddenly fail (Shapiro and Pham; 2008). However, studies have shown that the debt to equity ratio of large private equity firms was much less (2.3 to 1) than investments of much larger financial institutions during the highly speculative period of late 1990s, when large subsequent losses did not produce systemic problems and even less than the debt-equity ratio of investment banks (27 to 1) that recently produced systemic problems. Further, a systemic crisis involves cascading effects transmitted across financial institutions. However, according to one school of thought, a private equity firm is unlikely to be so interconnected so as to cause ripple effects. The financial institutions central to this cascading pattern hold only about one third of the investments in private equity funds, while pension funds, endowments and wealthy individuals that hold a majority of these investments are less subject to severe selling pressure from sudden losses (Chart 4).

Chart 4: Sources of New Funds Raised by PE funds originating in Europe in 2007
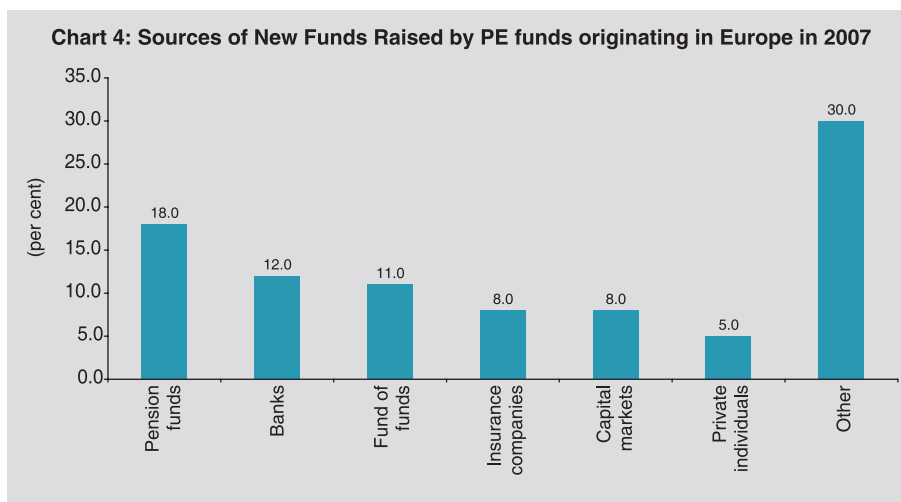
Moreover, private equity investors usually cannot exit a fund without giving considerable notice, even when a large loss occurs, thereby reducing the probability of any panic selling.

However, after the US financial crisis in 2007, central banks around the world have become particularly alarmed about the activities of financial institutions. Concerns have been expressed about the interconnectedness between banking institutions and private pools of capital such as private equity and hedge funds and their role in igniting and fuelling a systemic crisis. There is increasing evidence that in the lure of high transaction fees and other revenue earning ancillary services, banks have been competing to provide the debt finance for private equity transactions on cheapest and most flexible terms. The private equity fund manager, in turn, combines debt finance into highly leveraged package, making all or none offer to banks. Because of their ability to distribute debt, banks accept such high leverage levels without regard to the credit terms, credit quality and interest rates. However, there is rising probability that inability to refinance on competitive terms and drying up of the institutional debt market can increase the cost of funds for private equity firms. The appetite for new private equity investment may go down if the participants in the institutional debt market lose on their investments. Hence, there is an emerging consensus that banks should be subject to prudential norms with respect to their exposure to private equity investments. The G-30 Report on 'Financial Reform – A Framework for Financial System', 2009 has observed that systemically important banking institutions should be prohibited from sponsoring and managing commingled private pools of capital. Large proprietary trading in such institutions should be limited by strict capital and liquidity requirements. In the meantime, the political sensitivity towards regulation of private equity has also gone up. Towards this objective, the European Parliament in October 2008 has passed a resolution demanding greater regulation of private equity funds calling for capital requirements, binding disclosure and transparency norms, controls on asset stripping and capital depletion and limits on

director's remuneration. The developments in the coming days may enable emerging economies like India where private equity is a relatively new institution to develop their regulation framework for the same. In this context, the following insight into the cross-country experience in regulation of PE in developed and some emerging market economies would be a learning experience for others who are at a formative stage. Given the alarming increase in the demand for regulation of private equity business activity, the following section takes a stock of the existing legislations in different countries with respect to a private equity firm.

III.5.2 Cross-Country Regulatory Experiences

The regulation of private equity in most countries is at an evolving stage. Private equity is a regulated entity in US and UK. Both the countries have standalone rules and regulations for private equity. However, in most other countries, they are regulated within the framework of existing regulations in the state. For example, private equity investment from abroad is considered as foreign direct investment (FDI) which is subject to the regulations on foreign capital such as sectoral caps and lock-in period as in India. Similarly, since private equity firms indulge in mergers and acquisitions, they are bounded by the rules of takeover legislation in respective countries. However, they are not subject to any universal prudential norms like the 'Basel norms for banks'. In some countries, private equity funds are not regulated above and beyond that of any corporate body (Cumming and Johan, 2007). Given the fact that the investors in private equity funds are institutional investors and high net worth individuals and not retail investors, these funds have not received the same degree of scrutiny as other types of retail based funds such as mutual funds. They are only subject to the corporate and taxation laws of limited partnership, if structured so. Further, the industry insists on self regulation where disclosures are made between investors (limited partners) and owners (general partners). In other words, unlike a publicly listed company which has to publish its financial results, annual reports and updates and forecasts of their performance to regulators, private equity faces no equivalent

pressures to provide detailed accounts of their activities. The majority of statistical information about private equity ultimately derives from what member firms report to associations voluntarily. However, this leads to moral hazard as there is an incentive on the part of private equity firms to report only successful activities. Hence such a report can only provide skewed image of the impact of the private equity on economy, society and polity at large. However, of late, recognising the positive impact of regulation on future deal flow, as documented in many research studies, several private equity associations like European Venture Capital Association (EVCA), British Venture Capital Association (BVCA) and US Venture Capital Association (UVCA) have framed reporting standards and valuation best practice guidelines to enable investors make informed choices (Box 1).

United States[2]

The regulatory environment for private equity firms in United States has evolved over a period of time gaining from the experience of various transparency lawsuits brought upon by private equity investors on private equity sponsors (State of Connecticut vs Forstmann Little & Co.; CaLpers vs SEC). The primary regulatory requirements for private equity firms consists of registration under the US Securities Act of 1933, Investment Company Act of 1940 and Employee Retirement Income Security Act of 1974 (Erisa). However, each of these laws are provided with several exemptions. For example, under the federal securities laws, a non-US fund may offer and sell interests to US investors without registration, provided that it does not make a public offering in the US, the fund has no more than 100 US investors or that all of its US investors be 'qualified purchasers'[3]. If a fund makes offers only to sophisticated investors and qualifies for an exception from registration as described above, it is not required to make any specific disclosures to prospective investors.

---

[2]   Adapted from www.altassets.net.

[3]   In general, individuals with investment portfolios of US$ 5m or more and institutions with investment portfolios of US$ 25m or more are 'qualified purchasers'.

Box 1: International Private Equity and Venture Capital Valuation Guidelines

The increasing importance placed by international accounting authorities on Fair Value reinforced the need for the consistent use of valuation standards in valuing private equity investments. Hence AFIC, EVCA and BVCA developed a set of guidelines to set out the best practice where private equity investments are reported at "Fair value" with a view to promoting best practice and hence helping investors in private equity funds make better economic decisions. The requirements and implications of International Financial Reporting Standards and US GAAP have been considered in the preparation of these guidelines.

1. Principles of Valuation

a. Investments should be valued at Fair Value where fair value is the amount for which an asset could be exchanged between knowledgeable, willing parties in an arm's length transaction. In the absence of an active market for a financial instrument, the Valuer must estimate Fair Value utilizing one of the valuation methodologies.

b. In private equity, value is generally crystallized through a sale or floatation of the entire business, rather than sale of an individual stake. Accordingly, the enterprise value will provide a base for estimating the Fair Value of an investment in that business.

2. Valuation Methodologies

a. Price of Recent Investment Methodology: When the investment being valued was itself made recently, the Valuer should use the cost of the investment itself or the price at which a significant amount of new investment into the company was made to estimate the Fair Value of the investment, but only for a limited period following the date of the relevant transaction.

b. Earnings Multiple: This involves application of an earnings multiple to the earnings of the business being valued in order to derive a value for business.

c. Net Assets: This methodology involves deriving the value of a business by reference to the value of its net assets. It is appropriate for a business whose value derives mainly from the underlying value of its assets rather than its earnings.

d. Discounted Cash Flows or Earnings: This involves deriving the value of a business by calculating the present value of expected future cash flows. The cash flows are those of 'underlying business' and not those from the investment itself.

References :

International Private Equity and Venture Capital Valuation Guidelines, www.evca.eu, September 2009.

Fund sponsors, like others who provide securities investment advice, are generally required to register with the Securities and Exchange Commission (SEC). However, a non-US firm is generally exempt from registration as an investment adviser if it furnishes advice to fewer than 15 clients and does not hold itself out as an investment adviser to the public in the US. Performance fee arrangements with clients who are resident outside of the US are no longer covered by the Investment Advisers Act of 1940 and SEC rules give an investment adviser wide latitude to structure fee arrangements with US investors that have a net worth of at least US$1.5m or have at least US$ 750,000 under the management of the investment adviser.

