(ISSN 0971 - 1864)

The Journal of Institute of Public Enterprise

Vol : 42 July – December, 2019 No : 2

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Vol : 42, No : 2
The Journal of Institute of Public Enterprise
July – December, 2019

The Journal of
Institute of Public Enterprise

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- IPE gratefully acknowledge to the Indian Council of Social Science Research (ICSSR), Ministry of Human Resource Development, Government of India, for the financial sponsorship to the **Journal of Institute of Public Enterprise.**

Published, Printed & Owned by : Institute of Public Enterprise, Hyderabad.
Place of Publication : Institute of Public Enterprise, Hyderabad.

(For information concerning the preparation of paper, see inside back cover)

The Journal of Institute of Public Enterprise

Vol : 42 July – December, 2019 No : 2

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The Journal of Institute of Public Enterprise, July-Dec, Vol. 42, No. 2
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Telecommunications Infrastructure and Economic Growth in India

Mohina Saxena* & Surajit Bhattacharyya**

This paper attempts to analyze whether there has been any causal relationship between telecommunications infrastructure and economic growth in India over more than three decades [1981-2018]; and identify whether such a causal relationship has been unidirectional or bidirectional in nature. We use the Johansen and Juselius (1990) test followed by the Granger (1969) causality test between output and telecommunications infrastructure. A multivariate VAR is also performed by considering other variables namely, domestic investment, trade volume and real effective exchange rate. There has been no long run relationship between telecommunications infrastructure and economic growth in India; short run unidirectional causality emanating from output growth to telecommunications infrastructure is observed. Interestingly, domestic investment does not Granger cause economic growth even in the short-run; however, there is unidirectional causality from REER to domestic investment and aggregate output. Short-run bidirectional causality between economic growth and volume of trade hints at a feedback effect.

Keywords : Telecom Infrastructure, Real GDP Growth, Granger Causality, Cointegration, Multivariate VAR.

1. Introduction

There are at least three channels through which development in telecom sector facilitates the economy; *firstly*, telecommunications infrastructure has the potential to increase efficiency in delivering the necessary social services along with increasing the level of productivity. This is because with the development in modern (communication) technologies, the cost of doing business drops that accelerates the consequent economic output. *Secondly*, in the backdrop of upsurge in number of call centers, BPOs as well as KPOs and software companies particularly in the last decade and half, it is evident that development in the telecom sector has provided significant employment opportunities in India. And *lastly*, penetration of telecom services has facilitated societies that were remotely located and women in particular, to reap economic benefits by increasing their incomes significantly. A notable

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example is of the fishermen in the west coast of India who regularly use cell phones to get information regarding market prices so as to decide the most profitable destination for selling off their stocks. This not only helps in reducing income volatility but on the other hand, contributes to the empowerment aspect of Sustainable Development Goals (SDGs). Thus, in pursuit of achieving these goals, Indian telecommunications industry has not only thrived to become one of the fastest growing in the world, it is in fact, ranked as the second largest in the world as of March, 2018.

From another perspective, it has been an undeniable argument that the government's ability to deliver various social service schemes as well as coping with the civil emergencies in an efficient way rests primarily on the efficacy of the telecommunications sector. Citizens not only become more aware but can also easily access as well as raise concerns regarding the implementation of government's welfare programmes and activities through a smooth well-functioning communication set up. Thus, the democratic essence of the nation state is largely protected by developments in the telecommunications sector as it helps in building an informed society. Also, with regards to the impact on education, the development of modern communication technologies has enabled a significant reach through the distance learning programmes that have helped a larger section of the society which had been excluded earlier due to several supply-side bottlenecks. In fact, with the advent of internet, it is of no surprise to witness the much-needed existence of a full-fledged virtual community, electronic market place and knowledge centres that have brought with itself rise in economic output. In this sense, an advanced telecommunications infrastructure such as mobile phones and internet is pivotal not only for generating economic gains but also for societal upliftment. In fact, in the backdrop of India's commitment to achieve the Sustainable Development Goals, it has been argued that development of telecommunications infrastructure leads India's way to succeed in achieving that target through its multi-fold beneficial effects on the economy at large.[1]

The importance of infrastructure to economic growth was initially brought out by the World Bank Development Report (1994) which highlighted that growth as well as productivity is higher in countries that have an adequate and efficient supply of infrastructure services. The India Infrastructure Report (1996) expressed a similar view towards the importance of infrastructure. Even, if we look back into the last decade, in the 11th five year plan

Government of India (GoI) emphasized the urgent need for removing infrastructure bottlenecks for sustained growth; [*Economic Survey* (2011-12)]. Subsequently, in the 12th five year plan the government had laid special emphasis on the infrastructure sector and recognized that the availability of quality infrastructure is important not only for sustaining high growth but also to ensure that the growth is inclusive; [*Economic Survey* (2012-13)]. During the last quarter of the 20th century, infrastructure developments in Information and Communication Technologies (ICT) were widely seen as having heralded an information age in which economic (and social) activity has been more productive, efficient, widened and deepened to the grassroots level. Over the years ICT development has been increasingly identified as the one that has a strong association with overall economic activities at a large scale and it is the fast-paced advancement in telecom infrastructure that has the ability to create spillover effects through network externalities.

Our study explores the inter-linkage between available physical infrastructure and growth prospects of the Indian economy by especially focusing on the developments in telecom sector infrastructure. Apart from other reasons that make the Indian telecom sector being so important of late, it is by now well argued in the policy-oriented literature that development in ICT is crucial to achieve the desired growth trajectory for the fast-growing developing economy of India.

According to the *Network Readiness Index* (2015) published by the World Economic Forum, most of the developing countries continue to lag in comparison with the developed (industrialized) countries in terms of physical infrastructure and preparation to participate and enjoy the benefits from ICT development. India has been relatively a late starter when it comes to identifying and developing state-of-the-art public infrastructure. Thus, telecommunications infrastructure becomes increasingly relevant in today's parlance when the policy makers and the academics are debating on the plausible effects of digital divide in a vast (as well as fast) growing emerging economy like India.

The planning strategies and policy initiatives induced by successive central governments were matched with fast paced positive response from the private sector and that resulted in such a phenomenal progress which perhaps portrays the biggest success story of India's reforms; Panagariya (2013). In spite of being plagued by so many challenges such as infrastructure bottlenecks, relatively slower penetration in rural areas and lack of skilled manpower in

telecom equipment manufacturing activities, the growth story of Indian telecommunications sector has remained encouraging even in the scenario of fluctuations in other core sectors of the economy. The cost saving externalities generated due to the increasing returns of communications foster the expansion of other markets and leads to lower transaction costs. It is therefore, imperative to explore whether a fast-growing emerging economy like India had benefitted from the large scale FDI inflows and massive investments made in the telecommunications sector that also house the highest level of employment opportunities in the private sector of the economy.

Section-2 presents significance of telecom sector in India's growth history. Section-3 discusses the empirical literature establishing the inter-linkage between telecommunications infrastructure and economic growth. In Section-4, we explain the empirical framework followed by construction of variables in Section-4.1 and estimation results in Section-4.2. Finally, Section-5 concludes this paper along with some plausible policy implications.

2. The Indian Telecom Sector

India has the second largest telecommunications network in the world with subscriber base of over 1,200 million as of March, 2018 [*TRAI* (2018)]. Since the last decade there has been an exponential growth in the Indian telecommunications sector especially in the cellular technology with the total number of mobile phone subscribers growing almost three hundred times in just ten years from 3 million in 2001 to 811.59 million in 2011 [*TRAI* (2011)]. Apart from contributing around 2-3 per cent of India's GDP, in the last one and a half decade the telecommunications sector has grown at the compounded annual growth rate of 22 per cent during 2000-18 in terms of its total subscriber base. In fact, just on the eve of launching the New Telecom Policy 2012 (NTP-2012), the Indian telecommunications sector had grown at the highest compounded annual growth rate of 44 per cent during 2006-2007 to 2011-2012 [*MoSPI*, (2014)].

The reforms in telecommunications sector infused competition and led to the adoption of new technologies which proved to outweigh any benefits that scale economies may bestow; Panagariya (*ibid*.). A glimpse at the magnitude of success achieved through the reforms process is reflected through the following facts. As on March 31, 1981, India had only 2.15 million telephone users. While alone in 2015, India added over 10 million telephones in each quarter. The wireless density had increased exponentially from 0.3 per cent in 1999-2000 to 91.09 per cent

in 2017-18; see *TRAI*, Annual Reports (*various issues*). Similarly, Figure-2 displays the addition in number of telephone lines for each of the ten-year period since 1981-82. The wireless local call tariff has reduced from ₹16.40 per minute in 1990 to ₹1 per minute in early 2000. The internet policy announced in 1998 ended the monopoly of VSNL and allowed the entry of private operators to induce competition without any significant licence fees. The enunciation of this policy has led to a significant increase in the number of internet subscribers from less than 1 million in 2000-01 to 493.96 million in 2017-18; (see Figure-3).

The telecommunications sector revenue had gone up from ₹125.18 billion during 1995-96 to ₹2556 billion in 2016-17; see Table-1. The Indian IT industry has evolved as the largest private sector employer with more than 3.5 million employees as of March, 2015. FDI in the telecom sector has grown at a compounded annual growth rate of 24.8 per cent between 2000-01 and 2011-12. In the last decade and half, the cumulative FDI inflow in telecommunications sector constituted around 7 per cent of total FDI inflows; (Department of Industrial Policy and Promotion, 2017).

2.1 Challenges in the Indian Telecom Sector

The subscriber base for telecom services is highly *skewed* in favour of *urban* areas. The significant "*digital divide*" with faster growth rate of urban subscribers as compared to the rural subscribers reflects that there are relatively lesser

Figure-1 : Teledensity in India (1981-2018)

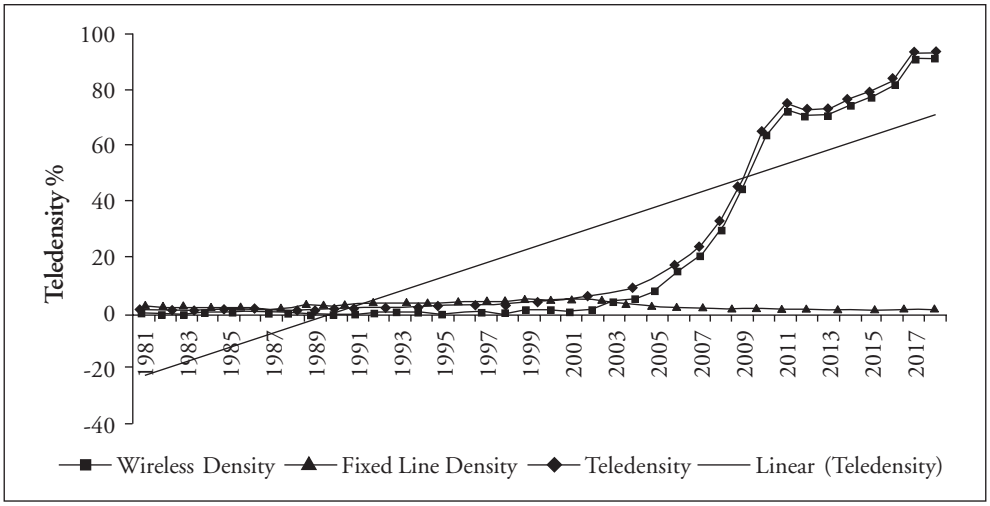
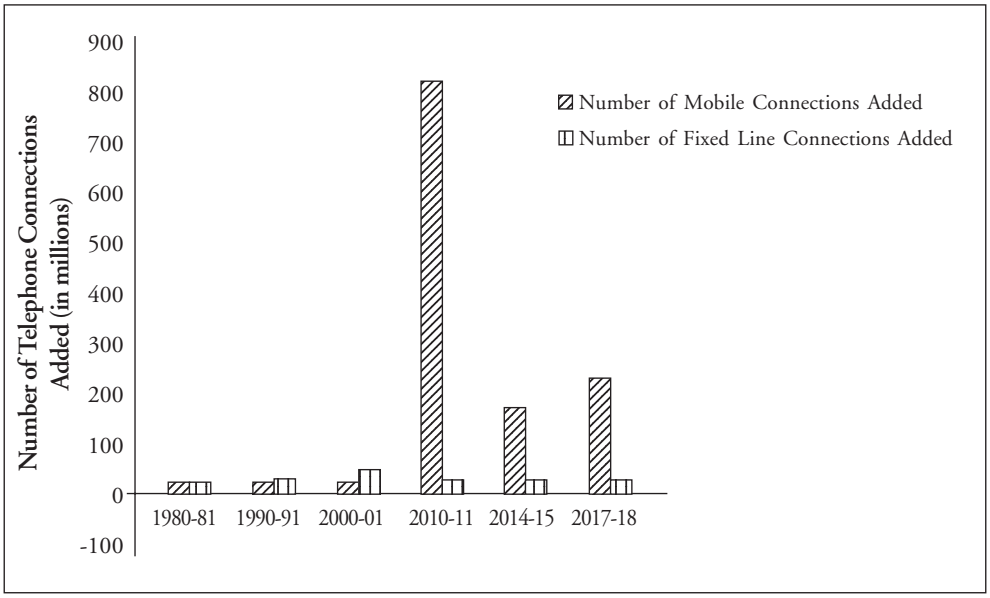
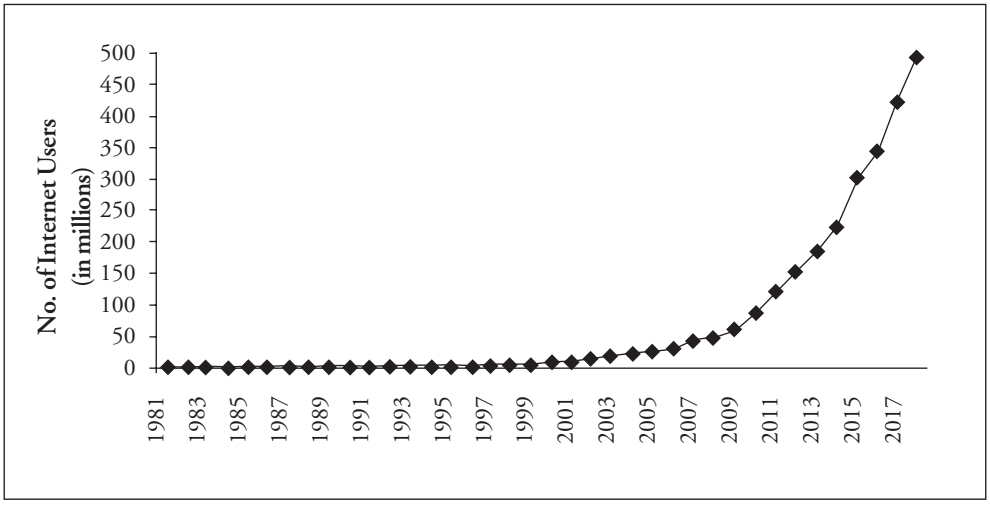


Figure-2 : Number of Telephone Connections Added



*Data Source : Telecom Regulatory Authority of India, Annual Report (*various issues*).*

Figure-3 : Number of Internet Users in India



Data Source : The World Bank, World Development Indicators.