For US investors in private equity funds, domestic and foreign entities are in general equally tax-efficient, provided the fund qualifies as a partnership for US tax purposes. Both foreign and domestic partnerships are 'pass-through' entities. No federal income tax is imposed on a partnership at the entry level and US investors are taxed on their shares of the taxable income of the partnership, not on the money or other assets the partnership distributes to them. US institutions, such as pension plans are subject to Unrelated Business Income Taxation (UBIT). UBIT generally applies to investments made by such institutions with borrowed money and may apply when tax-exempt US institutions earn income from 'leveraged' (*i.e.* geared) funds.

All US non-governmental employee benefit plans are subject to the Employee Retirement Income Security Act of 1974 (Erisa). Erisa imposes a comprehensive regulatory regime over persons who serve such plans. Among other things, Erisa establishes the standard of fiduciary care that must be shown by a person making investment decisions for such plans. Under Erisa's plan assets regulations, the assets of a fund with one or more Erisa investors are deemed to be 'plan assets'. If so, the private equity fund itself becomes subject to the substantive provisions of Erisa, including a comprehensive array of operating restrictions, among which are broad prohibitions on transactions with so called 'parties in interest' with respect to any of the Erisa investors. Moreover, the fund manager is held to

the standards of an Erisa fiduciary. In order to avoid these burdens, most private equity funds that have a significant proportion of Erisa investors, seek to qualify for the venture capital operating company (VCOC) exception under the plan assets regulation. If the fund qualifies as a VCOC (50 per cent of the assets in venture capital funds), only the Erisa plan's investment (*e.g.* its limited partnership interest) in the fund (and not any interest in the underlying assets of the fund) will be considered to be plan assets. Consequently, neither the fund nor its manager will be subject to the fiduciary requirements, prohibited transaction rules and penalties, and other provisions of Erisa.

Under the US Consumer Privacy legislation, private equity funds organized within US must disclose the firm's policies and practices with respect to disclosure of non-public personal information. Subject to certain exceptions, no non-public personal information may be shared with non-affiliates unless the regulated firm has given the consumer the opportunity to opt out of the proposed sharing of information.

At the state level (Blue Sky laws), most private equity funds were able to raise capital without being subject to any substantive review. The regulations were somewhat tightened after the terrorist attack of September 11, 2001. Now private equity firms are subject to scrutiny at their formation/capital raising stage and regulation of investment advisors and management of portfolio companies is undertaken according to Sarbanes Oxley Act of 2002 (SOA).

United Kingdom

The UK private equity industry is one of the only two regulated private equity and venture capital industries in the world (Speck and Tanega, 2006). The UK regulatory perimeter is set by the Regulated Activities Order (RAO) (FSA; 2006). Although the regulations under RAO define 'venture capital firm', the word 'private equity' does not find mention in the regulations. Hence any private equity firm which undertakes a business which is within the scope of 'venture capital business' mandatorily needs authorisation from the Financial Services Authority. However,

private equity firms which engages in activities beyond 'venture capital business' have broader permissions. Besides the ROA, the private equity firms have to adhere to the FSA Handbook requirements such as High Level Standards, Prudential Standards and Business Standards. If the activities of a private equity firm bring it under the cover of 'Investment Services Directive' (ISD), then it may be subject to prudential regulations. For example, a private equity firm carrying out portfolio management or the reception or transmission of orders is subject to minimum capital adequacy requirements. Private equity firms have to comply with the obligations contained in the Money Laundering Regulations, 2003 and Conduct of Business Requirements. However, each of these regulations provide for a number of exemptions. But with the implementation of the Markets in Financial Instruments Directive (MiFID) which is replacing the ISD, many investment services which were classified as non-core under ISD will be reclassified as core service under MiFID. As a result, more number of private equity firms will be brought under the regulatory purview of FSA. MiFID has more stringent requirements with respect to prudential norms. Apart from the FSA, the British Venture Capital Association (BVCA) has been undertaking periodical review of the self regulatory norms of the industry. The BVCA in collaboration with some private equity firms have set up a committee under David Walker in February 2007 to undertake a review of the transparency and disclosure requirements for the industry (Box 2).

However, post sub-prime crisis, there has been a sudden surge in the demand for regulation of private equity firms. In October 2008, the European Parliament adopted a resolution demanding regulation of private equity funds based on a report prepared by the Party of European Socialists. These demands include: limitations on debt levels in leveraged buyouts; measures to contain asset stripping of portfolio companies by private equity owners; greater transparency and disclosure rules for private equity with far greater scope than the voluntary "Codes of Conduct" which have been promoted as alternatives to regulation; greater capital adequacy

Box 2: Recommendations of the Walker Committee

In order to undertake an independent review of the adequacy of disclosure and transparency in private equity with a view to recommending a set of guidelines for conformity by the private equity industry on a voluntary basis, the British Venture Capital Association (BVCA) and a group of major private equity firms constituted a committee under David Walker in February 2007. The report set out guidelines for adoption in six areas *viz.,* (i) appropriate size thresholds for enhanced reporting by portfolio companies; (ii) appropriate ingredients in such reporting; (iii) the extent of public policy and other concerns about the prospective imbalance as between reporting by private equity portfolio companies and other large private companies; (iv) appropriateness of the elements envisaged for inclusion in annual reviews as a key element in greater openness on the part of private equity firms; (v) coverage of the agenda for significantly enhanced data collection and analysis by the BVCA on an industry-wide basis; (vi) an appropriate process for review of the guidelines.

Recommendations of the Committee

1. Thresholds: A portfolio company is a UK company which is acquired by one or more private equity firms in a public to private transaction/secondary or other non-market transaction where the market capitalization together with the premium for acquisition of control was in excess of £ 300 million/ enterprise value at the time of the transaction is in excess of £ 500 million, more than 50 per cent revenues were generated in the UK and UK employees totalled in excess of 1,000 full-time equivalents.

2. Disclosure by portfolio company:

➢ A portfolio company should include in its audited annual report enhanced disclosures such as the report should identify the private equity funds that own the company, details on composition of the Board, business review containing analysis of the main trends and factors likely to affect the future development, performance and position of the company's business and information about environmental matters, company's employees and social and community issues, financial review covering risk management objectives and policies in the light of principal financial risks and uncertainties facing the company including those relating to leverage.

➢ The report and accounts should be made available in no more than 6 months after the company year-end. The audited report should be readily accessible on the company website.

➢ Portfolio companies should provide to BVCA data on trading performance, including revenue and operating earnings, employment, capital structure, investment in working and fixed capital and expenditure on R&D and such other data as may be requested by BVCA.

3. Disclosure by Private Equity firm:

➢ An annual review on its website describing the way in which FSA-authorised entity fits into the firm of which it is a part;

➢ A commitment to conform to the guidelines on a comply or explain basis and to promote conformity on the part of portfolio companies owned by it;

➢ Description of UK portfolio companies in PE's portfolio;

➢ In reporting to limited partners, PE firms have to abide by EVCA guidelines. These guidelines require that PE firms produce semi-annual reports within 60 and 90 days; reporting should include details of commitments, drawdowns and distributions; changes to investment strategy, current and new investments, follow-ons; performance; detailed realization summary by investment; valuation of each investment; and clear statement of benefits, fees and net management fees.

➢ The PE firm should provide data to an accounting firm appointed by the BVCA informing the amounts raised in funds, acquisitions and disposals of portfolio companies, estimates of aggregate fee payments *etc*.

Adapted from "Guidelines for Disclosure and Transparency in Private Equity", November 2007.

requirements for financial instruments and institutions (including private equity and hedge funds), limitations on the easy securitization of leveraged loans ("originate and distribute") which have fuelled both the buyout boom and the financial crisis generally; and ensuring that employees in private equity-owned companies exercise the same rights to information as other EU private-sector employees. In reaction, EVCA has formed a formal group called as the Brussel's taskforce to respond to European Parliaments' resolutions on this aspect.