Table-1 : Contribution of Telecommunications Sector to GDP

Year	Telecom Sector Revenue (*in ₹ Billions*)	Contribution to GDP (%)	Total Government Levies (*in ₹ Billions*)
2004-05	720	2.2	104
2005-06	860	2.3	129
2006-07	1050	2.4	193
2007-08	1440	2.9	255
2008-09	1520	2.7	250
2009-10	1580	2.4	278
2010-11	1720	2.2	261
2011-12	1950	2.2	262
2012-13	2120	2.1	291
2013-14	2330	2.2	312
2014-15	2606	2.1	222
2015-16	2795	2	235
2016-17	2556	1.66	180

Data Source : TRAI, The Indian Telecom Services Performance Indicators, (various issues).

Table-2 : FDI Inflow in the Indian Telecom Sector

Year	FDI Inflow (in ₹ *Millions*)
2001-02	39,384.61
2002-03	9,077.31
2003-04	3,978.40
2004-05	5,411.01
2005-06	27,514.50
2006-07	21,495.77
2007-08	50,995.61
2008-09	1,16,848.11
2009-10	1,22,696.62

Year	FDI Inflow (in ₹ *Millions*)
2010-11	75,420.44
2011-12	90,115.26
2012-13	16,540.04
2013-14	79,872.83
2014-15	173,718.22
2015-16	86,370
2016-17	374,350
2017-18	397,480

Data Source : Department for Promotion of Industry and Internal Trade, Government of India.

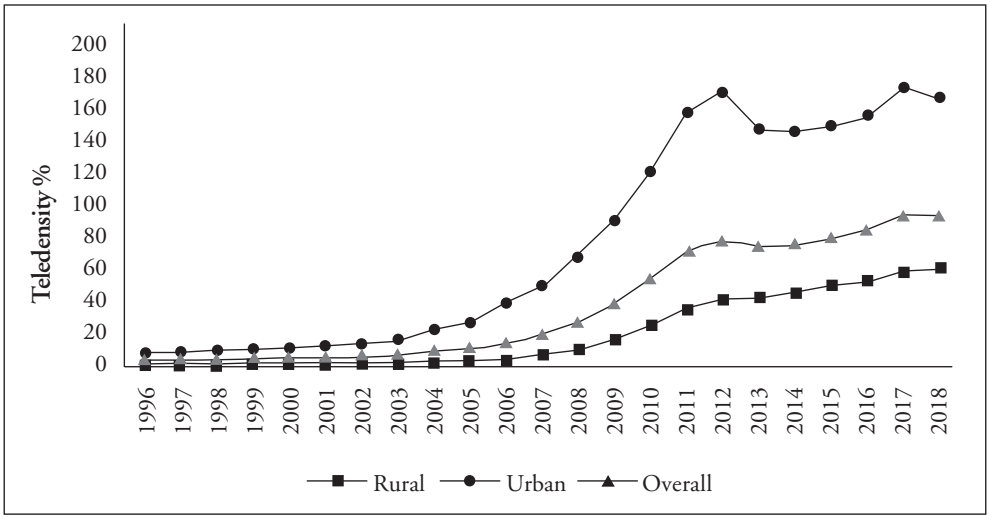
beneficial effects of competition for the rural population. The gap between urban and rural teledensity was as high as 13 times in 1996, it kept rising and reached its peak in 2006 (20 times) after which it started declining and currently the urban teledensity is around 3 times more than the rural teledensity. Pertinent in today's debate over reducing the so-called 'digital divide', it is argued in favour of identifying telecommunications as 'merit goods' that universal access to telecommunication services can significantly reduce social and economic exclusion and offer increased opportunities to the people at large.

The manufacturing of telecom equipment due to increased demand of mobile phones is increasing steadily but still lags behind the telecom services. In fact, the revenue of telecom manufacturing sector is significantly smaller than the services sector and has actually declined since 2009-10. Also, the telecom manufacturing sector is plagued by poor research and development; NCAER (2012). The liberal trade policy has fostered imports of equipments but the lack of capacity building has the potential to challenge the success of this industry. This reduces cost competitiveness of domestic industry and exposes it to disadvantage.

3. Review of Select Literature

The expansion of telecommunications sector has *direct* and *indirect* effects : it *directly* affects growth through new employment opportunities, diffusion

Figure-4 : Post-Reforms Digital Divide in India



Data Source : TRAI, The Indian Telecom Services Performance Indicators, (various issues).

of information and knowledge, increased investment as well as demand; and has *indirect* effects through increased productivity, enhanced efficient functioning of the markets by reaping the benefits from network externalities, among others; Thompson Jr. and Garbacz (2007).

One strand of literature using regression analysis depicts that telecommunications infrastructure has a positive and significant impact on economic growth; see, Hardy (1980) and Norton (1992), among others. In the Indian context, Kathuria *et al.* (2009) find that Indian states with higher mobile penetration can be expected to grow faster.

Another set of empirical studies examine the relationship between telecommunications infrastructure and growth through Granger-causality test using VAR framework and argue that telecommunications infrastructure is a precondition for economic growth; see, Dutta (2001), Cieslik and Kaniewsk (2004), among others. On the other hand, Beil et al. (2005) and Chakraborty and Nandi (2011) suggest that economic growth precedes telecommunications infrastructure; *i.e.*, telecommunications infrastructure is only a resultant outcome of economic growth that has already taken place. This proposition asserts that a growing economy demands better telecommunications infrastructure and hence, growth in telecommunications infrastructure take place. There is another notion that claims the existence of '*feedback effect*' between telecommunications infrastructure and economic growth; Cronin *et al*. (1991), Yoo and Kwak (2004). This implies that the growth of any one of them fosters the development of other.

There are only a very few studies that have actually considered Indian data and explored the inter-linkage between telecommunications infrastructure, in particular and economic growth. Narayana (2011) estimated the impact of telecom services on economic growth and argued that the contribution of telecom services to GDP growth has increased phenomenally in the post mobile phone era. The study also analyzed the determinants of demand for telecommunications infrastructure and found that all the explanatory variables (access price, usage price, monthly income, education, caste, and location) were statistically significant at 1 per cent level of statistical significance.

Ghosh and Prasad (2012) examined the nexus between telephone connections and economic activity in India during the period 1980-2007. The study included real gross fixed capital formation as a measure of investment and real GDP as a proxy for economic growth.

The *ARDL* bound test and *Johansen and Juselius* (1990) Maximum Likelihood Test indicated that there was no cointegration among telephone connections, real investment and real GDP. However, the Granger causality test found the presence of short run unidirectional causality running from telecom infrastructure to economic growth and to investment.

Therefore, there exists *inconsistency* across literature regarding the direction of causality between telecommunications infrastructure and economic growth. This can be attributed to different data periods, varied econometric modelling techniques and state of the economy considered in those studies.

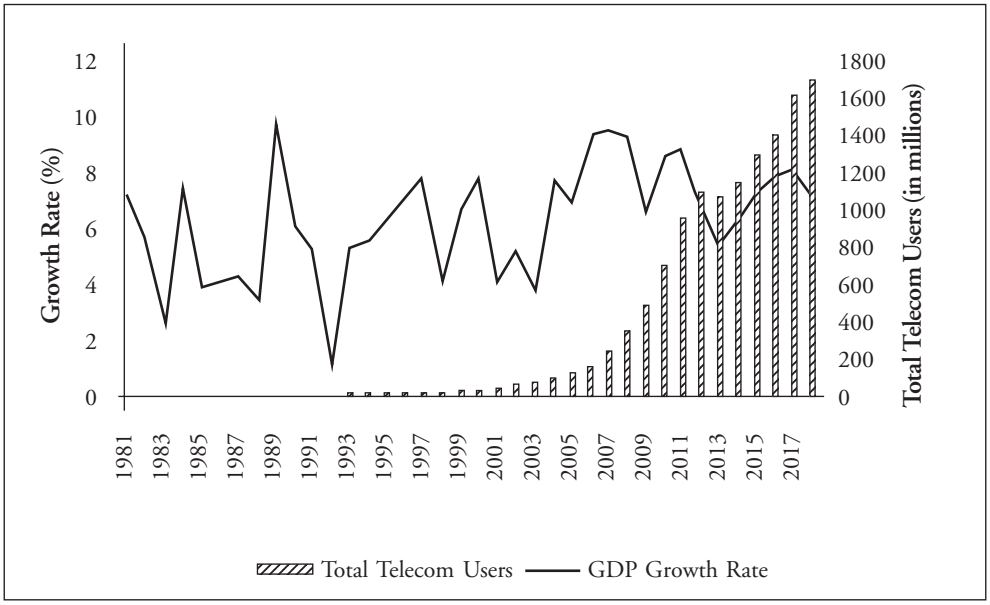
4. Empirical Analysis

Given the extant *inconclusive* empirical evidences available, we aim to explore whether the development in telecommunications infrastructure has been a stimulus to India's growth story or has it been merely a consequence of growth, if not both.

Our study differs from Ghosh and Prasad (2012) as well as Mehta (2017) on the count that, this study is perhaps the first attempt that encompasses a longer data period [1981-2018] than any other research work with specific reference to the case of India. As highlighted earlier, in the decade of 1980s India's teledensity was abysmally low; slowly it started accelerating since the eve of liberalization and had risen steeply from 2005 onwards. Figure-5 shows that during early 1980s to early 1990s although there were instances of hikes in real GDP growth rate but those sharp hikes were not accompanied by any noteworthy increase in telecommunications infrastructure. Given the absolutely low level of telecom users on the eve of economic reforms to even late 1990s, it seems that the occasional hikes in the growth rate (e.g., in the years 1983-84, 1988-89, and 1995-96) perhaps cannot be accrued to the development in telecommunications infrastructure in particular. In fact, it is argued that the impact of telecom infrastructure on a country's growth rate essentially requires a critical mass of users before any significant impact is felt; see, Röller and Waverman (2001).

The data period of Ghosh and Prasad (*ibid.*) ended at 2007, but the latest phase of telecom sector reforms began in 2007 itself. This latest phase of reforms brought in the removal of binding restrictions on the number of players within a mobile circle, and 122 new 2G licenses were given to various telecom companies on a first-come first-served basis in January 2008. The auction of 3G spectrum was held in 2010 and mobile number portability was introduced in 2011. Certainly, all of these initiatives

Figure-5 : Telecom Infrastructure and Growth Rate

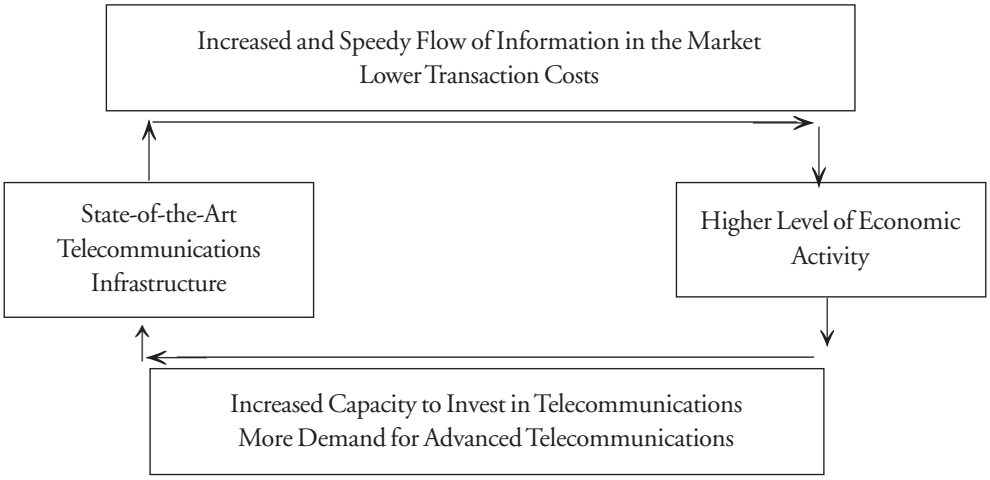


Data Source : TRAI *Annual Reports and Handbook of Statistics on Indian Economy, RBI.*

enabled the subscribers to execute a wider choice and the facility to switch between different service providers. In essence, such policy reforms enhanced the level of competition among the operators to retain their customers. Because increased demand for telecom usage induced the government as well as the private players to boost up infrastructure facilities. Mehta (2017) on the other hand have focused *only* on the data period 2007-2015. But we feel that given the *irreversible lumpy investment* required for building up some of the physical infrastructures, there has to be long run dynamism in such infrastructure building activities. Therefore, it is of significant importance to have considered the available data till 2018 since it becomes pertinent to examine the impact (if any) of increased economic growth on the development of telecommunications infrastructure in India.

Secondly, our study incorporates other macroeconomic variables namely, *total trade volume* and *real effective exchange rate* that are either not included or different from other studies on Indian telecommunications sector.

We conceptualize the basic empirical objective of our study as per the following diagrammatic representation.



4.1 Data and Variables Description

We consider time series data from various sources; *i.e.*, *TRAI Annual Reports*, *Handbook of Statistics on Indian Economy* provided by the RBI and World Bank. Annual data is considered for the Indian economy as a whole and we go back to 1981 till recent past (2018) to assess the possible causality between telecommunications infrastructure built up and the apparently successful growth story of India. Given the (secondary) data availability, our data period therefore, captures arguably the earliest phase of conceptualization of reforms that were planned during those early years of 1980s. Economic growth is proxied by considering the level of *real* GDP in a particular year. On the other hand, we measure the telecom infrastructure by adding up the total number of fixed line users, number of mobile phone users and number of internet users. Along the lines, this study extends from testing only the *bivariate* causality to incorporate three other macroeconomic variables, namely, gross fixed capital formation (*GFCF*), total trade volume (*TRD*), and real effective exchange rate (*REER*). Logarithmic transformations of all the variables are considered in order to easily convert non-stationarity series to stationary series after taking the first-difference.

4.2 Econometric Methods, Results and Discussion

We begin by examining the *bivariate* causality between real GDP and telecom infrastructure; and in the later part of the analysis we incorporate some other macroeconomic variables that we conceptualize to have affected the economic activity of Indian economy over the past three decades. To begin with, the '*unit root tests for stationarity*' of the data series have been conducted.

Table-3 : Variables and Sources of Data

Gross Domestic Product (*GDP*)	*RBI*
Gross Fixed Capital Formation (*GFCF*)	*RBI*
Telecom Infrastructure (*TI*)	*TRAI*, *World Bank*
Trade Volume (*TRD*)	*RBI*
Real Effective Exchange Rate (*REER*)	*Bruegel Datasets*

Note : All are real variables constructed considering the base year as 2004-05.

Table-4 : Descriptive Statistics

	LGDP	LTI	LTRD	LGFCF	LREER
Mean	16.94	4.82	10.80	15.66	4.67
Median	16.89	3.67	10.71	15.56	4.63
Max.	18.18	17.62	12.53	17.12	5.14
Min.	15.89	0.77	9.18	14.39	4.33
Std. Dev.	0.69	4.31	1.18	0.87	0.23
Skewness	0.20	1.82	0.08	0.21	0.50
Kurtosis	1.81	5.81	1.59	1.68	2.20

Unit Root Tests

It is by now oft-told and empirically well argued in the extant macro econometrics literature that many macroeconomic time series are found to contain unit root and hence, are *non-stationary*; see, Nelson and Plosser (1982). Therefore, conventional hypothesis tests cannot be conducted based on the estimated coefficients of non-stationary variables using the traditional *t*-test and/or *F*-test. In fact, the statistical significance of the concerned test statistic is then overstated and the results obtained are *a priori* spurious; see Granger and Newbold (1974) for details. Thus, it becomes imperative to first assess the *stationarity* of the relevant empirical variables in order to obtain statistically meaningful (and robust) results.

We conduct the two most commonly used tests for assessing the presence of unit roots following the seminal contributions of Dickey and Fuller (1979, 1981) and Phillips and Perron (1988). Dickey and Fuller (*ibid.*) also extended the procedure to an *augmented* version of the test which includes *extra lagged*

terms of the *dependent* variable in order to eliminate autocorrelation. The lag length is determined either by the *Akaike Information Criterion* [AIC] (1974) or *Schwartz Bayesian Criterion* [SBC] (1978). We use the *lag length which minimizes the value of the respective criteria used*. On the basis of obtained Augmented Dickey-Fuller (ADF) statistic, the *null hypothesis* (that *the series has a unit root*) is *accepted* for all the data series at their respective levels. However, after *first differencing* the variables, the respective series become *stationary*. In both the tests (ADF as well as Phillips Perron), the *unit root* test results are very *similar* and do *not* change qualitatively. Also, there are two other possible forms of the ADF test : one depicts the presence of a *drift* and the second captures the presence of both a *drift* and *non-stochastic trend*. We have tested *stationarity* for both the cases; *i.e.*, *with* and *without trend* in the presence of an *intercept term*; see Table-5.

Cointegration Test

Cointegration refers to a *stationary linear combination of non-stationary variables*, implying an existence of long run equilibrium relationship among the concerned economic variables; see for instance, Enders (2004) and Asteriou and Hall (2007).

Table-5 : Augmented Dickey-Fuller Test Results

Variables	Model with Constant Only	Model with Constant and Trend
LTI (2)	-2.14	-2.87
ΔLTI (1)	-5.94*	-5.82#
LGDP (0)	2.24	-1.45
ΔLGDP (0)	-4.35*	-4.92#
LGFCF (0)	0.68	-1.82
Δ LGFCF(0)	-5.34*	-5.97#
LTRD (1)	0.79	-2.93
Δ LTRD (1)	-4.82*	-4.95#
LREER (1)	-2.15	-0.54
ΔLREER (0)	-3.36*	-3.82#

Note : Δ denotes the first-difference. Numbers in parentheses denote lag length using AIC or SBC.

* : denotes significant at 5% level when compared with the critical value -2.97 in the first case; similarly, in the second case

\# : denotes significant at 5% when compared with the critical value -3.56.

For assessing the causality in case of non-stationary variables the unit roots should be removed after differencing appropriately. Therefore, in case of two $I(1)$ variables the causality test should be done only on the first difference of both the variables. However, if the variables are stationary at first difference, then there is a possibility of *cointegration*.

Based on the result of the test for cointegration, it is decided which time series model is appropriate for estimating the causal relationship. If the series are *not* cointegrated then an unrestricted Vector Autoregressive (*VAR*) model is used to assess causality, whereas, in the presence of cointegration a Vector Error Correction Model (*VECM*) is used because *VAR* in first differences is miss-specified since the system omits the 'error correction term' which is the lagged residual from the estimated long run relationship; Engle and Granger (1987).

Therefore, in case of non-stationary variables it is imperative to assess the presence of *cointegration* before estimating *Granger Causality*. In this paper, cointegration is tested using the Johansen and Juselius (1990) method. The cointegration test is done after finding out an appropriate lag structure on the basis of either *SBC* or *AIC*. The test statistics reveal that the null hypothesis of no cointegration cannot be rejected at 5 per cent level of statistical significance. Therefore, there is *no long run* relationship among the variables; see Table-6.

Granger Causality Test

A variable Y_t is said to Granger cause X_t, if X_t can be predicted with greater accuracy by using the past history of the other variable (Y) in addition to the past values of X rather than not using such past values; Granger (1969).

Since it is by now established that there is *no long run relationship* (cointegration) between the variables hence, the causality is tested through the *unrestricted vector auto-regression* framework by taking the first differences of the variables. Therefore, the *unrestricted VAR* model will be as follows :

$$\Delta LTI_t = \alpha_0 + \sum_{i=1}^{m} \alpha_{1i} \Delta LTI_{t-i} + \sum_{i=1}^{m} \alpha_{2i} \Delta LGDP_{t-i} + \varepsilon_{1t} \quad \ldots(1)$$

Table-6 : Johansen Cointegration Test Between Telecom Infrastructure and Real GDP

Test	Statistic	*p*-value	No. of Cointegrating Equations
Trace	11.13	0.06	0
Maximum Eigenvalue	9.60	0.17	0

$$\Delta LGDP_t = \beta_0 + \sum_{i=1}^{m} \beta_{1i} \Delta LGDP_{t-i} +$$

$$+ \sum_{i=1}^{m} \beta_{2i} \Delta LTI_{t-i} + \varepsilon_{2t} \qquad ...(2)$$

We find that the optimum lag length of the *bivariate VAR* is *one* according to *AIC* and *SBC*. The *bivariate* Granger-causality test results are reported in Table-7.

It is observed that when ΔLGDP is the dependent variable, ΔLTI turns out to be statistically insignificant at 5 per cent level indicating absence of any causality from ΔLTI to ΔLGDP. However, when ΔLTI is dependent variable then, ΔLGDP is statistically significant indicating a *short-run unidirectional causality running from real GDP to telecommunications infrastructure*. This confirms that economic growth causes telecommunications infrastructure and is *not* caused due to it; see, Beil *et al.* (2005), Chakraborty and Nandi (2011) and Pradhan *et al.* (2014) for similar results.

Table-8 shows that the estimated *unrestricted VAR* model satisfies the 'residual test' with the *null hypothesis* of *normal residuals*, *no autocorrelation* and *no heteroskedasticity* respectively, at *one percent* level of significance.

The *bivariate* analysis might involve *specification bias* due to the omission of some other relevant variables; therefore, we extend our econometric analysis to a *multivariate framework*. The following equation depicts the proposed functional relationship between telecommunications infrastructure, economic growth and other macroeconomic variables, such as real gross domestic investment, total volume of trade and real effective exchange rate.

Table-7 : Granger-Causality Test Results

Null Hypothesis	*F*-Statistic	Prob.	Decision
ΔLTI does *not* Granger Cause ΔLGDP	0.021	0.87	Accept
ΔLGDP does *not* Granger Cause LTI	4.121	0.05	*Reject*

Table-8 : Diagnostic Tests Results

	Test	Statistic	*p*-value	Conclusion
Normality	*JB*	10.62	0.04	Normal Residuals
	Kurtosis	3.12	0.25	
	Skewness	7.65	0.03	
Autocorrelation	*LM*(4)	4.55	0.35	*No Autocorrelation*
Heteroskedasticity	χ^2 (15)	25.10	0.06	*No Heteroskedasticity*

i.e., LTI = f (*LGDP*, *LGFCF*, *LTRD*, *LREER*)

There might also be *reverse* causality or *bidirectional* causality in this empirical model. Since we know that all the variables are *I*(1), we now verify if there exists any long run relationship or cointegration among them by employing the Johansen and Juselius (*ibid.*) Maximum Likelihood procedure; see Table-9. The optimal order of lags for the *VAR* model is again found to be 1 based on both the *AIC* and *SBC*.

Again, we *accept* the null hypothesis of no cointegration at 1 per cent level of significance and conclude that there is *no long run association* among the variables. As earlier, the short run causality is tested through the *unrestricted vector auto-regression* framework by taking the first differences of all the variables (since the variables are *I*(1)); see Table-10. We find that the *optimum lag length* of the multivariate unrestricted VAR is 1 according to *AIC* and *SBC*.

The *unrestricted multivariate* VAR model will be as follows :

$$\Delta LTI_t = \alpha_{10} + \sum_{i=1}^{m} \alpha_{11i} \Delta LTI_{t-i} + \sum_{i=1}^{m} \alpha_{12i} \Delta LGDP_{t-i} + \sum_{i=1}^{m} \alpha_{13i} \Delta LGFCF_{t-i} + \sum_{i=1}^{m} \alpha_{14i} \Delta LREER_{t-i} + \sum_{i=1}^{m} \alpha_{15i} \Delta LTRD_{t-i} + \varepsilon_{1t} \quad ...(3)$$

$$\Delta LGDP_t = \alpha_{20} + \sum_{i=1}^{m} \alpha_{21i} \Delta LGDP_{t-i} + \sum_{i=1}^{m} \alpha_{22i} \Delta LTI_{t-i} + \sum_{i=1}^{m} \alpha_{23i} \Delta LGFCF_{t-i} + \sum_{i=1}^{m} \alpha_{24i} \Delta LREER_{t-i} + \sum_{i=1}^{m} \alpha_{25i} \Delta LTRD_{t-i} + \varepsilon_{2t} \quad ...(4)$$

$$\Delta LGFCF_t = \alpha_{30} + \sum_{i=1}^{m} \alpha_{31i} \Delta LGFCF_{t-i} + \sum_{i=1}^{m} \alpha_{32i} \Delta LGDP_{t-i} + \sum_{i=1}^{m} \alpha_{33i} LTI_{t-i} + \sum_{i=1}^{m} \alpha_{34i} \Delta LREER_{t-i} + \sum_{i=1}^{m} \alpha_{35i} \Delta LTRD_{t-i} + \varepsilon_{3t} \quad ...(5)$$

$$\Delta LTRD_t = \alpha_{40} + \sum_{i=1}^{m} \alpha_{41i} \Delta LTRD_{t-i} + \sum_{i=1}^{m} \alpha_{42i} \Delta LGDP_{t-i} + \sum_{i=1}^{m} \alpha_{43i} \Delta LGFCF_{t-i} + \sum_{i=1}^{m} \alpha_{44i} \Delta LREER_{t-i} + \sum_{i=1}^{m} \alpha_{45i} \Delta LTI_{t-i} + \varepsilon_{4t} \quad ...(6)$$

Table-9 : Johansen Cointegration Test Results

Test	Statistic	*p*-value	No. of Cointegrating Equations
Trace	76.21	0.02	0
Maximum Eigen value	30.98	0.07	0

$$\Delta LREER_t = \alpha_{50} + \sum_{i=1}^{m} \alpha_{51i} \Delta LREER_{t-i} +$$
$$+ \sum_{i=1}^{m} \alpha_{52i} \Delta LGDP_{t-i} + \sum_{i=1}^{m} \alpha_{53i} \Delta LGFCF_{t-i}$$
$$+ \sum_{i=1}^{m} \alpha_{54i} \Delta LTRD_{t-i} + \sum_{i=1}^{m} \alpha_{55i} \Delta LTI_{t-i} + \varepsilon_{5t} \quad ...(7)$$

It can be observed from Table-10 that when ΔLTI is the dependent variable then ΔLGFCF, ΔLTRD and ΔLREER are statistically *insignificant*, whereas ΔLGDP appears to be *statistically significant* at 5 per cent level of significance. In equation (4), both ΔLTI and ΔLGFCF are statistically *insignificant* where as ΔLTRD and ΔLREER are statistically *significant*. The results indicate that there is *no unidirectional causality running from either telecommunications infrastructure or real GFCF to real GDP*. In case of real GFCF our results comply, whereas, for the case of telecommunications infrastructure our results *contradict* the findings of Ghosh and Prasad (2012) that concluded the presence of *unidirectional causality* running from *telecommunications infrastructure* to *economic growth*.

However, there is presence of *short run unidirectional causality* emanating from *real GDP* to *telecommunications infrastructure*. Thus, economic growth *causes* the development of telecom infrastructure in India and *not* the other way round. Also, in equation (6) ΔLGDP turns out to be statistically *significant* indicating presence of *bidirectional* causality between real GDP and total trade; see Pradhan *et al.* (2014) for similar results. In equation (7), ΔLTI, ΔLGDP, ΔLTRD and ΔLGFCF are statistically *insignificant*; indicating presence of *short run unidirectional causality running from REER to real GDP*. Short run *unidirectional* causality is found to be running from *real GFCF* to *total trade* and from *REER* to GFCF. The diagnostic test results of estimated *unrestricted VAR* model are reported in Table-11.

5. Summing Up

A significant section of rural India still struggles with social exclusion from quality health services, secondary and higher education, housing, water supply, sanitation and overall social security. It is indeed true that *growth without social justice is inhuman and social justice without adequate growth is inconceivable*. The desired benefits of telecom revolution in terms of attaining the SDGs can only be fruitfully reaped once India progressively steps toward addressing such issues of social exclusions.

Our study addressed the intriguing question—*whether the phenomenal development in the Indian telecom infrastructure caused a spur in economic growth; or, is it due to the steady economic growth in India that induced the much-needed*

Table-10 : Granger-Causality Test Results

Null Hypothesis	*F*-Statistic	Prob.	Decision
ΔLTI does not Granger Cause ΔLGFCF	0.002	0.95	Accept
ΔLGFCF does not Granger Cause ΔLTI	2.082	0.19	Accept
ΔLTI does not Granger Cause ΔLGDP	0.019	0.93	Accept
ΔLGDP does not Granger Cause ΔLTI	4.095	0.03**	*Reject*
ΔLTRD does not Granger Cause ΔLTI	0.172	0.61	Accept
ΔLTI does not Granger Cause ΔLTRD	1.875	0.13	Accept
ΔLGFCF does not Granger Cause ΔLTRD	5.924	0.02**	*Reject*
ΔLTRD does not Granger Cause ΔLGFCF	1.028	0.33	Accept
ΔLGDP does not Granger Cause ΔLTRD	4.896	0.02**	*Reject*
ΔLTRD does not Granger Cause ΔLGDP	2.934	0.07*	*Reject*
ΔLGDP does not Granger Cause ΔLGFCF	1.431	0.20	Accept
ΔLGFCF does not Granger Cause ΔLGDP	0.483	0.53	Accept
ΔLTI does not Granger Cause ΔLREER	1.295	0.25	Accept
ΔLREER does not Granger Cause ΔLTI	6.486	0.65	Accept
ΔLGDP does not Granger Cause ΔLREER	2.643	0.15	Accept
ΔLREER does not Granger Cause ΔLGDP	4.987	0.03**	*Reject*
ΔLGFCF does not Granger Cause ΔLREER	0.891	0.18	Accept
ΔLREER does not Granger Cause ΔLGFCF	4.912	0.03**	*Reject*
ΔLTRD does not Granger Cause ΔLREER	2.671	0.20	Accept
ΔLREER does not Granger Cause ΔLTRD	0.175	0.63	Accept

Note : **and * denote significant at 5% and 10% level respectively.

Table-11 : Diagnostic Test Results

	Test	Statistic	*p*-value	Conclusion
Normality	*JB* Kurtosis Skewness	18.83 7.86 8.65	0.06 0.17 0.08	Normal Residuals
Autocorrelation	*LM* (16)	12.89	0.81	*No Autocorrelation*
Heteroskedasticity	χ^2 (140)	165.94	0.09	*No Heteroskedasticity*

telecom infrastructure to maintain the growth momentum. Or, is there a '*feedback effect*'?

We first examined the long run relationship through the co-integration between telecom infrastructure and economic growth in India using annual data for the period 1981-2018. Our results fail to establish any long run relationship between telecom infrastructure and output level. However, we find short run *unidirectional* causal relationship emanating from economic growth to telecom infrastructure, indicating that advancement in telecommunications infrastructure has been a consequence of economic growth. The cointegration results remained unchanged even in the *multivariate VAR* analysis. Interestingly, the causality results remained valid as well. Apart from that, we also observe the presence of short-run unidirectional causality from real (gross) domestic investment to trade volume, from REER to real investment as well as to real GDP.