Switzerland[4]

Switzerland has been among the top continental European countries with growth rates of more than 100 per cent in 1999 and 2000. Private equity structures in Switzerland can take the form of limited partnership, investment fund or a joint stock company. Swiss

---

[4]   www.altassets.net

investment funds and investment foundations are highly regulated under the Swiss Investment Fund Act. Swiss investment funds may only be set up after the Federal Bank Commission (FBC) has approved the fund regulations established by the fund management and the depository bank. In addition, the Swiss fund manager has to obtain an authorisation from the FBC. Investment foundations are also regulated and supervised by a governmental authority. There are many compulsory investment restrictions, too. In particular, by law, investors in an investment fund must be entitled to make at least quarterly redemptions. For swiss investment funds, there might be high tax on the management's carried interest when compared to a manager's position in an offshore jurisdiction. Swiss joint stock companies have been used in the past for private equity purposes. Ordinarily, a standard Swiss holding company is set up as a two-layer structure with a wholly-owned offshore subsidiary holding company. The Swiss company collects funds by issuing shares to the public and the investments in the targeted private equity investments are then made through the offshore intermediary holding company. Companies structured in this way have been listed on the Swiss Exchange SWX in the investment companies segment. The company is governed by the well established provisions of the Swiss Code of Obligations (SCO) and is therefore in a well known legal environment. In Limited partnership structure, the general partner is required to be an individual under the Swiss law. A foreign limited partnership, on the other hand, is exempted from taxes in its chosen jurisdiction. If a limited partner is not resident in that jurisdiction, any income derived from the partnership's international operations and any interest the limited partner receives is not regarded as arising or accruing from a source in the partnership's jurisdiction. In addition, no inheritance, capital gains, gifts, turnover or sales taxes are levied in the chosen jurisdiction in connection with the acquisition, holding or disposal of interests and no stamp duty or similar taxation is levied on the issue or redemption of partnership interests. However, interests in the partnership are not freely transferable and no secondary market for such interests exists.

China

Private equity activity in China is restricted to venture capital and growth capital areas. The ability of foreign private equity investors to acquire a controlling stake even in unlisted companies is quite limited (Lange et al; 2007). Further the foreign investment policies of Chinese Government are designed to create a protective environment shielded from foreign competition to encourage the development of indigenous industries. And using its extensive powers of approval over foreign investment, Government has easily limited foreign acquisition of control over well known Chinese brands. Given this limited scope, major Western buyout funds have concentrated on acquiring substantial minority stakes in dynamic privately owned companies, hoping to fund a rapid expansion through both capital investment and acquisitions and to lead the company to a successful IPO within two to three years. The preferred strategy in doing this has been the "round trip investment" route. This involves the creation of an offshore holding company in which both the foreign private equity investors and Chinese resident would hold interests. And this offshore company would be used to control a Chinese company by either direct acquisition or captive contractual arrangement.

The Chinese Government overtime became increasingly sceptical about "round trip investments" and since 2005, the State Administration of Foreign Exchange (SAFE) which regulates such investments has made numerous attempts to restrict offshore holding companies. In October 2005, SAFE issued Circular No. 75 which required Chinese residents to register with local SAFE branch before establishing or controlling any offshore special purpose company. Failure to comply with Circular No. 75 prohibits the offshore parent company's Chinese subsidiary from distributing profits outside China. In September 2006, SAFE, Ministry of Commerce, the China Securities Regulatory Commission and State Administration of Taxation jointly issued regulations on mergers and acquisitions of domestic enterprises by foreign investors. According to the newly instituted rules, any acquisition by an offshore company that is controlled by a Chinese resident will require approval of the Central

Government. The M&A rules provide for reporting to Ministry of Commerce in advance of any transaction that would result in the control by foreign investors of a Chinese company that involves a key industry, has an impact on economic security or causes change of control of a Chinese company that owns a well known trademark. In May 2007, SAFE issued Circular No. 106 which contains the guidelines for implementation of Circular No.75. This imposes some extensive new requiements such as 3 year operating history of domestic target company. It also extends the definition of 'round trip investment' by requiring registration of greenfield investments by Chinese residents in offshore companies (Chao and Xu; 2008).

Other restriction on private equity firms include rules such as investors will have to complete their transactions in the local currency renminbi. Additionally, when they sell their stakes back to the public, they will have to list the company on mainland markets, rather than offshore exchanges. Furthermore, the government has made it clear that while it welcomes private equity funds, investors must have a long-term investment approach. However, till now deals often have to go through a plethora of regulators, ministries and councils on a case-by-case basis, with varying degree of success or transparency.

Malaysia

Malaysia has a robust and comprehensive Islamic financial system structured and managed in accordance with the Shariah principles. Hence the emphasis was to develop the Islamic venture capital and private equity where investments are made in businesses that offer Shariah-compliant products and services. The investment model is based on long-term active partnership and risk sharing consistent with the Shariah principles of *mudhurabah, musyarakah and wakaiah*. The venture capital industry of Malaysia is regulated by the Malaysian capital market regulator, the Securities Commission, under the Guidelines and Best Practices of Islamic Venture Capital. Under this, anyone trying to establish a venture capital corporation has to fulfil two fundamental requirements *viz.*, (i) The appointment of a Shariah adviser who provides continuous guidance in ensuring that amongst others, the proposed investment contract and

instrument structures are Shariah compliant; (ii) the core activities of the investee company are Shariah compliant. The best practices for Islamic venture capital corporations and management companies are voluntary in nature (MVCA; 2008).

Section IV
Evolution of Private Equity in India
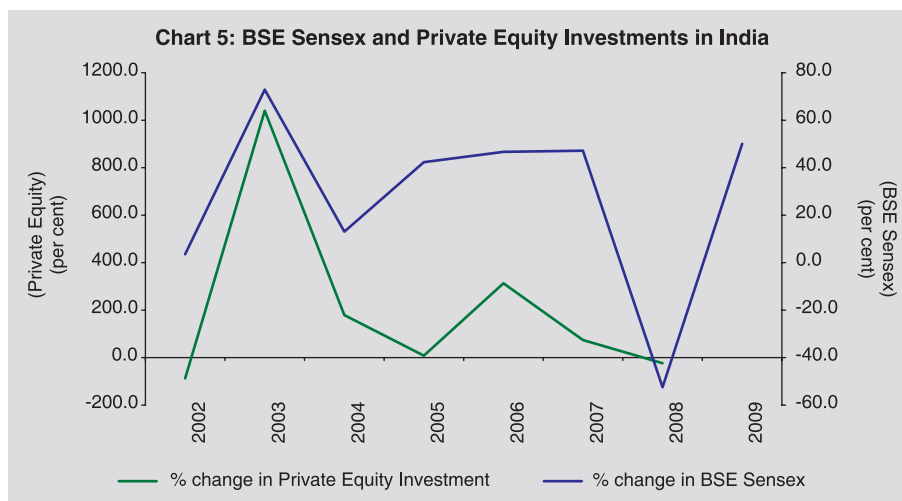
Historical Background

The history of private equity in most of the South Asian regions begins with venture capital firms which later graduated into the indigenous private equity firms by broadening their sphere of activities. The seeds of the Indian private equity industry was laid in the mid 80's. The first generation venture capital funds, which can be looked at as a subset of private equity funds were launched by financial institutions like ICICI and IFCI. In 1984, ICICI decided to launch its venture capital scheme to encourage start-up ventures in the private sector and emerging technology sectors. This was followed by the establishment of 'Technology Development and Information Company Ltd' and IFCI sponsored 'Risk Capital and Technology Finance Corporation of India Ltd'. Commercial banks like Canara Bank also came up with their own venture capital funds. Subsequently, various regional venture capital funds came up in Andhra Pradesh and Gujarat. In late 80's and early 90's, various private sector funds also came into being. Between 1995-2000, several foreign PE firms like Baring PE partners, CDC Capital, Draper International, HSBC Private Equity and Warbug Pincus also started coming in. Firms like Chrys Capital and West Bridge Capital set up by managers of Indian origin with foreign capital also embarked into India with a focus on IT and internet related investments in tune with the technology boom in US during the period (Venture Intelligence, 2005). During the mid 1990's, laws for venture capital funds formally started taking shape. The Securities and Exchange Board of India issued the SEBI (Venture Capital Funds), Regulations, 1996. These regulations were amended in 2000 on the recommendations of K.B. Chandrasekhar Committee.

The PE industry slowed down between 2001-03 after the technology boom burst in US in 2000. Many foreign PE investors fled India during that period. Investment activity revived in 2004 with the upward trend in domestic stock market. Six PE-backed companies went public successfully. Investment focus also turned towards non-IT investments like manufacturing, healthcare and those dependent on domestic consumption growth. However, despite a long history, the penetration of PE capital into India remains a miniscule 0.61 per cent of GDP today.

IV.2 Performance of Private Equity in India

In India too, private equity has been emerging as a potential source of corporate finance supplementing the traditional sources of resource mobilization such as public equity issues, private placements, euro issues and external commercial borrowings.

The key driving factors behind the flow of PE capital into India are its strong macro-economic fundamentals characterized by high growth rate, high gross domestic investment and a booming stock market. In fact, private equity interest in India grew from 2003 onwards when the domestic stock markets recorded higher returns (Chart 5). A booming secondary market and regulatory reforms in

Chart 5: BSE Sensex and Private Equity Investments in India

— % change in Private Equity Investment   — % change in BSE Sensex

the primary market widened the exit possibilities for private equity firms and hence attracted them to India. Over the last few years, private equity has emerged as a potential source of finance for the cash strapped small and medium enterprises, infrastructure sector, education and environment sensitive sectors too.

The number of private equity deals in India increased from 82 in 2004 to 439 in 2007 with the total investment rising from US$ 1,719 million in 2004 to US$ 13,269 million in 2007 (Table 5).

IV.2.1 Sectoral Analysis

Private equity mainly flowed into banking and financial services, construction and real estate, information technology, media and entertainment and other sectors (Chart 6). During 2007, the financial services sector accounted for around a quarter of the total investments and around 75.0 per cent of the investments in that sector is made by foreign private equity firms. Most of the deals were PIPE deals. The infrastructure sector also accounted for a good chunk of investments. Telecom sector in particular accounted for around 16.0 per cent of the total PE investments in India in 2007 and over 70.0 per cent of the investments were made by joint ventures between Indian and foreign private equity firms. The construction and real estate sector accounted for over 13.0 per cent of the investments, mostly by foreign private equity firms in late stage and PIPE deals (Chart 7). During 2008, private equity investments recorded a decline of 23.0 per cent to US$ 10.8 billion

Table 5: Private Equity Investments in India

(US$ million)

	No. of Deals	Amount
1	2	3
2004	82	1,718.84
2005	158	2,028.73
2006	326	6,631.47
2007	439	13,269.01
2008	399	10,800.00

Source: Private Equity Impact, 2009, Venture Intelligence.

Chart 6: Private Equity Investments in India by Type of Industry during 2007
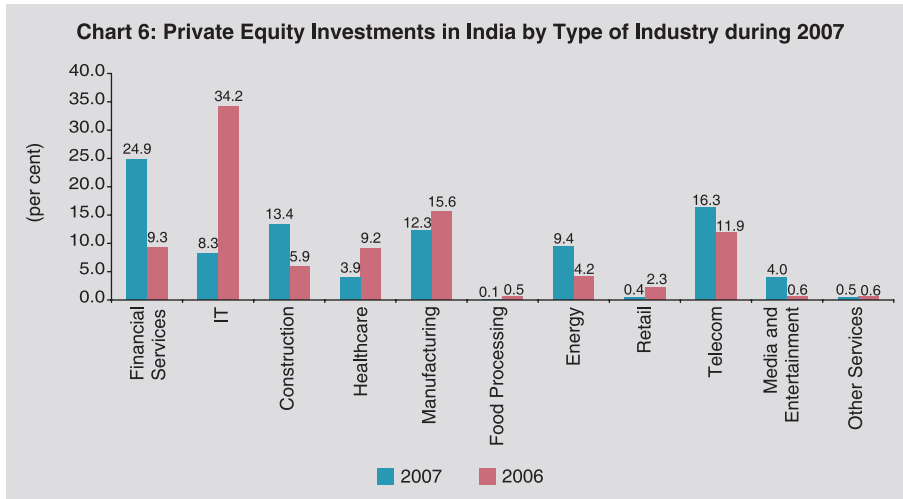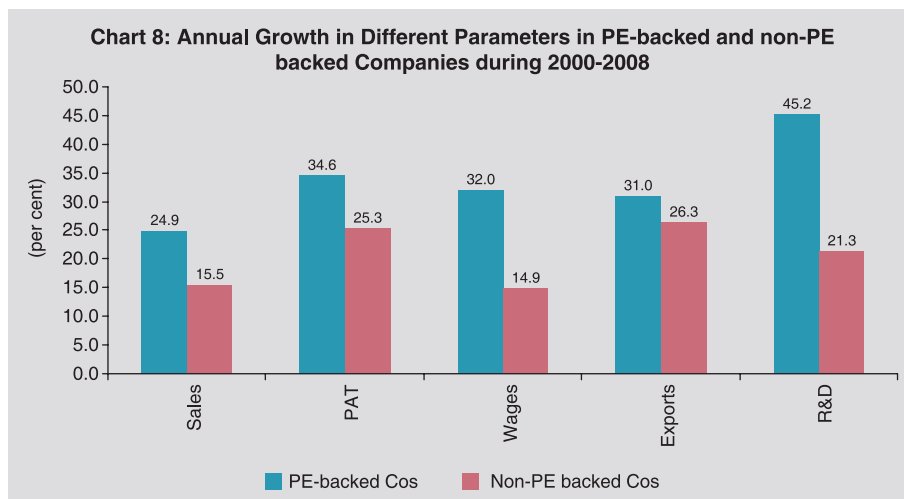

due mainly to the adverse impact of global financial turmoil (Appendix Table 1).

IV.2.2 *Performance of PE-backed companies*

Between 2000 and 2008, PE-backed companies registered comparatively better performance over non-PE-backed companies in terms of sales, profit after tax, foreign exchange earnings, job creation and growth in research and development (Chart 8).

Chart 7: Private Equity Investments by stage of investment in India during 2007

Chart 8: Annual Growth in Different Parameters in PE-backed and non-PE backed Companies during 2000-2008
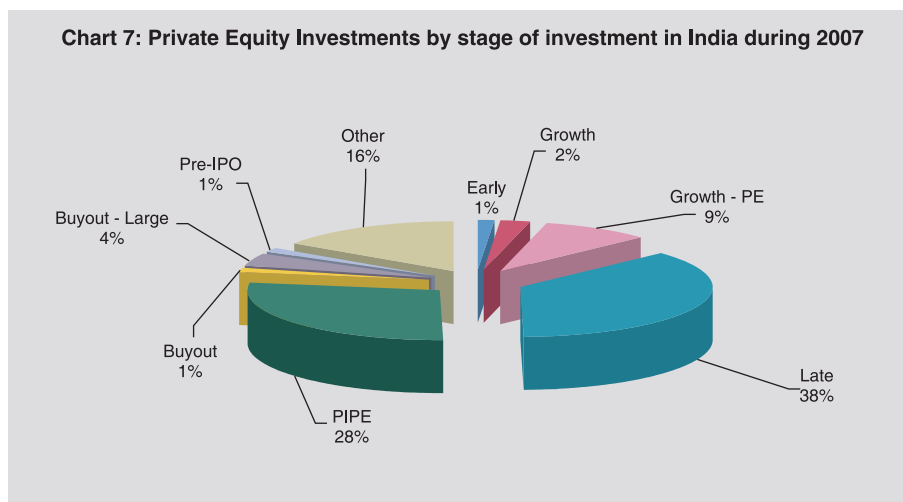
IV.2.3 Successful Private Equity Deals

One of the early and successful private equity deals in India was Bharti Airtel –Warbug Pincus deal which spurred further private equity activity in India. Bharti Airtel received US$ 292 million from Warbug Pincus over a two year period ending September 2001 (Venture Intelligence, 2005). The fund so raised enabled Bharti to expand its business from just two mobile telecom circles in Delhi and Himachal Pradesh to around 23 circles in 2004. Warbug not only provided capital but strategic inputs and mentored its management team. Warbug Pincus started its process of exiting Bharti Airtel in August 2004 by selling its stake in a piecemeal fashion. Warbug completed its exit in October 2005 by offloading its residual stake of 5.65 per cent to Vodafone for US$ 848 million. Warbug secured total gains of around US$ 1.3 billion in the sell-off.

The leveraged buyout of Infomedia by ICICI Venture in 2003 from Tata Group was another celebrated private equity deal in India. ICICI Venture worked on the company, built a unique business model, made value-added changes and made a successful exit from the company in 2007 by selling its controlling stake in Infomedia to a well known media house, TV 18.

Another notable PE success story lies in the NBFC field. The 'Shriram Transport Finance Corporation', a vehicle finance company opted for private equity capital from ChrysCapital and TPG Newbridge in 2005. It helped the company build a global outlook.

IV.3 Regulation of Private Equity in India

In India, private equity is not a regulated activity, *per se* (Gopinath; 2009). However, indigenous and foreign venture capital funds are regulated by SEBI (Venture Capital Funds) Regulations, 1996 and Foreign Venture Capital Funds Regulations, 2000. Further, private equity/venture capital funds investments from abroad have to adhere to the restrictions on foreign capital inflows. In other words, although there may not be any explicit regulations for private equity fundraising and investment in India like in US and UK, private equity funds are regulated within the ambit of existing regulations.

IV 3.1 SEBI (Venture Capital Funds) Regulations, 1996

Venture capital, which can be looked at as a subset of private equity, has been under regulatory oversight since 1996 when the SEBI (Venture Capital Funds) Regulations, 1996 came into existence. This legislation enumerated the norms for registration of venture capital funds, investment conditions and restrictions, general obligations and responsibilities and investigation and inspection. Under this, venture capital funds are prohibited from inviting subscription from public. They can only obtain funds through private placement of units. Further, no venture capital funds shall be eligible to list on a recognised stock exchange till the expiry of three years from the date of issuance of its units. Restrictions on investment conditions include disclosure of investment strategy at the time of registration of funds, investment in a particular undertaking shall not exceed 25 per cent of the corpus of the fund, *etc.*