It is often argued that the post-1991 structural reforms in the Indian economy brought in a phenomenal growth in the services sector and the result suggests that the recent development of telecom infrastructure has been apparently due to the growing demand of the flourishing services sector. Thus, it can be argued that services led increased economic growth had induced the advancement in telecom infrastructure of late.

The absence of long run relationship could arise due to heterogeneity of telecommunications penetration between rural and urban areas. Such a significant 'digital divide'impedes the development of telecom infrastructure in rural areas and hence, constraints the overall effect of telecommunications infrastructure on economic growth. Also, the telecom equipment manufacturing sector is highly dependent on imported equipment and therefore, most of the domestic demand is met through imports rather than home production. This also affects competitiveness of Indian telecom products in the international markets and contributes to decay the impact of telecommunications infrastructure on economic growth.

Given the spatial unevenness in the rural and urban telecom infrastructure, either the government has to mitigate the problem of relatively poor teledensity or adequately incentivize the private players to build up reasonable telecom infrastructure to tap the 'bottom of the pyramid' which is large enough for a populous country like India.

It would have been interesting to examine the nexus at the state level using panel cointegration framework.

Unfortunately, it is difficult to extract disaggregated data for all the concerned variables, especially for the telecommunications infrastructure. For instance, given the data period of our study we could not get the FDI data for the entire period and examine whether there is any inter-linkage between past FDI inflow into the country and improvement in telecom infrastructure.

End Note

1. The SDGs are a collection of 17 global goals set by the UN General Assembly in 2015 for the targets to be achieved by 2030.

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The Journal of Institute of Public Enterprise, July-Dec, Vol. 42, No. 2
ISSN : 0971-1864, © 2019.

Efficiency, Productivity and Returns to Scale of Indian General Insurance Industry : Evidence Based on Panel Data

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The present study compares the efficiency-productivity-returns to scale performance of 15 general insurance companies operating in India during the period 2009-10 to 2013-14. We have used a panel data approach towards estimation leading to inter-temporal comparison of performance in respect of both efficiency and returns to scale. The estimation of efficiency indicates that under the assumption that technology is local, the efficiency performance of the insurer's has improved during the period. However, returns to scale estimation indicates that most insurance companies were not operating at the optimal scale. Further, estimation of Malmquist productivity index indicates that while efficiency shifts have been positive during the period under consideration, technical change has been on the negative side indicating a lowering of the frontier.

Keywords : General Insurance, Window Analysis, Total Factor Productivity, Bootstrap, DEA.

Introduction

The Indian insurance sector experienced deregulation of entry in the aftermath of the introduction of banking sector reform in India. The insurance sector changes can be considered as an integral part of the overall program of financial sector reform. Infusion of competition through private sector entry in the insurance sector was essential to promote scale and scope economies in the sector. From the international perspective also, this was quite essential as India was committed to the international community to open up its financial services sector which, for long, remained a monopoly of the public sector. Thus, the deregulation of entry in the Indian insurance sector took place in 1999 along with the establishment of the insurance market regulator namely the Insurance Regulatory and Development Authority. The changes in the regulatory architecture and competition scenario were followed by deregulation of tariffs and many other important policy changes which significantly influenced the working of the general insurance sector. Against the backdrop, the present study seeks to estimate efficiency, total factor productivity

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changes and returns to scale for fifteen general insurance companies for the period 2009-10 to 2013-14.

While adopting the non-parametric methodology for the estimation of insurer performance, we have departed from the extant approach used in the Indian context in several respects. In the estimation of efficiency performance of the in-sample insurers, we have adopted the panel data approach instead of the cross-section approach used in the current literature. Thus the benchmark used in our study is based on the entire observation period. A similar procedure has been adopted for the estimation of returns to scale.

Estimation of efficiency on the basis of a panel data approach requires the assumption there is no technical change causing the frontier to shift in between. This is a limitation of the efficiency analysis. Thus, in the next phase, we have also estimated total factor productivity change for the period under observation. While we have followed the popular non-parametric approach for the estimation of total factor productivity, we have made a major departure from the past. Since the sample size for the present study is small, we have resorted to bootstrap DEA estimation of productivity and its components. Apart from giving bias-corrected estimates, this methodology enables us to provide interval estimates of productivity thereby enabling us to get statistical interpretation of the scores including interval estimates.

The paper has five sections and proceeds as follows. Section-1 provides an overview of the post-reform general insurance sector. Section-2 describes the methodology. Section-3 describes the related research work. Section-3 provides a brief overview of the related research work. Section-4 discusses the results.Section-5 concludes.

Section-1 : An Overview of the Indian General Insurance Industry

Indian general insurance industry is quite small when compared to the International standard. The sector is also smaller than the life insurance counterpart. Thus there is considerable scope for the expansion of the sector.

During the period under consideration, the total number of diversified general insurers increased from 19 to 21. On the other hand, the total number of standalone health insurers increased from 1 to 4 during 2009-10 to 2013-14. The number of specialized insurer's, however, remained unchanged during the period. See Table-1 for details.

Of particular interest is the standing of the Indian general insurance sector *vis-a-vis* the global scenario. For the sake

Table-1 : Players in the General Insurance Market(1999-00 to 2013-14)

Year	1999-00	2009-10	2013-14
No of diversified general insurers	4	19	21
Standalone health insurer	0	1	4
Specialised general insurers	1	2	2

Source : IRDA (2014) : Handbook on Indian Insurance Statistics 2013-14.

Table-2 : General Insurance Density and Penetration : India and the World (2014)

General Insurance	Insurance Density	Insurance Penetration
India	11	0.70
World	294	2.70

Source : IRDA (2017) : Handbook on Indian Insurance Statistics 2016-17.

of international comparison, we consider two performance indicators-insurance density and insurance penetration. Insurance density is calculated as the ratio of insurance premium (in US $) to the total population of the country. On the other hand, insurance penetration is computed as the ratio of insurance premium to GDP (in % terms).

Section-2 : Efficiency, Total Factor Productivity and Returns to Scale

In a market driven economy with competition coming from both domestic and overseas competing firms, each productive entity needs to remain concerned about efficiency, productivity and returns to scale. In plain language, efficiency corresponds to the performance of a productive unit with respect to some observed/ virtual best practice unit. Productivity corresponds to the ratio of output(s) to input(s). Returns to scale implies the change in output in relation to changes in the scale of operation. Thus, depending on whether the return is more than proportionate, exactly proportionate or less than proportionate, we can classify returns to scale into three types : increasing, constant and decreasing.

In the computation of efficiency and productivity, the concept of returns to scale plays an important role. If the technology exhibits constant returns to scale throughout, the technology is global implying that the same benchmark

applies for all firms irrespective of their scale of operations. However, if the returns to scale is variable, then the reference units can be different for different units under observation. In a similar vein, the returns to scale exhibited by an unit has important implications for the average productivity of the firm. Depending on the nature of returns to scale, the observed firm observed scale size will be less than, equal to or greater than the most productive scale size (Banker, 1984).

Efficiency, Productivity and Returns to Scale for a Single Input-Single Output Technology

In order to provide a more formal presentation of the relationship of returns to scale with efficiency and productivity, let us consider a single input-single output technology (Ray, 2004) characterized by the production possibility set :

$$P_S = [(x,y) : y \leq f(x)]$$

Here y and x stand for output and input respectively. The inequality sign allows the possibility of x-inefficiency : observed output can be less than or equal to the potential output suggested by the technology. Efficiency from the output perspective is defined as : $E^o = \frac{y}{f(x)}$. Let $f_{irs}(x)$, $f_{crs}(x)$ and $f_{drs}(x)$ represent the best practice output under increasing, constant and decreasing returns to scale. Since in the case of Most Productive Scale Size (MPSS), the technology exhibits constant returns to scale, we have $f_{irs}(x) < f_{crs}(x)$ and $f_{drs}(x) < f_{crs}(x)$. Thus if we accommodate variable returns to scale (i.e. returns to scale can be increasing, constant or decreasing) then $E^o_{vrs} \geq E^o_{crs}$.

Now let us consider the linkage of productivity with the returns to scale. We define average productivity AP= $\frac{f(x)}{x}$. By using the previous logic, $AP_{crs} = \frac{f_{crs}(x)}{x} \geq \frac{f_{vrs}(x)}{x}$. Thus average productivity is highest when the firm experiences MPSS.

Efficiency, Productivity and Returns to Scale in a Multi-Input Multi-Output Setting

We now consider a technology P_T which models the transformation of inputs x (numbering 1,2, ..., n) on to outputs y (numbering 1,2, ..., m). Thus $x \in R^N_+$ and $y \in R^M_+$.

Then the production technology can be represented as :

$$P_T = [(x,y) : x \text{ can produce } y]$$

Invoking Shephard (1953,1970), the output distance function may be expressed as :

$$D_f^o(x,y) = \min\left\{\mu : \left(x, \frac{y}{\mu}\right) \in T\right\} =$$

$$= \left[\max\{\delta : (x, \delta y) \in P_T\}\right]^{-1}$$

An observed firm is inefficient when $D_f^o(x,y) < 1$ and is efficient when $D_f^o(x,y) = 1$.

For a firm with observed output and input vectors being y_0 and x_0 respectively, the optimization problem is : Max δ

Subject to : $\delta y_0 \le \lambda Y$ and $x_0 \ge \lambda X, e\lambda = 1$ (for vrs). Thus = $E_o = \frac{1}{\delta}$

Note that, for period-wise data, we make use of the period specific observations on input and output as the reference sets. However, for panel data, we can use the entire panel as the reference set (see Charnes et.al., 1985). Thus if we have a panel of observations relating to the inputs and outputs (in our case n.t observations on inputs and m.t observations on outputs assuming that observations are available for time periods 1,2, ..., t), then the modified mathematical program would be :

Max δp

Subject to : $\delta y_0 \le \lambda Y_p$ and $x_0 \ge \lambda X_p, e\lambda = 1$ (for vrs). Thus $E_0 = \frac{1}{\delta_p}$ where the subscript p implied that the reference set is actually a panel.

While estimating productivity, we are primarily interested in knowing how productivity has changed inter-temporally. The non-parametric approach of productivity estimation assumes the existence of a production/cost function but does not require a parametric relationship between the outputs and inputs. The most popular non-parametric measure of total factor productivity change is the the Malmquist Productivity Index which was introduced by. Caves, Christensen and Diewert (1982). The computation of Malmquist Productivity Index, like the case of DEA based efficiency estimation, is based on the concept of input and output distance functions originally introduced by Shephard (1953, 1970).

For understanding the methodology of Malmquist productivity estimation, let us consider two consecutive time periods 0 and 1. Using the technology of time period 0, the Malmquist Productivity Index as per Caves, Christensen and Diewert (1982) can be defined as :

$$M_0 = \frac{D_f^0(x^1, y^1)}{D_f^0(x^0, y^0)} \times \frac{\frac{x^1}{y^1}}{\frac{x^0}{y^0}} \quad \text{and}$$

$$M_1 = \frac{D_f^1(x^1, y^1)}{D_f^1(x^0, y^0)} \times \frac{\frac{x^1}{y^1}}{\frac{x^0}{y^0}}$$

Under the assumption of constant returns to scale, the frontier is an upward rising straight line implying that, $\frac{x^1}{y^1}=\frac{x^0}{y^0}$. we have $M_0=\frac{D_f^0(x^1,y^1)}{D_f^0(x^0,y^0)}$

and $M_1=\frac{D_f^1(x^1,y^1)}{D_f^1(x^0,y^0)}$.

The Malmquist productivity change index is computed as = $\sqrt{M_0}.M_1$

Under the operation of constant returns to scale, Färe, Grosskopf, Lindgren and Roos(1989,1992) decomposed the output based Malmquist index into the following two components: Efficiency Change and Technical Change.

Efficiency Change = $\frac{D_f^0(x^1,y^1)}{D_f^0(x^0,y^0)}$

Technical Change =

$$\left[\frac{D_f^0(x^1,y^1)}{D_f^1(x^1,y^1)}\times\frac{D_f^0(x^0,y^0)}{D_f^1(x^0,y^0)}\right]^{\frac{1}{2}}$$

Under variable returns to scale, both efficiency change and technical change components can be decomposed further. Färe, Grosskopf, Norris and Zhang (1994) decomposed the efficiency change component of Malmquist index into pure efficiency and scale components.

Pure Efficiency Change = $\frac{D_{f(VRS)}^1(x^1,y^1)}{D_{f(VRS)}^0(x^0,y^0)}$

Scale Efficiency Change =

$$=\frac{\frac{D_{f(CRS)}^1(x^1,y^1)}{D_{f(VRS)}^1(x^1,y^1)}}{\frac{D_{f(CRS)}^0(x^0,y^0)}{D_{f(VRS)}^0(x^0,y^0)}}$$

Wheelock and Wilson (1999) decomposed the Technical Change (CRS) in to the two components : Pure Technical Change and Change in Scale of Technology. Thus as per Wheelock and Wilson (1999), Malmquist Productivity Index (VRS)= Pure Efficiency Change X Scale Efficiency Change X Pure Technical Change X Change in Scale of Technology.

Change in Scale of Technology =

$$=\sqrt{\left(\frac{\frac{D_{f(CRS)}^0(x^1,y^1)\times D_{f(CRS)}^0(x^0,y^0)}{D_{f(VRS)}^0(x^1,y^1)D_{f(VRS)}^0(x^0,y^0)}}{\frac{D_{f(CRS)}^1(x^0,y^0)\,D_{f(CRS)}^1(x^0,y^0)}{D_{f(VRS)}^1(x^0,y^0)\,D_{f(VRS)}^1(x^0,y^0)}}\right)}$$

Bootstrap Estimation of Malmquist Productivity

In the present context, we have observations on only 15 insurance companies per year. In the estimation of Malmquist productivity index, we make a pair-wise comparison for two years. Thus the sample size is quite small. For a finite sample size, Banker admitted that for a finite sample size, the estimated production frontier would

lie below the theoretical frontier. Thus, DEA estimates of efficiency would overestimate the true position. Further, Korostelev, et al (1995a, 1995b) have demonstrated that while the DEA estimates are consistent (under very weak general conditions) the rate of convergence (to the true frontier) is very slow, Thirdly and finally, the DEA based estimates by giving only point estimates, are not amenable to statistical interpretation.

In order to overcome the problem, we have made use of smoothed bootstrap method suggested by Simar and Wilson (1998). The plain vanilla bootstrap method suggested by Efron (1979) implies procedure of drawing with replacement from a sample and the resultant samples mimic the data generating process of the underlying true model which can be used for statistical inference. In the context of efficiency analysis, the conditional density of the distance function has bounded support over the interval (0,1) and is right discontinuous at 1. In order to cope with the problem, Simar and Wilson (1998) made bootstrap estimation of the distance function using univariate kernel estimates of the marginal density of the original estimates. Thus for a random variable X having values x_1, x_2, ..., x_n with probability density function f and cumulative distribution function F, f is estimated by using the Parkan-Rosenblatt kernel = $f_n^e = (nh)^{-1}\sum_{i=1}^{n} k\left(\frac{x-\theta}{h}\right)$ where the kernel k is an univariate pdf and h is the smoothing parameter. In case of efficiency estimation, x <1. then a symmetric kernel is used : $g_n^e = nh^{-1}\sum_{i=1}^{n}\left\{k\frac{(x-\theta)}{h} + k\frac{x-2+\theta}{h}\right\}$. Appropriate values of the smoothing parameter is found by maximizing the likelihood cross validation function (refer Silverman (1986)).