IV.3.2 Foreign Venture Capital Funds Regulations, 2000

Subsequently, SEBI introduced Foreign Venture Capital Investors (FVCI) Regulations in 2000 to enable foreign funds to

register with SEBI and avail of some benefits which are otherwise not available under FDI route. Some of these benefits include no lock up of shares held by registered investors and exemption from applicability of valuation norms, thereby enabling investors to buy and sell shares in Indian unlisted companies at prices they deem appropriate, upon mutual agreement between buyers/sellers. However, they cannot invest more than 33.3 per cent of the investible funds in shares of listed companies or debt instruments. Further, the provisions of SEBI (Substantial Acquisitions of Shares and Takeover) Regulations, 1997 do not apply to shares transferred from an FVCI to the promoters of the company or the company itself. Thus if the promoters intend to buy-back their shares from FVCI, they will not be required to comply with the public offering requirements of the Takeover Code. FVCIs registered with SEBI are 'Qualified Institutional Buyers' under SEBI (Disclosure and Investor Protection) Guidelines, 2000 and hence are eligible to participate in the primary issuance process. They are subject to regular inspection and investigation by SEBI. Further, Indian venture capital funds (VCFs) are entitled to tax benefits under Section 10(23FB) of the Income Tax Act (1961) under which any income earned by SEBI registered VCF, established either as a trust or company, to raise funds for investment in VCF, is exempt from tax. Further, FVCIs particularly benefit from the Section 90(2) of Income Tax Act which provides relief from double taxation to non-resident investors residing in countries with whom India has Double Tax Avoidance Agreement such as Mauritius. Mauritius is now increasingly used by foreign investors to establish offshore entities and invest into Indian VCFs, thus benefiting from the tax avoidance treaty. However, while considering an FVCI application, SEBI reviews the applicants track record, professional competence, financial soundness, experience, general reputation, whether the applicant is regulated by an appropriate foreign regulatory authority or is an income tax payer, amongst other factors. However, it is not manadatory for a foreign venture capital fund to register with SEBI. They can still invest in India *via* the foreign direct investment route subject to compliance with applicable securities pricing norms.

IV.3.3 Restrictions on Inflow of Foreign Private Equity

Foreign venture and private equity funds came to invest in India through the FDI route. Foreign investments, either through FII route or FDI route, are subject to sectoral caps. Government of India has imposed investment limits for FIIs of 10 per cent and the maximum FII investment in each publicly listed company may at times be lower than the sectoral cap for foreign investment in that company. Under the FDI route, FIPB approval is required for foreign investments where the proposed shareholding is above the prescribed sector cap or for investments in sectors where FDI is not permitted or where it is mandatory that proposals be routed through the FIPB. Very recently, the Foreign Investment Promotion Board has ruled that foreign investment can flow into private equity funds registered as trusts. The Department of Industrial Policy and Promotion is framing the guidelines for allowing investments in trusts that invest in companies, especially start-ups, with the aim of long-term capital gains.

IV.3.4 Prudential Regulations for private equity

As of now, there are no prudential regulations on private equity unlike Indian banks. However, keeping in view that Indian financial sector is largely bank-intermediated and there have been recent cases of Indian banks engaging in sponsoring and managing private pools of capital such as venture capital funds and infrastructure funds, the Reserve Bank of India had mandated maintenance of certain level of economic capital in some of the cases approved in the recent past (Gopinath, 2009). Further, in the Annual Policy Statement 2009-10, RBI has proposed to issue a paper on prudential issues in banks floating and managing private pools of capital.

However, legal caution still prevails with respect to private equity investment into leveraged buyouts and exit through foreign listing. The laws for leveraged buyout of Indian companies are not conducive. Companies Act 1956, Section 77(2) prohibits a public company (or a private company which is a subsidiary of a public company) from providing any financial assistance whether by means of guarantee,

provision of security in connection with purchase of their shares or shares of their holding companies. Further, if a public company is listed, prior to being acquired in a LBO, the company must delist and convert itself to a private company. FIPB's Press Note 9 bars a foreign investment company from borrowing from an Indian bank to buy into a company in India (Chokshi, 2007).

While exit of private equity investment through domestic public listing is under the process of liberalization, laws still hold back exit through foreign listing. SEBI guidelines require mandatory listing of Indian companies on domestic exchange prior to foreign listing. Bulk of the private equity transactions in India are minority transactions. This is because in a large number of Indian companies, management control rests with promoters who may not want to divest their controlling stake for additional capital. In the absence of control, it may be difficult to finance a minority investment using leverage given the control over the cash flows of the target company to service the debt. Further, a minority private equity investor, will be unable to sell it's holding to a strategic buyer, thereby limiting the exit options available for the investment.

Besides, there are restrictions on the use of investment instruments. Funds investing in Indian companies have the option of investing in equity shares, preference shares, debentures and other instruments depending on the status of the portfolio company *i.e.* whether it is a private limited company, public unlisted or public listed company. Usage of innovative customized instruments while investing in private limited companies require the prior approval of Government. Hence, private equity investors mostly subscribe to traditional instruments while investing in private companies. Even within the available instruments, investing in preference shares and debentures raises several regulatory restrictions. For example, proceeds raised by non convertible/ optionally convertible debentures or preference shares cannot be used for general corporate purposes. Also such instruments need to have a minimum maturity period and cap on the coupon payable, if they are to be issued without approval (Gandhi, 2008).

Section V
Private Equity – Implications for India

V.1 Trade off between Private Equity and other Non-bank Sources of Finance

There is no gainsaying that private equity is a boon for capital constrained developing economies as they help to bridge large saving-investment gaps. However, does easy access to private equity funds delay firms' decision to go for public offers? Similarly, does it compete away investments/suck liquidity from the domestic debt market? In other words, does private equity compete with traditional non-bank sources of finance like public issues and private placement or supplement them?

Some traces of trade off between non-bank sources of resource mobilization by corporates was found in the first half of 2008-09 in the Indian equity market. With the Indian equity markets on a downswing, the public issues virtually dried up during the first half of 2008-09. Resource mobilization through public issues market declined by 61.2 per cent to Rs.12,361 crore during April-September 2008-09 in tandem with the subdued conditions in the secondary market. Similarly, resource mobilization through private placement market declined by 31.2 per cent during April-June 2008-09 to Rs.34,719 crore. The number of issues also declined as several companies either withdrew their issues from the market due to lacklustre response from investors or postponed their fund raising indefinitely. Under uncertainty, such firms had been induced to tap alternative investment sources like private equity. 'Worckhardt' is one such example to conjure with. However, it is difficult to establish whether private equity funds delay initial attempts at public issues because PE firms themselves seek exit from an investment 4-5 years down the line by handing over its stake either through public offer or sell-off to another company. Further, after investing in a company, PE firms emphasise organizational changes and encourage the host company to go for raising of debt. In view of that, it is natural to expect a positive relationship between private equity and other non-bank sources of finance such as public/ rights issues and resources raised through private placement of debt. This is an important hypothesis to test because any tendency to compete

away or delay public issue by companies may not be a healthy trend as resource mobilization through public offers is more transparent as it involves a number of public disclosures as opposed to private equity. However, testing of this hypothesis requires long period data, which is presently not available in case of India.

In order to test the key hypothesis – whether firms delay public offers due to the availability of private equity finance on easy terms and less paperwork - we analysed the resource mobilization history of those companies that issued private equity during 2004 to 2007 and their resource mobilization through alternative sources. Out of the 78 companies that issued private equity in 2004, five, three and four companies raised debt resources through private placement in 2005, 2006 and 2007, respectively. Out of the 78 companies, four companies were listed in 2005 and one in 2006 (Table 6). In 2007, there was an appreciable rise in the number of companies that raised resources through private equity and also in the number of companies that participated in the private placement and public issues market. Out of 364 companies that raised private equity in 2007, 19 companies raised debt through private placement and 9 companies listed on the stock exchange during 2007 and 2008. From this data, it appears that private equity does not discourage resource mobilization through public issues and private placement market. Rather, it encourages resource mobilization through the traditional sources. Understandably, taking up minority/majority shareholding in a company by a PE firm, induces the parent firm to go for restructuring including mergers and

Table 6: Head Count of Companies availing PE, Public offer and Private Placement Route to raise resources

No. of Cos. that issued PE		Cos. That raised resources through private placement in years subsequent to raising PE					Cos. That raised resources through public issues (IPOs) subsequent to raising PE					Cos. That raised resources Through FPOs/rights subsequent to raising PE				
		2004	2005	2006	2007	2008	2004	2005	2006	2007	2008	2004	2005	2006	2007	2008
2004	78	–	5	3	4	0	1	4	1	0	0	–	1	–	–	–
2005	149	–	–	0	0	0	4	4	3	0	0	2	4	–	–	–
2006	285	–	–	1	1	0	1	0	3	0	0	–	–	4	–	–
2007	364	–	–	–	9	10	2	6	5	9	0	1	2	0	3	0

acquisitions which in turn places the need for raising of debt from the market. Further, it is to be noted that private equity may appear as an easy alternative in the short run for unlisted companies, but such companies come back to the public issues market after three to four years to divest their stake and exit the investment to realise their gains. It also needs to be mentioned that during a financial downturn, conditions in the PE market are equally uncertain. Hence, private equity may not be able to crowd out resources from the public issues and private placement market.