For incorporating the bootstrap process for the estimation of efficiency, we assume a data generating process (DGP) in which the firms deviate in a random fashion from the production frontier at time t. From the output perspective, this is measured by the output distance function D_0^t. In the bootstrap approach, this DGP is replicated multiple times resulting in a large number (say B) of pseudo samples of input and output variables : $T^b = \{x_{it}^b, y_{it}^b\}$ where i = 1,2, ..., n and t = 0,1, The original estimators are now applied to these pseudo samples. For each bootstrap sample $b_s \in B$, efficiency is computed by measuring the distance of each observation belonging to the original sample from the frontier constructed from the pseudodata.

In the context of computation of the Malmquist productivity index, it is essential to utilise the relationship $P_T^* = \{x_{it}^*, y_{it}^*\}$ for measuring the distance

of each observation belonging to the original sample from the frontier created out of the pseudo sample of inputs and outputs.

$$\left\{D_r^0(x_0,y_0)\right\}^{-1} = \sup_{\theta,y}\theta$$

$$\text{Subject to : } \theta y_0 \le Y_0^b \qquad .....(5)$$

$$x_0 \ge \lambda X_0^b, \sum_j \lambda_j, \lambda_j \ge 0$$

$$\left\{D_r^1(x_1,y_1)\right\}^{-1} = \sup_{\theta,\lambda}\theta$$

$$\text{Subject to : } \theta y_1 \le \lambda Y_1^b \qquad .....(6)$$

$$x_1 \ge \lambda X_1^b, \sum_j \lambda_j, \lambda_j \ge 0$$

$$\left\{D_r^0(x_1,y_1)\right\}^{-1} = \sup_{\theta,\lambda}\theta$$

$$\text{Subject to : } \theta y_1 \le \lambda Y_0^b \qquad .....(7)$$

$$x_1 \ge \lambda X_0^b, \sum_j \lambda_j, \lambda_j \ge 0$$

$$\left\{D_r^1(x_0,y_0)\right\}^{-1} = \sup_{\theta,\lambda}\theta$$

$$\text{Subject to : } \theta y_0 \le \lambda Y_1^b \qquad .....(8)$$

$$x_0 \ge \lambda X_1^b, \sum_j \lambda_j, \lambda_j \ge 0$$

In case of estimation of Malmquist index of productivity change, we deal with panel data with the possibility of temporal correlation. To preserve this, the joint density of two period distance functions is estimated. The bivariate kernel can be written as : $f_{bn}^e = \frac{1}{nh^2}\sum_{i=1}^{n} k\left(\frac{x^* - \theta^*}{h}\right)$ where x* has (1X2) dimension and $\theta^* = (D^{0/0}, D^{1/1})$. However, when the support of f is bounded (as is the case with Malmquist Productivity Index) the estimated density from the bivariate kernel is inconsistent and asymptotically biased. Thus we use the symmetric kernel using Silverman's reflection method. For further details on this issue, see Simar and Wilson (1999).

The next issue is that of bias correction. After the computation of the bootstrap values it is essential to correct for the finite sample bias prevailing in the original estimators of the distance function. The bias is calculated as :

Bias $(M_0) = \frac{\sum_{b=1}^{B} M_0^*}{B} - M_0$ Thus the bias corrected estimate of Malmquist index of productivity change is computed as : $M_0^{bc} = 2M_0 - \frac{\sum_{b=1}^{B} M_0^*}{B}$

Finally, we need to generate interval estimates of Malmquist index of productivity change. For this, we approximate the unknown distribution of $\left(\widehat{M_0} - M_0\right)$ by $\left(M_0^* - M_0\right)$ conditioned on the original sample data. Since we do not know the distribution of $\left(\widehat{M_0} - M_0\right)$, we can use the bootstrap estimates to find out values a_α^* and b_α^* such that Prob $\left\{-b_a^* \le \left(\widehat{M_0} - M_0\right) \le -a_\alpha^*\right\}$ tends to 1-α. By reversing the sign and rearranging the terms we get a confidence interval of 1-α :

$$\widehat{M_0} + a_\alpha^* \le M_0 \le \widehat{M_0} + b_\alpha^*$$

Related Research Work

One of the earliest efficiency-productivity study in the context of the general (non-life) insurance industry was by Toivanen (1997) who researched for the presence of economies of scale and scope in the Finnish non-life insurance sector using data for the period 1984-91. The study involved the estimation of a quadratic cost function. During the period of study Finnish non-life business was branch centric in nature and the insurance firms tried to expand their branch network for gaining market power or informational advantages. The study revealed that diseconomies of scale existed at the firm level whereas economies of scale was present at the branch level. Economies of scope was present in the production process.

Fukuyama and Weber (2001) estimated efficiency and productivity growth of Japanese non-life insurance companies for the time period 1983-1994. The study estimated Farrell, Russell and Zieschang measures of output oriented technical efficiency and on the basis of these measures, constructed Malmquist index of total factor productivity change. Then the index is decomposed into efficiency change and technological change indices. The outcomes of the study showed that between 1983-90 productivity improved significantly and it was mainly due to technological change. In the next three years, the collapsed bubble economy resulted in the stagnation of technological change. However, by 1993-94, there was again an upturn in technological change.

Cummins and Xie (2008) assessed the efficiency and productivity effects of mergers and acquisitions in the US property-liability insurance industry during the period 1994-2003 using data envelopment analysis (DEA) and Malmquist productivity index. The study examined efficiency and productivity shifts for three types of insurers : acquirers, acquisition targets, and non-M&A firms. For examining characteristics of the in-sample firms, the study employed probit analysis. The results provide evidence that mergers and acquisitions in property-liability insurance industry enhanced firm valuation. The study further found that the acquiring firms achieved more revenue efficiency gains than the non-acquiring firms, and target firms experienced greater cost and allocative efficiency growth compared to non-targets.

Kasman and Turgutlu (2009) applied the Malmquist total factor productivity index to examine productivity growth in Turkish insurance industry for the period 2000-2005. The overall productivity growth is the decomposed in to technological change and efficiency change. Their study found that during

the period the non-life sector had a positive productivity growth (especially during 2003-05) while the life insurance sector regressed. The growth in the non-life sector was mainly due to favourable efficiency shifts.

Barros, Nektarios and Assaf (2010) employed the two-stage double bootstrap approach to evaluate the performance of Greek life and non-life insurance companies using the global technology framework for the period 1994-2003. The first stage efficiency results indicate a decline in efficiency over the sample period. The second stage truncated regression confirmed that the competition for market shares is a major influencing factor of efficiency performance in the Greek insurance industry.

Vencappa et.al. (2013) estimated and decomposed productivity growth for an unbalanced panel of European insurance companies for the period 1995-2008. The study estimated productivity growth using a parametric stochastic frontier method. Total factor productivity change is then decomposed in to four components : (i) technical change, (ii) scale efficiency change, (iii) technical efficiency change and (iv) scale efficiency change. In order to capture the inherent variability encountered in the insurance sector, the study used three output proxies : total premiums collected, total claims incurred and the sum of claims paid and any changes made to the insurer's loss reserves. The study found that total productivity growth in the European insurance sector was volatile in nature and driven primarily by changes in mean technical efficiency.

Javaheri (2014) estimated total factor productivity change in respect of all Iranian insurance companies relative to the period 2003-2009 using data envelopment analysis. In order to examine the influence of environmental variable on productivity, he used to bit regression was. The results indicated that the policy of liberalization had a positive impact on productivity growth. Further, the results also indicated that dimension and the field of activity had significant positive effect on productivity changes.

Alhassan and Biekpe (2015) analyse deficiency, productivity and returns to scale economies in the non-life insurance market in South Africa for the time span 2007-2012. Data envelopment analysis was employed to estimate efficiency and returns to scale while productivity growth was analysed by using Malmquist productivity index. They applied Truncated bootstrapped and logistic regression techniques for finding out the determinants of efficiency and the probability of operating under

constant returns to scale. The results showed that non-life insurers operated with about 50 per cent efficiency. Approximately 20 per cent of insurers were scale efficient. The study also found productivity improvements during the period which was mainly due to technological changes. The results of the regression analysis indicated a non-linear impact of size on efficiency and constant returns to scale. Variables like product line diversification, reinsurance and leverage also had a significant relationship with efficiency and constant returns to scale.

Data, Results and Discussion

Inputs, Outputs and Data

Estimation of efficiency and productivity performance of the non-life insurance companies require the identification of performance indicators (inputs and outputs of the production process). However, this is a challenging task in so far as the general insurance industry is concerned. There are long-standing disagreements among the researchers regarding the appropriate choice of inputs and outputs. The same variable has been used as an input in some research studies and as an outputs in other studies. For getting more information on the extant approaches to the selection of inputs and outputs, see Eling and Luhnen (2010), Leverty and Grace (2019) and Jarraya and Bouri (2012). On the whole, as suggested by Leverty and Grace (2010), there are two dominant competing approaches for the identification and selection : the Flow Approach and the Value Added Approach.

The Flow Approach treats the insurance firms as financial intermediaries which acts as transforming institutions of premiums in to claims payment. The important Flow Approach output indicators are rate of return on investments, the ratio of liquid assets to liabilities and the probability of solvency of the insurance company. The inputs include the current policy holder's surplus, the sum of the costs incurred for performing the underwriting and investment functions and the policyholder supplied debt capital (represented by the sum of unpaid net losses, unpaid loss adjustment expenses and unearned premium reserves).

The alternative approach i.e., the Value Added Approach uses outputs related to the amount of financial services provided by the insurance firms. The important output indicators in the Value Added Approach include claims expected to be paid as a result of providing insurance coverage during a particular period and the average real invested assets of a firm. The important input indicators include expenditure on labour and physical capital, financial

equity capital and policy holder supplied debt capital.

In the present context, we have used a hybrid approach with the inclusion of two inputs and two outputs. The two inputs are operating expenses and net premium income. Since item-wise expenses relating to labour and physical capital are not available, operating expenses relating to the insurance business serves as a broad indicator for these expenses. On the output side, there are two important indicators: benefits paid and asset under management. The first one i.e. benefits to the policy holders represents the claims paid to the policy holders i.e. it represents the real insurance services provided by the general insurers. The second one represents invested assets of the firm and it has been taken as a free output link. The in-sample insurance companies are assumed to operate under variable returns to scale. Productivity estimation is made for the output-oriented approach. The nominal data have been appropriately deflated to facilitate inter-temporal comparison.

Data related to the Indian general insurance companies have been collected for the period 2009-10 to 2013-14 from IRDA Annual Reports and the Handbooks of Indian Insurance Statistics for the financial years 2011-12 and 2013-14. Fifteen general insurance companies have been included in the study. Other companies could not been included because it was essential to form a balanced panel of observations.

Results and Discussion

In the present section, we provide estimates of panel (window) based estimates of efficiency, bias corrected bootstrap estimates of Malmquist productivity estimate and it components and returns to scale exhibited by the in sample general insurers.

Window Analysis of Efficiency

Table-3 provides the descriptive statistics of output oriented efficiency estimates for the in-sample general insurers for the period under observation. However, the efficiency scores are derived using the entire panel of

Table-3 : Selected Performance Indicators

Indicators	Input Indicator	Output Indicator
Net premium income	√	X
Operating expenses	√	X
Benefits paid	X	√
Asset under management	X	√

Source : Author's own.

observations (including 80 observation points) as the reference set. Since the reference set is the same, the efficiency scores are comparable from one period of time another. The results clearly point out that during reference time span, mean efficiency has improved. Similar improvement is also seen in respect of minimum efficiency scores and standard deviation of efficiency scores except for 2010-11. The detailed insurer- wise efficiency scores are available in appendix Table-A1.

Returns to Scale Estimates

Table-5 provides the summary information regarding returns to scale estimates exhibited by the general insurers for the period under observation. The Table shows that during the last two observed years (2012-13 and 2013-14 respectively), 14 out of the 15 general insurers exhibited decreasing returns to scale. Thus most of the general insurers were not operating at the optimal scale where observed productivity

Table-4 : Window Based Estimation of Efficiency

Particulars	2009-10	2010-11	2011-12	2012-13	2013-14
Mean Efficiency	0.7641	0.7852	0.9245	0.9288	0.9314
Maximum	1	1	1	1	1
Minimum	0.5228	0.3860	0.7399	0.7540	0.7582
Standard Deviation	0.1813	0.2159	0.0995	0.0840	0.0785

Source : Calculated.

Figure-1 : Inter-Temporal Movement in Efficiency

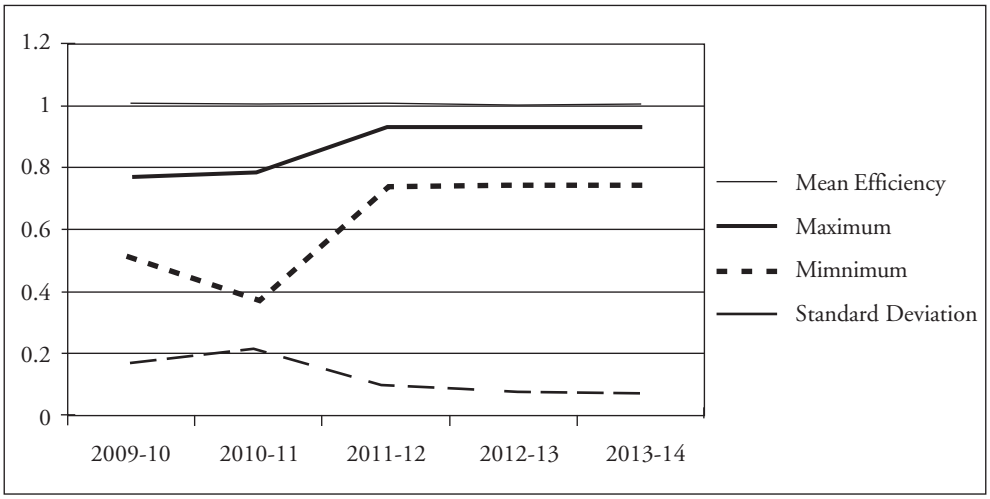


Table-5 : Summary Information about Returns to Scale

Particulars	2009-10	2010-11	2011-12	2012-13	2013-14
Number of general insurers exhibiting CRS	1	1	0	1	1
Number of general insurers exhibiting IRS	3	3	2	0	0
Number of general insurers exhibiting DRS	11	11	13	14	14

Source : Calculated.

equals the optimal. The detailed insurer-wise information about returns to scale for the period under observation is available in appendix Table-A2.

Trends in Total Factor Productivity

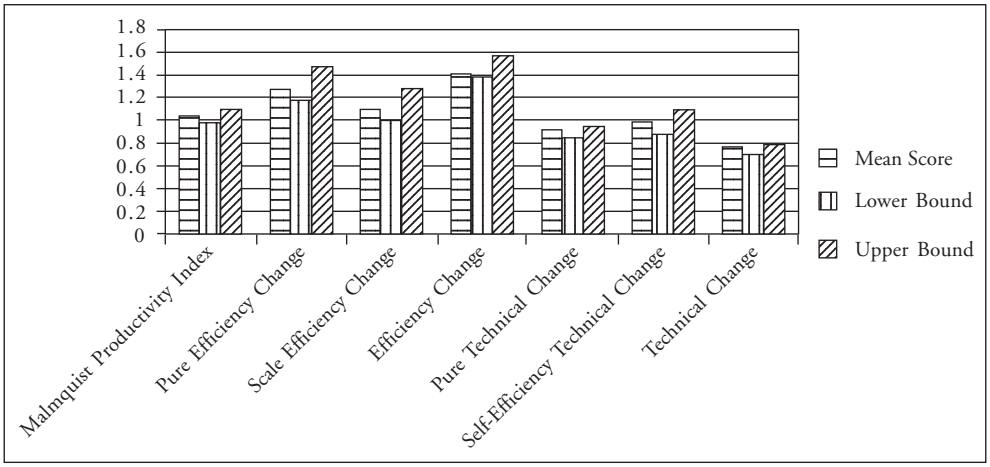
In the present context, computation of efficiency has been made without considering the fact that during the period under consideration, the frontier itself might have shifted due to technological change. As indicated earlier, the computation of Malmquist productivity index along with its component enables us to understand how productivity change has been influenced by its two major constituents: change in efficiency and change in the frontier itself. Table-5 provides the mean bias-corrected scores relating to the index and its components (and sub-components) for the entire period under consideration. The insurer-wise estimates are available in appendix Tables-A3 to A8.

Table-5 : Bias-Corrected Productivity Scores Over the Period Under Observation

Productivity Measure	Mean Score	Lower Bound	Upper Bound
Malmquist Productivity Index	1.0450	0.9849	1.0985
Pure Efficiency Change	1.2718	1.1777	1.4802
Scale Efficiency Change	1.0982	1.0112	1.2907
Efficiency Change	1.4147	1.3997	1.5629
Pure Technical Change	0.9308	0.8439	0.9498
Scale Efficiency of Technical Change	0.9877	0.8888	1.0994
Technical Change	0.7838	0.7176	0.7966

Source : Calculated.

Figure-2 : Point and Interval Estimates of Productivity Indicators



Concluding Observations

The present paper made use of two inter-temporal approaches for the estimation of insurer performance over the five year span 2009-10 to 2013-14. Initially we have assumed that there is no technical change during the period under consider and treat each insurer in a particular year as a distinct decision-making unit. The window approach to efficiency analysis reveals that during the period under consideration, mean efficiency scores have improved implying that the insurance companies have reached closer to the frontier.

However, we have assumed that the production technology is local and thus from the estimation process, we are unable to get any information about scale efficiency. Thus, in the next stage, we have computed returns to scale on the basis of panel data. The outcomes indicate that most of the insurers are not operating at the optimal scale and the proportion of insurers exhibiting decreasing returns to scale has increased over the observation period.

The window analysis is silent about technical progress/regress and for ascertaining total factor productivity changes, we have estimated Malmquist productivity index and its efficiency and technical change components. The results indicate that while the insurers witnessed positive efficiency shifts during the period, technical change has been on the negative direction. Decomposition of efficiency change in to pure and scale components indicate that the pure efficiency change factor is the dominant one. However, the decomposition of technical change leads to the infeasibility problem for six out of the 15 in-sample general insurers and no

conclusion should be drawn on the basis of the truncated sample.

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Appendix

Table-A1: Efficiency Performance of the In-Sample General Insurers

Insurer	2010	2011	2012	2013	2014
Bajaj Allianz	0.6783	0.8279	0.8353	0.828185	0.847435
Bharti AXA	0.5847	0.3860	1	1	0.954402
Cholamandalam	0.5641	0.5684	0.769548	0.849898	0.878305
Future Generali	0.5580	0.4498	0.999999	1	1
HDFC Ergo	0.7319	0.7273	0.909503	0.836035	0.902241
ICICI Lombard	0.9413	1	1	0.966219	0.972695
IFFCO Tokio	0.8206	1	0.955501	0.8396	0.835531
Reliance	0.7150	0.7871	1	1	1
Royal Sundaram	0.6104	0.6536	0.739913	0.928925	0.861348
Shri Ram General	1	1	1	1	1
Tata AIG	0.5228	0.5640	0.752072	0.754029	0.758194
National	0.7442	0.9388	0.942914	1	0.961148
New India	1	1	1	1	1
Oriental	0.9894	0.8749	0.962079	0.943038	1
United	1	1	1	0.986481	1

Source : Calculated.

Table-A2 : Insurer-wise Returns to Scale for the In-Sample Years

Insurer	2009-10	2010-11	2011-12	2012-13	2013-14
Bajaj Allianz	Decreasing	Decreasing	Decreasing	Decreasing	Decreasing
Bharti AXA	Decreasing	Increasing	Decreasing	Decreasing	Decreasing
Cholamandalam	Increasing	Decreasing	Decreasing	Decreasing	Decreasing
Future Generali	Increasing	Increasing	Increasing	Decreasing	Decreasing
HDFC Ergo	Increasing	Decreasing	Decreasing	Decreasing	Decreasing
ICICI Lombard	Decreasing	Decreasing	Decreasing	Decreasing	Decreasing
IFFCO Tokio	Decreasing	Constant	Decreasing	Decreasing	Decreasing
Reliance	Decreasing	Decreasing	Decreasing	Decreasing	Decreasing
Royal Sundaram	Decreasing	Decreasing	Decreasing	Decreasing	Decreasing
Shri Ram General	Constant	Increasing	Increasing	Constant	Constant
Tata AIG	Decreasing	Decreasing	Decreasing	Decreasing	Decreasing
National	Decreasing	Decreasing	Decreasing	Decreasing	Decreasing
New India	Decreasing	Decreasing	Decreasing	Decreasing	Decreasing
Oriental	Decreasing	Decreasing	Decreasing	Decreasing	Decreasing
United	Decreasing	Decreasing	Decreasing	Decreasing	Decreasing

Source : Calculated.

Table-A3 : Bias Corrected Estimates of Mean Productivity, Efficiency and Technical Change

Insurer	Malmquist Productivity	Efficiency Change	Technical Change
Bajaj Allianz	1.1734	1.1995	0.9116
Bharti AXA	1.0715	3.3732	0.3567
Cholamandalam	1.1803	1.6273	0.7172
Future Generali	1.0475	2.0312	0.5598
HDFC Ergo	0.9755	1.3574	0.7481
ICICI Lombard	0.9227	0.9760	0.8717
IFFCO Tokio	1.0045	1.0231	0.8778
Reliance	1.2297	1.4191	0.8056
Royal Sundaram	1.1549	1.3595	0.7718
Shri Ram General	0.1577	0.9025	0.1815
Tata AIG	1.1698	1.6158	0.7340
National	1.0282	1.1878	0.7718
New India	1.0063	1.0080	0.8692
Oriental	0.7770	0.9492	0.7463
United	0.8737	0.9660	0.8404

Source : Calculated.

Table-A4 : Bias Corrected Estimates of Mean Efficiency and Technical Change Components

Insurer	Pure Efficiency Change	Scale Efficiency Change	Pure Technical Change	Scale Efficiency of Technical Change
Bajaj Allianz	1.1569	0.9591	0.9119	0.9551
Bharti AXA	1.5514	1.8563	NA	NA
Cholamandalam	1.4968	1.0079	NA	NA
Future Generali	1.5185	1.1066	NA	NA
HDFC Ergo	1.1687	1.0524	NA	NA
ICICI Lombard	0.9703	0.9258	0.8474	0.9593
IFFCO Tokio	0.9547	0.9986	0.9109	0.9414
Reliance	1.2683	1.0000	0.8185	0.8570
Royal Sundaram	1.3506	0.9377	0.6926	0.9788
Shri Ram General	0.9025	1.0000	NA	NA
Tata AIG	1.4080	1.0000	NA	NA
National	1.1677	0.8270	0.8402	0.8442
New India	0.9194	0.7855	0.9873	0.6854
Oriental	0.9221	0.8821	0.7434	0.9224
United	0.9097	0.8296	0.8430	0.8553

Source : Calculated.

Table-A5: Bias Corrected Lower Bounds of Productivity, Efficiency and Technical Change

Insurer	Malmquist Productivity	Efficiency Change	Technical Change
Bajaj Allianz	1.1734	1.1995	0.9116
Bharti AXA	1.0715	3.3732	0.3567
Cholamandalam	1.1803	1.6273	0.7172
Future Generali	1.0475	2.0312	0.5598
HDFC Ergo	0.9755	1.3574	0.7481
ICICI Lombard	0.9227	0.9760	0.8717
IFFCO Tokio	1.0045	1.0231	0.8778
Reliance	1.2297	1.4191	0.8056
Royal Sundaram	1.1549	1.3595	0.7718
Shri Ram General	0.1577	0.9025	0.1815
Tata AIG	1.1698	1.6158	0.7340
National	1.0282	1.1878	0.7718
New India	1.0063	1.0080	0.8692
Oriental	0.7770	0.9492	0.7463
United	0.8737	0.9660	0.8404

Source : Calculated.

Table-A6 : Bias Corrected Upper Bounds of Productivity, Efficiency and Technical Change

Insurer	Pure Efficiency Change	Scale Efficiency Change	Pure Technical Change	Scale Efficiency of Technical Change
Bajaj Allianz	1.1569	0.9591	0.9119	0.9551
Bharti AXA	1.5514	1.8563	Infeasible LP	Infeasible LP
Cholamandalam	1.4968	1.0079	Infeasible LP	Infeasible LP
Future Generali	1.5185	1.1066	Infeasible LP	Infeasible LP
HDFC Ergo	1.1687	1.0524	Infeasible LP	Infeasible LP
ICICI Lombard	0.9703	0.9258	0.8474	0.9593
IFFCO Tokio	0.9547	0.9986	0.9109	0.9414
Reliance	1.2683	1.0000	0.8185	0.8570
Royal Sundaram	1.3506	0.9377	0.6926	0.9788
Shri Ram General	0.9025	1.0000	Infeasible LP	Infeasible LP
Tata AIG	1.4080	1.0000	Infeasible LP	Infeasible LP
National	1.1677	0.8270	0.8402	0.8442
New India	0.9194	0.7855	0.9873	0.6854
Oriental	0.9221	0.8821	0.7434	0.9224
United	0.9097	0.8296	0.8430	0.8553

Source : Calculated.

Table-A7 : Bias Corrected Upper Bounds of Productivity, Efficiency and Technical Change

Insurer	Malmquist Productivity	Efficiency Change	Technical Change
Bajaj Allianz	1.2798	1.3895	1.0259
Bharti AXA	1.4066	3.6739	0.3603
Cholamandalam	1.3277	1.7339	0.7666
Future Generali	1.2879	2.1445	0.5691
HDFC Ergo	1.1201	1.4238	0.7772
ICICI Lombard	1.0087	1.1019	0.9892
IFFCO Tokio	1.0829	1.2018	1.0164
Reliance	1.3276	1.5888	0.9051
Royal Sundaram	1.2176	1.5248	0.8732
Shri Ram General	0.2277	1.2317	0.1905
Tata AIG	1.2955	1.6564	0.7735
National	1.0672	1.3604	0.8797
New India	1.0615	1.2304	1.0295
Oriental	0.8296	1.0666	0.8483
United	0.9368	1.1157	0.9453

Source : Calculated.

Table-A8 : Bias Corrected Upper Bounds of Productivity, Efficiency and Technical Change

Insurer	Pure Efficiency Change	Scale Efficiency Change	Pure Technical Change	Scale Efficiency of Technical Change
Bajaj Allianz	1.4253	1.1701	1.0088	1.0623
Bharti AXA	1.8384	2.4302	Infeasible LP	Infeasible LP
Cholamandalam	1.7342	1.2010	Infeasible LP	Infeasible LP
Future Generali	2.3082	1.2932	Infeasible LP	Infeasible LP
HDFC Ergo	1.3577	1.2320	Infeasible LP	Infeasible LP
ICICI Lombard	1.1598	1.1213	0.9584	1.0982
IFFCO Tokio	1.1421	1.1109	1.0029	1.0308
Reliance	1.5826	1.2889	0.9293	1.0009
Royal Sundaram	1.5708	1.0794	0.8335	1.1338
Shri Ram General	1.2317	1.0000	Infeasible LP	Infeasible LP
Tata AIG	1.5970	1.3314	NA	NA
National	1.5841	1.2163	0.8925	1.1425
New India	1.2792	1.4015	1.1955	1.1465
Oriental	1.1383	1.2693	0.8024	1.1358
United	1.2534	1.2149	0.9247	1.1442

Source : Calculated.

The Journal of Institute of Public Enterprise, July-Dec, Vol. 42, No. 2
ISSN : 0971-1864, © 2019.

Impact of Privatisation on the Performance of the Divested Firms : Appraisal of Empirical Studies

Jugal Kishore Mohapatra*

Privatisation of State-owned enterprises (SOEs) has evolved as a major tool of economic policy since 1980s across the globe – both in the developed as well as developing countries. This trend has continued even during the more recent period with record levels of revenues raised from privatisation during 2015 and 2016. To a large extent, governments committed to diverse political ideologies have taken recourse to privatisation with the expectation that change of ownership of these enterprises would, inter-alia, bring about significant improvement in their financial and operating performance, and raise their productivity and efficiency. Has privatisation indeed led to substantive and significant improvement in the performance of the divested SOEs? An attempt has been made in this survey to review and synthesise the evidence provided by forty-six seminal empirical studies which have investigated the impact of privatisation on the performance of the divested enterprises using univariate and multivariate analysis, parametric and non-parametric methods. Based on the appraisal of these studies, key methodological issues and takeaways have been summarised. One of the significant learning's from these studies is that privatisation per se does not automatically lead to improvement in the performance of the divested enterprises. Post-privatisation performance of these firms may be significantly contingent on contextual, institutional and organisational factors.

Keywords : Privatisation, State-owned Enterprises, Financial and Operating Performance, Efficiency.