V.2 *Trade off between PE Regulation and Non-Regulation*

Private equity regulation has raised some typical issues in recent times. For example, the activities that private equity firms indulge in, mainly activities like leveraged buyouts may not be compatible with the corporate laws of the state. In European corporate law, for example, leveraged buyouts are perceived as an indirect and fraudulent instance of financial assistance and are as such not immune to the ban imposed by Article 23 of Directive 77/91/EEC under which a company may not provide 'financial assistance' for the purchase of its own shares. In Italy, the legality of LBOs has always been under dispute. Until February 2000, the legitimacy of buyouts were uncertain in Italy. On February 04, 2000, the Italian Supreme Court sentenced LBOs to be illegal (Bottazzi; 2008). Critics have alleged that LBOs fall within the scope of the provisions of Italian Civil Code that prescribes criminal sanctions for directors who damage the integrity of a company's share capital through an acquisition or subscription of shares of the company, or in case of a merger cause harm to the company's creditors. In 2001, the Italian parliament specifically requested to reconsider the buyout regulation and hence in January 2004, a new legislative decree was issued where LBOs were legitimized subject to the fulfillment of additional disclosure requirements and provided they do not violate any financial assistance law. The American law, on the other hand, stresses on the social utility of LBOs. The US legal treatment draws an ex-post distinction between 'illegal' and 'legal' LBOs on the basis of whether or not such transfers are intentionally fraudulent. Such disputes indicate the need for some

universal laws for the operation of private equity such as basel norms for banks.

Another issue emerging from this relates to whether regulations should be made applicable uniformly to banks, hedge funds and private equity firms, irrespective of the diversity of their risk behavior. Each of these institutions have different investment objectives, different capacity to bear various sets of risks and hence different risk behaviour. Under similar kinds of transparency, valuation, accounting and risk management rules, these players would behave homogenously in case of eventuality thereby reducing financial market liquidity and enhancing systemic fragility.

VI. *Prospects for the Private Equity Market in India*

The shift in financial conditions since the US sub-prime crisis in August 2007 has magnified vulnerabilities that extend beyond the mortgage markets. Tangentially related markets like the leveraged buyout market are being affected through second and third order effects as concerns in structured finance markets triggered a broad-based increase in risk premia and induced a reluctance to lend, a reduced distinction between investments and other changes in market psychology (GFSR; 2008). At higher leverage and price multiples, the LBO business of private equity firms are facing high economic risks today. The Global Financial Stability Report of IMF, 2008 has stated that private equity deals are most sensitive to situations of high growth and high interest rates. Rising interest rates have been squeezing the interest coverage ratios (cash flows relative to cash interest payments) and consequently narrowing the gains to private equity holders on LBO targets. The medium term prospects also appear challenging for LBO market because most recent deals are likely to face financing difficulties. Private equity firms may not be able to secure financing on attractive terms and may also have to carry more demanding debt service burden than anticipated in the coming months (GFSR; 2008). Given this gloomy scenario in the rest of the world, what are the prospects for the private equity inflow into India?

The correlation between developed world markets and emerging markets have increased in recent years due to opening up of the trade and financial sector. But due to the gradual pace of opening of the economy, efficient regulatory supervision, strong domestic demand and comparatively limited dependence on foreign trade, economies like India have been able to partially shield themselves from the uncertainties in the rest of the world economy. Thus when the rest of the world has submerged into a recession after the global financial crisis, India has revived relatively faster from the initial contagion of global downturn. India's growth prospects remain robust with the growth forecast for 2009-10 at 6.5 per cent and gross domestic investment expected to be steady at 36.5 per cent of GDP (estimates of PM's Economic Advisory Council). India's industrial and service sector growth remains resilient. Given this congenial investment climate and sound business outlook, India remains a relatively high-return and low risk source of diversifying returns for private equity investments.

However, fresh private equity inflows may witness some re-arrangement in portfolio allocations in the near term. Thus while there may be a trend away from sectors like manufacturing and export oriented IT sectors because of slowdown, banking and financial institutions, media and entertainment and telecom sectors may see more inflows in the coming years given the Government's proposal to infuse more reforms into these sectors (PwC, 2008). Further, capital market reforms may also reinforce growth of private equity finance. SEBI has amended SEBI (Disclosure and Investor Protection) guidelines and listing agreement to reduce the time duration for Rights issue to 43 days from the present 109 days. Efforts are on to squeeze the IPO process to the international best practice of 7 days from the current 21 days. SEBI has also eased SEBI (Substantial Acquisitions of Shares and Takeovers) Regulations, 1997 to extend the creeping acquisitions limit beyond 55 per cent. Under this, SEBI has done away with the requirement of public announcement by non-promoters before acquiring stake in any company. The efforts towards setting up of stock exchange for small and medium enterprises and easing

of several public listing norms including reduction of the time period for listing would go a long way in attracting private equity investment into India. Emphasis on infrastructure development and affordable housing will also attract private equity investment into India in a big way. However, tougher trading conditions throughout most economic sectors would shift the way private equity firms create value. Whereas previously private equity firms have achieved high returns through acquisitions, balance sheet restructuring and rising valuations, today they may have to emphasise on growth improvements for which organizational changes and operational improvements would become essential (PwC, 2008).

Section VII
Conclusion

The advent of venture capital and private equity industry has energized the entrepreneurial climate in India. They have been facilitating the productive use of existing assets and resources, usually by identifying companies with untapped potential and reorganizing their operations in ways that increase their value. In fact, the concept of financial inclusion agents may be extended beyond the purview of banks to include enterprises like 'private equity firms' which can commit much needed and timely financial assistance to sectors like small and medium industries, infrastructure sector with long gestation periods and excess capacities in the short run, high value agriculture investments *etc.* With India aiming at more than 9.0 per cent growth and a lot more scope remaining for infrastructure development, private equity investment will have a seminal role to play in the coming years. However, the rapid growth and globalization of the PE industry has raised demands for increased regulation and disclosure within the sector due to concerns regarding anti-competitive behavior, excessive tax benefits and stock manipulation. However, there is a popular discourse as how much restriction is optimum restriction for an evolving industry. This question is particularly important for India. At present the industry is largely self regulated. In India, the quality and end-use of foreign PE capital is well regulated under FDI norms.

The three year lock-in requirement on FDI also restricts the sudden withdrawal of such capital thus limiting the probability of a crisis. As such, the probability of a pure private equity firm interested in long term investments causing a systemic crisis is rather limited. However, one issue that has raised some alarm is banks engaging in sponsoring and managing private pools of capital such as venture capital funds and infrastructure funds. Regarding this, the RBI, in its Annual Policy Statement, 2009-10, has proposed a paper on prudential issue in banks floating and managing private pools of capital. Another issue that has not yet received much attention is diversification of many private equity firms into hedge funds. This may call for some concern in the near future as the activities of hedge funds are rather non-transparent and may lead to information asymmetries. Hence, there is a need to clearly define in our regulations as to what is a private equity firm and the kind of activities they are allowed to indulge in India. At present there is no provision in our existing regulations to report the sources of funds and investments of private equity firms on a regular basis. Hence it is necessary that private equity firms originating in India be asked to file an annual report giving details of the fund raising and investments in a year. At the same time, it is important to create an enabling environment for the development of a vibrant private equity market by relaxing both entry and exit barriers for the industry. To encourage this, there is a need to relax caps on FDI sectors especially infrastructure and technology intensive sectors, easing of norms on repatriation of profits, reform of labour laws and urban land ceiling legislation, rationalisation of tax laws to bring transparency and stability in tax policies and expediting capital market reforms such as developing corporate debt market and shortening of the IPO process to enable smooth flow of capital to more productive sectors.

Appendix Table 1: Major Private Equity Deals during 2008

Private Equity Firm	Parent Firm	Deal Size (in cr)	Per centage stake
January			
Frontline Ventures	Futura Infraprojects	160	10.0
Kubera Cross Border Fund	GSS America	4	10.2
ICICI Venture	Vikram Hospital	95	-
Aditya Birla Group	Core Projects and Technologies	13.5	5.0
Blackstone, Merill Lynch, Deutsche Bank and Galleon Group	Pipavav Shipyard	105	2.3
Goldman Sachs Strategic Investments and Lehmann Brothers India Holdings Mauritius II	Times Innovative Media Limited	200	16.6
Shyam Equiities Private Limited	Independent News Service	100	20.0
Deutsche Asset Management (India) Pvt. Ltd.	Golden Gate Properties	27.4	Undisclosed
February			
ICICI Venture	Arow Webtex	130-140	14.9
BTS Investment Advisors (Swiss)	QAI India Limited	1.6	Undisclosed
DE Shaw	Mack Star Marketing (HDIL)	100	Undisclosed
NYLIM Jacob Ballas Fund III	Saravana Global Energy Limited	10	Undisclosed
IDG Ventures in India	Aujas Networks Pvt. Ltd.	1.2	Undisclosed
Monsoon India Inflection and Jackson Heights Investment (Mauritius)	Acme Telepower	400	3.35
March			
Henderson Equity Partners	Sharda Worldwide Exports	8.6	Undisclosed
Deutsche Bank Developers	Ramprastha Promoters and	32	40.0
Tano Capital	Anil Printers Ltd.	3	Undisclosed
Lehmann Brothers and Deutsche Bank	Unitech SPV	200	Undisclosed
Nalanda India	WNS	13.6	5.3

Merill Lynch	DRS Group SPV	400	Undisclosed
Baring PE	ShareKhan	23.6	12.0
April			
Warbug Pincus	Mannat Group	300	Undisclosed
Blackstone Real Estate Partners	Synergy Property Developemnt Services	7.2	Undisclosed
Dubai Investment Group	Chiranjeevi Wind Energy Ltd.	40	40.0
India Value Fund Advisors	Atria Convergence Technologies	Undisclosed	Majority Stake
Blue River Capital	Wilson Sandhu Logistics	40	Minority Stake
PremjiInvest	Koutons Retail	80	2.0
DE Shaw	ExcelSoft	125	35.0
Firstrand (Ireland) PLC	Lizer Cylinders Limited	4	Undisclosed
May			
Reliance Technology Ventures	Pelago, Inc.	Undisclosed	Undisclosed
Providence Equity Partners	Aditya Birla Telecom	256	Undisclosed
Healthcare Investment	Apollo Health Street	61	8.5
IDFC Project Equity and Lehman Brothers	Konaseema Gas Power	500	16.7
Axis Bank	Harish Chandra India Limited	126	Undisclosed
Blackstone, New Vernon and Reliance	Everron Systems	167.89	Undisclosed
Beacon India PE Fund	New Horizon Media	Undisclosed	Undisclosed
June			
Frontline Strategy (Mauritius)	Shriram SEPL Composites	Undisclosed	26.0
Axis Bank	Lavasa Corporation	250	2.5
Phi Advisors	First Choice	80	Undisclosed
Standard Chartered Bank (Mauritius)	Religare Finvest	100	Undisclosed
GIC Special Investments (Singapore)	Reid and Taylor (S.Kumars)	900	25.4
Actis	Vaishnavi Infrastructure	10	Undisclosed
India Business Excellence Fund	Dixon Technologies	40	Undisclosed

July			
Sun Apollo Ventures	Amrapali Group (SPV)	300	35.0-40.0
TAIB Bank (Bahrain)	Anant Raj Projects	216	26.0
Sequoia Capital and Light Speed Venture Partners	Tutor Vista.com	7.2	Undisclosed
JP Morgan Chase	Alok Infrastructure (SPV)	130	33.0
GE Commercial Finance India	Controls and Switchgear	100	Undisclosed
August			
ECL Finance	Max India	Undisclosed	5.18
Sequoia Capital	Cotton County	120	Undisclosed
Indivision India Partners	Blue Foods	Undisclosed	40.0-50.0
September			
Deutsche Bank	BPL Ltd.	Undisclosed	Undisclosed
IDFC PE	Suzlon Energy	34.4	Undisclosed
International Finance Corporation	Polycab	552	12.0
October			
Nalanda India	Mastek	Undisclosed	5.2
IL&FS	JB Pharma SEZ	75	30.0
Goldman Sachs	ICSA India	35	Undisclosed
November			
Blackstone	CMS Comp	250	Undisclosed
Berrgruen Holdings and Cycladic Capital	Gemini Equipment	7.5	80
Peepul Capital	TeleDNA	5	Undisclosed
State General Reserve Fund of Oman	Ansal API	Undisclosed	24.5
Sierra Ventures	Carwale.com	3.5	Undisclosed
December			
Milestone	The Cerebrum	139	Undisclosed
IDFC PE	Deepak Cables	20	Undisclosed
Blackstone	CMS	Undisclosed	55

Source: India PE

References

1. Bottazzi (2008): 'Private Equity Regulation: Lesson from Italy', RGE, May 2008.

2. Brander, J, Egan, E and Hellman, T (2008): 'Government Sponsored Versus Private Venture Capital: Canadian Evidence', NBER Working Paper No. 14029, May 2008.

3. Centre for Asian Private Equity Research (2008): Asian Private Equity Review, www.asiape.com.

4. Chao, H and Xu, K (2008): 'China's Regulation of Round Trip Investments', O'Melveny and Myers LLP Research Report, January 2008.

5. Chokshi (2007): "Challenges in Executing Leveraged Buyouts in India, The Evolution of the Growth Buyout", Glucksman Institute of Research in Securities Markets, April 2007.

6. Cumming, D and Walz, U (2007): 'Private Equity Returns and Disclosure Around the World', http://www.ssrn.com, July 2007.

7. Cumming, D and Johan, S (2006): '', "Private Equity Markets and Regulation: Policy Issues and Lessons from Dutch Institutional Investors", http://www.ssrn.com, January 2006.

8. EMPEA (2008): Emerging Markets Private Equity Association, www.empea.net.

9. EVCA (2007): 'Guide on Private Equity and Venture Capital for Entrepreneurs', An EVCA Special Paper, November 2007.

10. Fenn, G, Liang, N and Prowse, S (1995): 'The Economics of the Private Equity Market', Working Paper No. 168, Board of Governors of the Federal Reserve System.

11. Financial Services Authority (2006): 'Private Equity – A Discussion of Risk and Regulatory Engagement, DP06/6, www.fsa.gov.uk, November 2006.

12. Gandhi, V (2008): Private Equity and Venture Capital Investments in India, Certain Legal Aspects, IVCA, September 2008.

13. Gans, J, Hsu, D and Stern, S (2002):'When does Start up Innovation Spur the Gale of Creature Destruction?', RAND Journal of Economics, 33(4), 571-86.

14. GFSR (2008): 'Assessing Risks to Global Financial Stability', Chapter 1, Global Financial Stability Report, April 2008

15. Gopinath, S (2009): 'Addressing Regulatory Perimeter Issues – Indian Experience', Speech by Deputy Governor, RBI at the Ninth Annual International Seminar on Policy Challenges for the Financial Sector, co-hosted by The Board of Governors of the Federal Reserve System, The IMF, and The World Bank on "Emerging from the Crisis - Building a Stronger International Financial System", June 3-5, 2009, Washington, D.C.

16. Hellman, T and Puri, M (2000): 'The Interaction between Product Market and Financing Strategy: The Role of Venture Capital, Review of Financial Studies, 13(4).

17. Holman *et al* (2006):" Analysis of Private Equity Experiences in Brazil and Mexico, A Report for Turkven Private Equity, McDonough School of Business Working Papers, March 2006.

18. IFSL Research (2008): Private Equity 2008, August 2008.

19. Kaplan, S. N. (1989): 'The Effects of Management Buyouts on Operations and Value, Journal of Financial Economics, Vol.24, pp: 217-254.

20. Katz, S (2008): 'Earnings Quality and Ownership Structure: The Role of Private Equity Sponsors', NBER Working Paper No. 14085, June 2008.

21. KPMG (2008): "Private Equity: Implications for Economic Growth in Asia Pacific".

22. Lange, J, Weiss, P, Wharton, R and Garrison LLP (2007): 'Private Equity in China – Bringing Home', ALM Guide to Investing in China, October 2007.

23. Lerner, J (1999): 'Venture Capital and Private Equity – A Casebook', New York, John Wiley and Sons, Inc.

24. Ljungqvist, A and Richardson (2003): The Cash Flows, Return and Risk Characteristics of Private Equity, CEPR, January 2003.

25. Malaysian Venture Capital and Private Equity Association (MVCA), (2008): 'e-Newsletter', September 04, 2008.

26. McKinsey Global Institute (2007): The New Power Brokers: How Oil, Asia, Hedge Funds, and Private Equity Are Shaping Global Capital Markets, October 2007.

27. Melveny, O and Myers LLP (2008): 'Topics in Chinese Law', January 2008.

28. Metric, A and Yasuda, A (2008): 'The Economics of Private Equity Funds' , Journal of Economic Literature, September 2008.

29. Michelacci, C and Suarez, J (2004): 'Business Creation and the Stock Market, Review of Economic Studies, 71(2), 459-81.

30. Morgan, J (2007): Private Equity Finance: How it works, what its effects are, can it be justified? Working Paper No.3, The Center of Excellence in Global Governance Research, July 2007.

31. Persaud (2008):"Regulation, Valuation and Systemic Liquidity", Bank of France Working Papers, 2008.

32. Povaly, S (2007): 'Private Equity Exits', Springer.

33. Pratt, S (1981): 'Guide to Venture Capital Sources', 5th Edition, Wellesley, MA, Capital Publishing.

34. Private Equity Valuation (2006): "International Private Equity and Venture Capital Guidelines", October 2006.

35. PwC (2008): 'The Global Private Equity Report', Price WaterHouseCooper.

36. Renneboog, L, Simons T and Wright, M (2007): 'Why do public firms go private in the UK? The impact of Private Equity Investors, Incentive Realignment and Undervaluation, Journal of Corporate Finance, 13 (2007), 591-628.

37. Rin, M (2007): 'The Effect of Venture Capital on Innovation Strategies', NBER Working Paper No. 13636, November 2007.

38. Rin, M and Penas, M (2007): 'The Effect of Venture Capital on Innovation Strategies', NBER Working Paper No.13636.

39. Shapiro, R.J and Pham, N.D (2008): 'The Role of Private Equity in US Capital Markets', October 2008.

40. Speck, B.D and Tanega, J (2000): 'Private Equity Placements, Comparing the Laws in Switzerland, the European Union, the UK and the US; Part II'.