1. Introduction : The Context

Privatisation broadly "considered as any material transaction by which State's ultimate ownership of corporate entities is reduced"[1] – has evolved as a significant and major tool of economic policy since 1980s across the globe-both in the developed and developing countries- cutting across governments of diverse ideological hues and stripes. Though the conservative Government led by the 'Iron Lady' – Mrs.Thatcher – in UK is commonly reckoned as the

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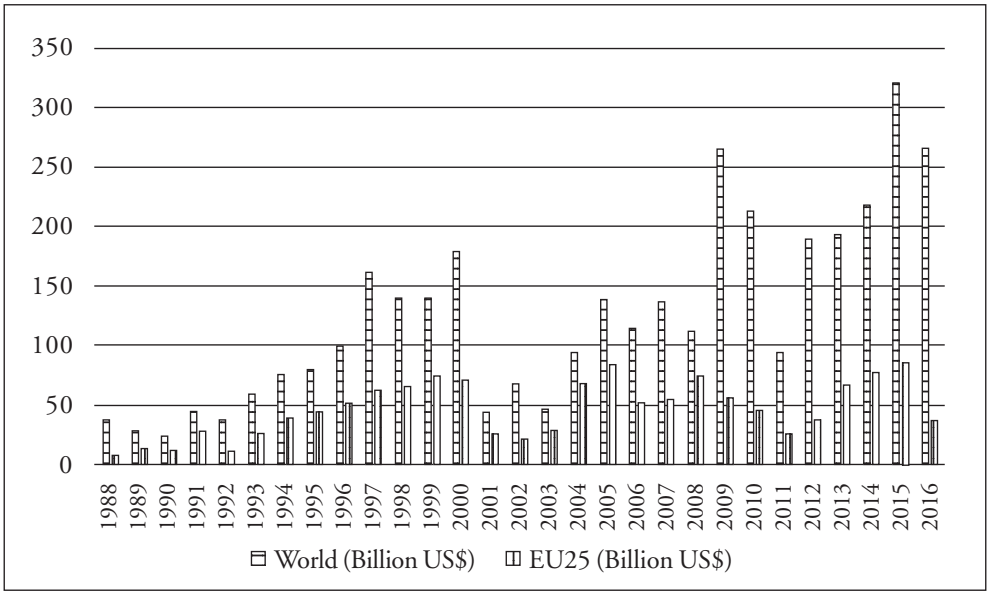
torch-bearer of this trend, it should be noted that the first ideologically driven large-scale 'de-nationalisation' programme was indeed launched by Konrad Adenauer's government (Megginson et al., 1994) in the erstwhile Federal Republic of Germany (FRG) in the early 1960s – kick started by the sale of majority stake in Volkswagen through a public share issues in 1961, followed by an even larger secondary share issue for VEBA in 1965. However, admittedly the 'tipping-point' tilting the political and ideological landscape in favour of privatisation was triggered by Mrs. Thatcher's programme of divestiture of the British State-Owned Enterprises (SOEs) during the decade of 1980s. Her privatisation programme was not only viewed as audacious in terms of size at that point in time; it was also considered as bold in terms of scope as well – covering diverse sectors of the economy including the core sectors and covering enterprises operating under both competition and monopolistic regimes. During the period of her premiership, over 50 companies were reportedly privatised-including many in the power and water industries – which generated more that £50 billion for the Exchequer[2].

Following the path charted by Thatcher's Britain, the next major country to embrace a sizeable privatisation programme was France under Jacques Chirac. The French programme is also remarkable since it constituted a structural break in the country's long standing *'dirigiste'* tradition of pervasive state intervention. Over a brief period of 15 months during 1986-87, the Chirac government divested 22 large companies worth $12 billion (MNR, 1994). After 1987, adoption of privatisation programmes gained momentum and traction across the world, particularly in the developing economies of South America, Africa and Asia.

This global trend of divestitures of SOEs has continued even during the first and second decade of the 21st century notwithstanding the world-wide financial crisis in 2008. According to the Privatisation Barometer Report 2015/16 (PBR 2015/16) the total proceeds of privatisation revenue during 1988-2016 was of the order $3.634 trillion[3].

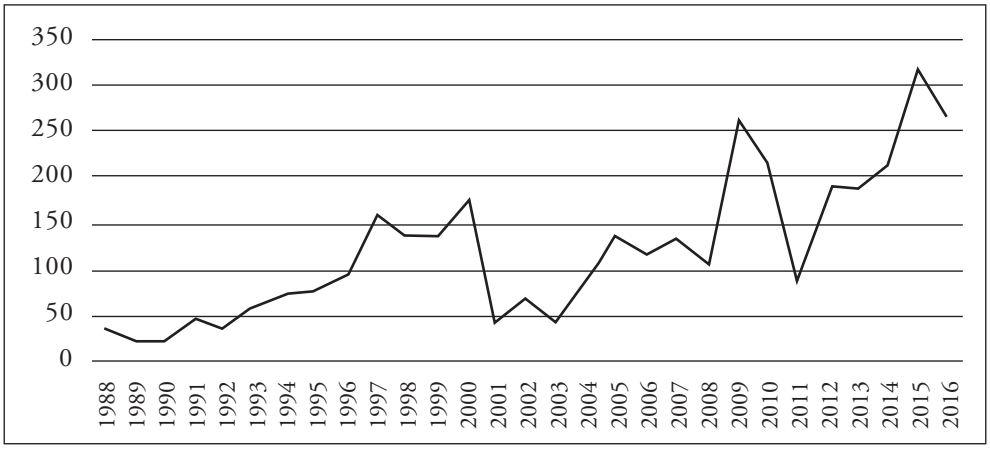
This report also brings out three distinct and significant emerging trends. First, the fraction of privatisation revenue raised by EU governments in the world-wide totals significantly declined from its long-run average of about 37.5 per cent to an all-time low of 14.1 per cent. Secondly, for the first time the amount raised by governments through privatisation sales worldwide reached a record level in 2015 exceeding the $300 billion mark, shattering the previous high of $265.2 billion in 2009. Notably,

Figure-1 : Worldwide Privatisation Revenue



Source : Privatisation Barometer Report 2015/2016.

Figure-2 : Worldwide Privatisation Revenue (Billion US$)



Source : Privatisation Barometer Report 2015/2016.

the global value of privatisation in 2016 – $266.4 billion- is the second highest on record. These record levels of divestiture revenues during the latest two years is a pointer towards continuing momentum of privatisation globally – though its geographical coverage in terms of size and scope has not remained

unaltered. Third, China has emerged as the leading privatising country during both the years in 2015 and 2016. China executed 297 sales of at least $50 million – 45 of which raised $1billions plus each - and raised a staggering $173.2 billion during 2015 and 276 sales in 2016 (32 worth $1 billion+ each) raising $148.0 billion. China alone has mobilised nearly 55 per cent of the global revenue from privatisation during 2015/16.

Besides China, major economies of the Organisation for Economic Co-operation and Development (OECD) including United States, Canada, Japan and Australia as well as developing countries like India and Malaysia have also resorted to privatisation on a substantial scale during 2015/16. Ranking of the top ten countries in terms of the scale of privatisation during these two years is shown in Table-1.

As regards the future outlook of divestiture in 2017 and later years, the PBR 2015/16 notes that seven national programmes – China, Australia, Russia, Turkey, India, Pakistan and Japan – stand out either in terms of aggregate size, scope or both. Closer home, in India, emphatic announcement by the Union Finance Minister in her speech presenting

Table-1 : Ranking of Countries by Total Privatisation Revenues 2015 and 2016

Rank	2015 Country	No. of Deals	Value ($million)	2016 Country	No. of Deals	Value ($ million)
1.	China	297	173,303	China	276	148,047
2.	United Kingdom	13	34,779	Australia	5	25,705
3.	Italy	11	12,383	France	9	9,596
4.	Japan	3	11,947	India	35	7,393
5.	India	34	11,358	Netherlands	4	7,099
6.	Sweden	6	9,114	Malaysia	11	5,330
7.	Australia	5	8,590	Italy	3	4,878
8.	United States	6	8,230	Canada	3	4,271
9.	Netherlands	3	6,208	Japan	2	4,145
10.	Ireland	6	5,712	Greece	4	2,72
	2015 World Total	468	319,895	2016 World Total	434	266,389

Source : Privatisation Barometer Report 2015/2016.

the Union Budget for the financial year (FY) 2019-20 that "strategic disinvestment of select CPSEs would continue to remain a priority of this government" and "in view of the current macro-economic parameters, government would not only reinitiate the process of strategic disinvestment of Air India, but would offer more CPSEs for strategic participation by the private sector" has signalled a stronger intent of the government to mount a much bolder privatisation programme than witnessed over the preceding decade[4]. All these trends suggest that privatisation has neither lost its stream nor its relevance and acceptability as a public policy option.

Why have governments committed to varied political ideologies display such continued and sustained zeal for privatisation? What are the principal motivating factors underlying this phenomenon? While privatisation revenues – raised through sale of assets and shares of SOEs – does alleviate the fiscal deficit of the government and reduce the public sector borrowing requirements, arguably the overarching goal of almost all privatisation programme has been the desire to improve the efficiency of these enterprises. Has privatisation, indeed, led to substantive improvement in the performance of the divested SOEs? Does it lead one-off performance improvement or the resultant efficiency gains are sustained over time? Does the extent of efficiency improvement depend on the extent of privatisation, i.e. majority or partial stake sale? Does the impact of privatisation on the performance of the divested SOEs depend on business cycles, external macro-economic factors and other exogenous policy changes? What happens to employment in the privatised SOEs?

Though there is a fairly large repository of firm-level empirical studies which have explored the issues raised above, their findings are not unequivocal and found to be at variance and inconsistent even in respect of some focal thematic issues. Only a handful of surveys have attempted to critically analyse and synthesize findings of these studies to glean a broad measure of consensus on some more generic and contextual conclusions relating to the effects of privatisation on the performance of the divested SOEs. Megginson and Netter (2001), the first major survey in this research area and arguably the most widely cited too, largely covers empirical studies of privatisation in the developed and middle income countries during the period 1980-2000. This is, of course, understandable and unexceptionable given the fact that few studies relating to the developing countries were available at that point of time. Guriev and Megginson (2007) is more inclusive in terms of its coverage of the less developed countries, particularly of Latin

America and transition economies; but even their survey is restricted to the analysis of evidence from enterprise level studies up to 2002-03. Estrin et al. (2009) assesses findings of studies relating exclusively to the transition economies of Central Europe (CEE), Common wealth of Independent States (CIS) and China covering the period 1989-2006. Estrin and Pelletier (2018), evaluates more recent firm level studies of privatisation mainly in the developing countries, though it is restricted in respect of its sectoral focus having covered only the regulated sectors of banking, telecommunications and utilities.

The present survey seeks to build on the evidence and findings of the previous surveys and contribute to the research in this area in the following respects. First of all, it has attempted a more representative and comprehensive coverage of the empirical studies relating to the developed, developing and transition economies. Secondly, in terms of time period of coverage, studies from the mid-1990s up to more recent years have been included in this survey. Thirdly, methodological issues relating to the firm level empirical studies of privatisation have been discussed more exhaustively in this paper including a critical appraisal of the different methodological approaches used in the studies.

This paper seeks to present and critically appraise salient findings of a set of forty-six empirical studies which have researched –relying on credible empirical evidence and using dependable methodology – how ownership change, through privatisation, affects "performance" of the divested enterprises.Remainder of the paper is organised as follows. Section-2 contains a brief discussion of the alternate theories of privatisation which seek to explain the superior efficiency of private/privatised enterprises vis-à-vis public ownership. Section-3 describes the typology of empirical studies on the impact of privatisation on the performance of the divested enterprises which have been covered in this survey. It also contains salient findings of the studies and a discussion of the methodological issues germane to these empirical studies. Section-4 summarises the key takeaways from these studies and Section-5 concludes.

Section-2 : Privatisation : Theoretical Foundations

Since privatisation has been pursued as a tool of economic policy by countries across the globe, a logical and obvious question that arises is whether it has robust theoretical foundations in mainstream economics which explain why and how transfer of ownership of SOEs to the private sector fosters superior productive and allocative efficiency.

Theoretical studies that have examined the comparative efficiency of private versus public ownership of firms can be broadly subsumed under three distinct approaches[5]:

1) "Agency / Property Rights Theory"

2) "Public Choice Theory"; and

3) "Organisation Theories".

Each of these approaches, though divergent in their *premises* and analytical perspective, seek to provide alternative explanations for a commonly agreed proposition that private firms perform more efficiently that the SOEs.

The 'Agency Theory' identifies divorce of ownership from control as the root cause of comparative inefficiency of the SOEs. Though it is assumed, under this theoretical construct, that 'managers' (the agent) of both private and public firms, maximise of their own utility instead of utility of the owners/shareholders of the firm (the principal); for the private firms existence of the following external, market based mechanisms mitigate this conflict of interest and hold the managers (the agents) accountable for their performance:

i) Market for ownership rights which provides an exit option/window to the owners to divest their stakes in case they are dissatisfied with the managers' performance;

ii) The threat and risk of bankruptcy; and

iii) A labour market for managers.

In contrast, SOEs do not have recourse to any of these performance-risk mitigating mechanisms. Managers of these enterprises do not have to suffer the economic consequences of their decisions as a result of which they have very weak incentives to reduce economic waste (overstaffing, excessive compensation packages and redundant or over-investment) and maximise profitability. Presence of 'soft budget constraints' also implies that for the SOEs the bankruptcy risk virtually does not exist. Furthermore, in contrast to the private firms which have a 'simple' and direct principal-agent relationship, SOEs have to contend with layers of intermediate agencies intervening between "the principals" (i.e. the public) and "the ultimate agents" (i.e. the managers of SOEs), including elected politicians, ministers and nominated boards. Unsurprisingly, the managers (the 'bureaucrats in business' as agents) have a significant informational advantage vis-à-vis their owners on account of this information asymmetry. This may lead not only to the problem of adverse selection of the agents; owners of the SOEs would also have to face the problem of moral hazard and inhibited from effective, concurrent monitoring

of the conduct and behaviour of the managers. Thus, the structural and operating environment of the SOEs do not create appropriate incentives and disincentives to enforce accountability and to induce the managers to optimize their performance.

The main thrust of the *public choice theories* is that politicians and bureaucrats/managers primarily seek to maximise their "self-interest" instead of "public interest", for instance, their job security, career advancement, and higher compensation packages. Their self-seeking conduct led to more expansive budgets, excess staffing and over-supply of public output, entailing wastage and higher losses, thereby significantly impairing the enterprise efficiency. The politicians tend to impose goals on the State-owned firms that may maximise their electoral clientele; though these may adversely impact the firms' efficiency. For instance, this may protect and promote the interest of some stakeholders irrespective of its cost implications. For the citizens, who are "the ultimate owners" of the public enterprises, the costs of monitoring the behaviour of the "agents" may exceed the consequential benefits (such as lower taxes or more efficient public expenditure). The essence of this theoretical approach is captured and demonstrated in a simple but elegant model in Boycko, et.al. (1996) in which a firm is required to choose only its level of expenditure on labour 'E'. It has the option of spending an efficient amount- 'L' or a higher amount 'H' (H> L). The key parameter in this model is who 'decides' and 'controls' the level of labour spending. It is fair and reasonable to assume that in a firm that is publicly owned and controlled, 'E' would be chosen by the politician. This assumption is realistic for the SOEs, since the government exercise significant influence over their major decisions, particularly politically sensitive ones concerning employment. When the politician controls 'E', axiomatically he would set E=H, since the marginal political benefits additional spending on labour exceed the marginal political costs in terms of profits foregone by the treasury from such spending. In this way, this simple model demonstrates that political control is likely to cause inefficiencies which promote the politicians' goals to the detriment of the public exchequer and other stakeholders.

Organisation theories draw extensively from both the above theories and highlight the organisational features of the private firms which are different in SOEs such as incentives and disincentives, systems of internal controls, cultural factors, organisational structures, communications / reporting systems.

All the three theoretical approaches, thus essentially argue that public and private firms are distinct in conduct and performance because of the fundamental difference in their operating environment and incentive mechanisms in the face of information asymmetry and incomplete information.