41. Venture Intelligence (2005 and 2006): 'Private Equity Impact Report', Venture Intelligence.

42. Weidig and Mathonet (2004): 'The Risk Profiles of Private Equity', January 2004.

Banking Regulations and Globalisation, by Andreas Busch, Oxford University Press, United States, 2009. Rs. 6,866, pp300.

The present context of global financial crisis and the utter failure of the banking and financial market regulatory mechanism across the globe fascinated me to choose this book for reading. The book is title as 'Banking Regulations and Globalisation' by Andreas Busch, who has a number of well researched publication to his credit. Does globalization erode the nation state's capacity to act ? Are nation states forced to change their policies even if this goes against the democratic will of their electorates? How does government action change under conditions of globalization? Questions like these have not only featured highly in political debates in recent years, but also in academic discourse. This book seeks to contribute to that debate. The general question it addresses is whether globalization leads to policy convergence—a central, but contested topic in the debate, as theoretical arguments can be advanced both in favor of and against the likelihood of such a development. The author brings alive the main issues confronting the banks, legislatures, and regulators, providing deep background on the development of their banking and regulatory system the political debates that shaped them and the crises and scandals that shook them. He shows that whatever the common pressures, countries have taken different trajectories toward reform, some successful and others not. Though the book touches upon the financial markets but specifically it focuses on the banking sector for a number of reasons.

The book is designed to include 8 chapters in all including the last chapter on conclusion. The first chapter is more of setting the problem in perspective. It attempts to bring out varied definitions on 'globalisation' from the literature. However, it leaves it with inconclusiveness, as the definition of 'globalisation' varies from concentration on very specific economic phenomenon to more general socialised effects on a global scale. It is interesting to note the presentation in the form of a chart on the tremendous progress

in the literature on globalisation since 1990s till date, a phenomenal increase to more than 1200 publications per year from a mere around 10 in 1990. The author brings out three clear distinct phases of globaliation; the first phase includes the popularisation of the term of globalisation among the academia which took relatively the crude stance on globaliation and that seem to be exaggerated both of their positive as well as the negative aspects of globalisation. The second stream of literature is relating to the collection of empirical facts which then focused on the critically examined claims of the first wave. This book seeks to contribute to the third phase by providing a detailed analysis of a specific policy area across four major economies and an extended time span. The book covers four countries, *viz.,* the US, the UK, Germany and the Swiss as deliberate choice, as these countries are not only major financial hubs or banking centers in the world, but they also have strong similarities and very distinct political as well as financial and banking system. The four country specific case-study forms the empirical core of the book. These countries, according to the author's definition, fall under four categories, such as 'liberal market economies (UK)', 'credit oriented system (Germany)', capital market dominated (USA)' and 'coordinated market economies (Swiss)'. The study covers a period of 25 years from 1974 to 1999.

Chapter 2 elucidates a brief introduction into the peculiarities of the banking system and the principal tools used by different countries in their hand for regulating them. It also addresses the challenges the countries faced during the period under analysis. It also needs to be mentioned that, this was also the period which coincided with liberalisation of capital and currency markets, great strides were made in the information technology and computerisation and their application in the banking as also a lot of innovations in the financial world creating great opportunities as well as the risks. In a nutshell, it gives a general overview of the banking developments and the regulation in the context of simultaneous progess toward globalised phenomenon.

The book follows the same prototype for each country by providing a brief historical background on their respective banking system as also the regulatory system, followed by a description of the new challenges, a description of the sectoral policy network, a narrative and concluding remarks. Chapter 3 strongly puts across that in US a political reform of the restrictive 1930s New Deal banking regulation largely failed in the 1980s and 1990s. Even though there was agreement on the necessity of change as evidenced by the banking crisis of savings and loans sector in the late 1980s, it was the courts and regulatory agencies provided for the safety valve functions in the system through reinterpretation of existing regulations. However, in the US a set of domestic factors ensured that there was no long term strategy guiding reforms of the regulatory system. Although major changes took place, attempts to steer policy towards a well-defined aims were very few.

Chapter 4 argues out that in Germany's banking system, more often consultative, informal policy style was predominant and which the author is convinced that it paid well, especially when coupled with a high degree of self regulations. It also contributed for institutional continuity and stability to a successful policy outcome with no major bank failures after the 1974 case of Herstatt Bank. The author candidly pointed out that this success, of course, had its own costs as well. As the administrative system was not forced to enhance state capacity in this area and thus found it difficult to project its interest onto the European and international level which both grew importance. In the sense that, the Germany could not market this model somehow for the outside world and even within Europe as much as other major countries such as the UK in particular.

Chapter 5 deals on the regulatory policy approach in the UK which has been charecterised by reaction to the crises in the banking system, *viz*., the secondary banking crises in the 1970s the failure of Johnson Matthey Bank (JMB) in the 1980s and the Bank of Credit and Commerce International (BCCI) and Barings in the 1990s. It is pertinent to note the author's remarks that the role for parliament

was weak which led the Bank of England to initially dominate the 'club-style' sectoral policy network. With repeated piecemeal reforms in the banking regulation failed to provide long-term stability the latter was disempowered in favour of a new 'unified financial regulatory agency' thus providing an example of major shake up in the institutional change. In fact, the unified model introduced by the UK was later adopted by several nations across the world.

In chapter 6 the author presents the regulatory system in the Swiss, which according to him, is charecterised as 'consensual style' for policy making and also applies to banking regulation. Such a style has produced largely a positive policy outcome in the face of a high potential risk caused by concentration in the banking system. The highly federal political system does therefore not lead to political deadlock since a strong element of centralized self regulation manages to balance the fragmentation. It is also very important underline that the influence of European regulations are considerable, it is however, concealed in the euphemistic phrase of 'autonomous adaptation'.

Chapter 7 is indeed very interesting to read, it basically draws together all the four country-specific analyses and comparatively evaluates the findings. It compares the structures and outputs of the four policy networks, arguing that the country-specific contingencies lead to different outcomes in the face of similar challenges during the period of investigation. In the US, a pluralist system of associations in combination with a fragmented regulatory and legislative system leads to policy failure and blockade, in the UK market concentration and a concentrated regulatory and legislative system creates high state capacity despite a pluralist system of associations. In Germany, on the other, a concerted associational system is weakened by market fragmentation but combined with concentrated regulation creates policy successes; and in Swiss a segmented but concentrated market combines with comprehensive concentration to create flexible adaptation with minimal resource requirements. Compared with these factors, the most significant aspect emerge out of whole analysis was, that the standard political

institutions show little influences on their own, but a mediated one depending on the context.

Finally, Chapter 8, on the whole, evaluates the outcome of the study in terms of the competing hypotheses of policy convergence and diversity. It postulates that a distinction between the dimensions of policy, politics and polity helps to gain new insights here; while there is substantial, if far from perfect, convergence in the policy dimension (the content of regulation) no such effects can be found in the other two dimension (the processes and the institutional aspects of banking regulation). The study, thus, confirms that, in so far as, financial market regulation is concerned, the global forces contribute more to reinforcement of national differences than convergence that the underlying financial system and their regulatory structure continue to exhibit considerable differences rather than convergence.

Based on careful analysis of historical developments, specific challenges, the character of policy networks and institutions, and their interaction in the political process, this book concludes that nation states still possess considerable room for maneuver in pursuing their policies. Even if they choose supranational coordination and cooperation, their national institutional configurations still function as filters in the globalization process. The key national distinctions remain in the regulation and supervision of banking despite there has been great deal of globalisation. The author also emphatic about the importance of such national filters in a more globalised world.

The special feature of this book need necessarily a mention that apart from the above coverage, since the book was released amidst the global financial crisis, rightly it attempted to gather some of the key factuals and developments relating to the recent global financial crisis, although strictly speaking it is beyond the scope of the book as the study covers the period of 1974 to 1999. Accordingly, the book had, presented a postscriptum : The Subprime Mortgage Crisis and Banking Regulation, the readers are compelled to expect

that the book will throw some light on the regulatory aspects in the backdrop of rich research experience on the banking regulation of the four major countries. However, this section presents the collection of facts that were reported in various newspapers/journals with rare comments sprinkled by the author and one such comment is picked up and cited hereunder:

'…the three big central banks in the area most affected by the credit crisis have thus apparently opted not to coordinate their actions, but to follow individual and different courses of actions. ..'

However, the above comments does not seem to be valid, as the crisis deepened practically all the major central banks as also the governments around the world have extended close cooperation and exercised coordinated actions in tackling the crisis. In fact the unique feature of the present financial market crisis resolution endeavour was that all major central banks as well as the political setups came together to resolve the crisis through mostly unconventional means in an unprecedental way. But for these historic steps, the crisis would have led to a situation much worse than the great depression as described by a number of experts.

The book doubtlessly throws very valuable insights on the evolution of regulatory systems in these four major financial and banking systems and therefore it is a valuable addition to the existing literature on globalisation and banking regulation and for academics and students of dynamics of globalisation for its intricate analysis and lucid presentation.

A. Karunagaran*

* A. Karunagaran is Assistant Advisor, Department of Economic Analysis and Policy, Reserve Bank of India.