Though a detailed critique of these theories, which have evolved in the context of the institutional land scape of the developed market economies, is beyond the scope of this paper; it is pertinent to offer some comments regarding their applicability and relevance to the less developed countries and emerging market economies. In an influential paper Dharwadkar, et al. (2000) have argued that both 'internal and external control mechanisms' (weak governance and limited protection of minority shareholders) are likely to exacerbate the 'agency problems' in the emerging economies. Hence privatisation of SOEs without addressing these risks regulatory reforms of the corporate governance, capital market, corporate bankruptcy and mergers and acquisition processes might not deliver the anticipated efficiency gains. As regards the public choice theory, it needs to be mentioned that the public accountability mechanisms are likely to be far weaker in the developing countries. Their enforcement capacity is also likely to be constrained. Besides, SOEs in these countries are more likely to be driven by political mandates than the objective of maximising returns to the shareholders and hence, less likely to be subjected to 'hard budget constraints'. In such a scenario, privatisation can be expected to improve performance of the firms provided, of course, the private sector itself is functioning in a well regulated ecosystem and not distorted by market failures. The approach of the 'organisation theories', being somewhat more generic in nature, possibly has as much validity tor the firms in the emerging markets as those in the developed countries. To sum up, these theoretical approaches do tend to conditionally favour a case for divestiture even in the developing countries contingent upon the risks flagged therein are mitigated through appropriate institutional and organisational reforms.

Section-3 : Privatisation and Performance : Methodology and Salient Findings

3.1 Typology of Empirical Research

3.1.1 However logical and persuasive the theoretical studies assessing the relatively superior efficiency of the private ownership may be, validity and generalizability of such hypotheses can only be tested through rigorous empirical research. It is worth recalling an oft-cited observation of Laffont and Tirole (1993) in this context who,

after presenting their analysis of public and private ownership in stimulating efficiency, came round to the view that "theory alone is thus unlikely to be conclusive in this respect".

3.1.2 In the literature we come across two broad strands of empirical research using eco-matric methods which has addressed the question whether privatisation improves performance and efficiency of the divested SOEs. The first set of studies examine firm level impact of privatisation on the performance of the divested enterprises on the basis of empirical evidence in a multi-country, multi-sectoral framework. The other stream of empirical research examines the enterprise level impact of privatisation on efficiency in a single country and these studies are also mostly multi-sectoral. Publication of these studies started around mid-90s since adequate number of privatised firm level observations from a cross-section of developed as well as developing countries were available for rigorous econometric analysis and statistical testing.

3.1.3 For the purpose of this study, we have selected as many as 46 such studies, of which 33 are country-specific and 13 are multi-country studies (including one study that has used case study approach[6]). The studies which have used econometric methods can be further categorized into distinct types based on the methods used : whether they have used univariate or multivariate methods, and whether they have used parametric or non-parametric methods. The following Tables-1A and 1B indicate the broad classification of the studies in terms of these filters.

Table-1A : (Typology of Empirical Studies)

Coverage	Univariate Analysis	Multivariate Analysis	Both	Total
Multi-County Studies	5	4	3	12
Single Country Studies (India)	6(1)	12(3)	15(5)	33(9)
Total	11(1)	16(3)	18(5)	45(9)

Table-1B : (Typology of Empirical Studies)

Coverage	Parametric Method	Non-parametric Method	Both	Total
Multi-Country Studies	4	5	3	12
Single Country studies	15(8)	6(0)	12(1)	33(9)
Total	19(8)	11(0)	15(1)	45(9)

Note : One single country study has not used either parametric or non-parametric tests.
Figures in the parentheses show the type of method used in studies relating to India.

3.1.4 Studies which have used univariate analysis largely follow the methodology pioneered by Megginson et. al. (1994) – hereinafter "MNR (1994)" – which is based on comparison of pre- and post-privatisation 'averages' (computed usually for 3-5 pre-privatisation years and equal or more number of post-privatisation years) of selected performance proxies. Statistical significance of the differences in these averages is tested by applying parametric or non-parametric tests. Studies relying on multivariate analysis have used multivariate regression (OLS, Panel data regression methods -24 studies) and Data Envelopment Analysis (DEA-5 studies).

3.1.5 As many as 18 studies covered in the survey have used both univariate and multivariate analysis and 15 studies have used both parametric as well as non-parametric methods. It may also be mentioned that the studies included in the survey provide adequate representation to the privatisation programmes of both the developed and developing countries including three large multi-country studies covering the transition economic of Eastern and Central Europe. Since China has emerged as the leading country in terms of its scale of privatisation in the recent years, three country-specific studies of China have been included. As far as India is concerned, 9 studies have been included purposively, since in our considered view this has so far been a relatively under-researched area. An attempt has been made to cover possibly all the major papers published in the top-tier journals which have empirically researched the effects of privatisation on the performance of the divested firms.

3.2 *Salient Findings of the Empirical Studies*

3.2.1 Synopsis of the salient findings of the multi-country and single country empirical studies of privatisation, covered in this survey, have been presented in respectively, along with the sample description, period analysed and methodology used. The overall picture that emerges from these studies is fairly mixed as indicated in Table-2.

Table-2 : Overall Findings of Empirical Studies

Overall Findings	Multi-Country Studies	Single Country Studies	Total
Supportive	8	12	20
Not Supportive	1	6	7
Partially Supportive/Mixed/ Inconsistent findings	4	14	18
Total	13	32	45

It would be hard to categorically and unequivocally claim or assert, on the basis of the conclusions derived by these studies, that privatisation of SOEs *per se* – through transfer of ownership and management control, brings about statistically significant efficiency improvements in the divested entities. That said, however, these empirical studies do bring out emphatically the need for the complementary institutional reforms and policy action to be pursued alongside privatisation in order to achieve the desired efficiency outcomes.

3.2.2 Significant divergences among the empirical studies of privatisations motivated Bachiller (2017) to carry out a meta-analysis of 60 studies published during 1989-2014; the sample covering 48 countries for the period 1961-2010. The study examined whether the method of privatisation and the level of development of the country of the privatised enterprises can explain variance in the "financial performance" of the privatized SOEs. Results of the meta regression analysis indicated that the method of privatisation (whether divested through initial public offer- IPO- or through other methods) significantly determines the performance of the privatised companies. Besides, the results contradicted the more commonly held assumption that privatisation of SOEs in the developing countries does not improve their financial performance.

3.2.3 Estrin and Pelletier (2018) have reviewed fifteen recent papers on the economic effects of privatisation on the efficiency and performance of the firms in the developing countries. Studies included in this paper have analysed evidence of the impact of privatisation in three sectors – banking, telecommunications and utilities- using single or cross-country samples. The overall conclusion of this survey also reconfirms the proposition that transfer of ownership by itself is unlikely to yield the expected efficiency gains and the impact of privatisation could well be more context and sector-specific contingent, inter alia, on the following factors :

- Selection effect- i.e. selection of the firms for stake sale.
- Extent of privatisation- total or partial. Evidence from the studies included in their survey provides evidence that the effect of total privatisation is likely to benefit more in terms of efficiency gains.
- Quality and effectiveness of the regulatory framework, which is largely dependent on the prevailing political and institutional setting.
- Competitiveness of the market structure and existence of institutional mechanisms to promote and enforce effective competition.

3.3 *Methodological Issues in Empirical Studies of Privatisation*

3.3.1 Assessment of effects of privatisation on enterprise performance through empirical studies poses a complex set of methodological issues. First of all, for determination of the effect of the ownership change, we need to have the right 'control group' comprising of entities similar in all respects to the 'treatment group' – i.e. the sample of privatised SOEs – but which were not subjected to the policy intervention being investigated (which in this case is privatisation). How do we identify the most appropriate 'control group'? Should we take the same set of SOEs 'before' privatisation as the 'control group', as has been done in a number of studies based on MNR (1994) methodology, or identify firms having similar economic characteristics – matched at least in terms of relevant, major parameters – from the SOE sector or from the private sector? In case we opt for the latter,should we identify the firms to be included in the 'control group' on the basis of simple and straight forward comparison of the descriptive statistics or should we take recourse to more advanced techniques like Propensity Score Matching (PSM)? Thus, figuring out what would have happened to the sample SOEs, had they not been privatised, is arguably complex and problematic. Secondly, which performance indicators/proxies should be used for evaluating the effects of privatisation? Should we use the conventional accounting measures of financial and operating efficiency – which are partial measures- or should we use more comprehensive measures of productivity – such as 'multi-factor productivity' (MFP) or 'technical efficiency' (TE)? In case we opt for the partial accounting measures, we again have to decide which are the 'right' or 'most appropriate' set of indicators or proxies. In this context, we also need to recognize that even at a conceptual level the objective function of the SOEs is assumed to be less profit-oriented and more tilted towards non-profit goals; whereas enterprises under private ownership are more likely to maximize profits and returns to the shareholders. Given this fundamental premise, would it be appropriate to assess the enterprise performance – "before and after divestiture"- on the basis of changes in profitability? Would it not favour privatisation *abinitio* if non-profit objectives, such as lower prices, or higher employment were being deliberately pursued under state ownership? Thirdly, privatisation may affect 'allocative efficiency' and even income distribution besides the 'productive or technical efficiency' of the firms by changing the relative prices both in the output as well as input markets. As

such, it may have spill over effects on the rest of the economy which is why assessment of its impact can be ideally carried out in a general equilibrium model. However, setting up General Equilibrium (GE) models is enormously complex requiring humongous economy wide data on a huge set of variables. Unsurprisingly, therefore, few empirical studies of privatisation have relied on economy wide GE models[7]. Fourthly, how to determine the direction of causality in assessing the relationship between privatisation and performance? Just as there are studies to show that privatisation impacts enterprise performance; there are also studies which show that better enterprise performance makes a firm more attractive and likely candidate for divestiture. As such, can we *a priori* rule out 'simultaneous causality' and 'endogeneity' of privatisation? If not, how do we handle this problem in the empirical investigation? Fifthly, even the policy announcement of privatisation of a SOE may spur intense internal effort, within the firm, including its financial and HR restructuring, to improve its performance. It is also not unlikely that the momentum of improved performance, generated by these efforts prior to the privatisation, may continue even after divestiture. In such a scenario, do we treat the observed improvement in performance after privatisation as the 'privatisation effect' or as the 'announcement effect'? In reality, the situation may be even more complex. The observed change in the enterprise performance after divestiture may be a combination of these two effects. In that case, we have to find out whether careful and diligent efforts have been made in the empirical study to decompose these effects.

Finally, more often than not, privatisation is not a 'stand-alone' reforms. Governments pursuing privatisation programmes simultaneously resort to a whole range of key policy changes – particularly in the developing countries- such as de-regulation, trade liberalization, promoting competition, strengthening corporate governance, setting up regulatory regimes for non-competitive enterprises and freer capital movement. The observed performance change in the divested enterprises cannot, in such a scenario, be simply or solely attributed to the ownership change. These exogenous, structural policy changes and business cycles are likely to affect the enterprise performance, both independently and also by interacting with the ownership change. How do we precisely quantity the effects of privatisation by factoring out the effects of the above mentioned exogenous policy changes and macroeconomic changes?

3.3.2 Empirical studies reviewed in this paper cover diverse geographies and different time periods, based on a wide array of methodologies. Not surprisingly, their conclusions differ. What is more important from our perspective is how robust are the methodologies used to arrive at these conclusions. The most widely used univariate analysis in empirical studies of privatisation – MNR (1994) methodology – is vulnerable to selection bias and does not adequately control the effects of concurrent and exogenous macroeconomic and policy changes as well as institutional developments. In addition, this type of analysis does not capture the trend of performance improvement which is often observed after the announcement of privatization, even before its actual execution. Treating the sample SOEs before privatisation as the 'control group', without sufficiently controlling for these factors, might not, therefore, yield unbiased estimates of the efficiency effects of privatisation. Some, studies, based on this metho-dology, have, however, sought to mitigate these deficiencies by using 'adjusted performance measures' – benchmarking the raw performance measures to the market or industry averages or indices. For example, such an approach has been used in Boubakri and Cosset (1998), Garcia and Anson (2007) and Aussengg and Jelic (2007). Notably, results based on the adjusted performance measures in these studies were found to be less significant than those based on the unadjusted measures. Wei et al. (2003) and La Porta and Lopez-de-Silanes (1999), Omran (2004), Jerome (2008) and Jiang et al. (2009) have followed a somewhat different approach to address these problems- by using the firms in the sample (i.e. the divested SOEs) as the "treatment group" and compared their performance with a matched "control group" of SOEs which were comparable in terms of size, performance and operating in the same industry but not divested. Notwithstanding these improvisations, however, findings of studies solely based on the MNR (1994) methodology require further robustness checks and validation, preferably, by taking recourse to a different approach, as has been done in many studies included in this survey (which have used both univariate analysis and multivariate regression analysis).

3.3.3 As regards studies which have used multivariate regressions – in most cases advanced panel data techniques – the key issue relates to the appropriateness of the model used to address selection bias, endogeneity of privatisation, simultaneous causality and the possibility of 'omitted variables'. Choice of the dependent variables and independent variables for the model, including the control variables, also require careful

consideration; though in this respect most studies, which have used these methods, have largely relied on prior studies on the subject. In general, most of these studies have also subjected their results to a variety of robustness checks. Notably, the multivariate regression models provide flexibility to determine the impact of a variety of factors – "economic, political, organizational and institutional" – on the post divestiture performance of the firms. Besides, one can capture, with some degree of precision, the "dynamic effects" of privatisation – the "announcement effects", the "short-run effects" and the "long-run effects". Thus, we can assess whether privatisation brings about 'one-off' or 'sustained' improvement in the enterprise performance.

3.3.4 The third set of studies has assessed the effects of privatisation by estimating productive or technical efficiency of the firms using Data Envelopment Analysis (DEA) or Stochastic Frontier Analysis (SFA). Some of these studies have also used a two-stage approach – combining DEA with Tobit regression to analyse factors impacting changes in the TE of the divested enterprises. Productive efficiency of a firm can be estimated using two alternative methods : parametric SFA and non-parametric DEA. Both methods have their pros and cons. The key strength of SFA is that it incorporates a stochastic element in the production process. Accordingly, the estimates from SFA can be subjected to the conventional parametric hypothesis testing. On the flipside, however, SFA requires imposition of an explicit functional form of the production function and also assumptions with regard to the random error term. As such, results of the SFA may be sensitive to the parametric functional form used in the model. In contrast, prior specification of the form of the production function is not required for DEA. Hence, its sensitivity to misspecification is less likely. No assumption regarding the distribution of the error term is also necessary. Its main disadvantage, however, emanates from its deterministic approach. Unlike stochastic frontier models, DEA assumes absence of 'random noise' in the data and attributes deviations from the estimated efficiency frontier to inefficiency. Thus, the estimates of DEA may be prone to errors in measurement and noise in the data. However, as discussed in the study of Arocena and Oliveros (2012), the deterministic nature of DEA can be overcome by taking recourse to bootstrapping methods to generate confidence intervals for the TE estimates and accordingly, subject these estimates to hypothesis testing.

Studies using two stage DEA approach – combining DEA with Tobit regression – have to address an additional

methodological problem arising out of serial correlation among the DEA estimates. Arocena and Oliveros (2012) have demonstrated how bias-corrected and consistent efficiency estimates can be obtained by application of bootstrapping techniques in the second stage analysis.

Having due regard to the relative merits and demerits of both the methods, however, the choice between SFA and DEA primarily depends on the diagnostic tests which indicate whether the data set has significant noise or not.

3.3.5 The major strength of methodology used by Galal et al. (1994) lies in the manner in which a "counter factual scenario" is constructed, which enables estimation of both financial and welfare gains from privatisation. Notwithstanding rigour and robustness of its methodology, however, few subsequent studies have used it, primarily because mapping out the 'counter factual' and its long range projection necessitate a number of assumptions to be made about the structure and future trends in the economy over a long period, including the future scenario in the industries and the sectors in which the divested SOEs operate, which is inherently fraught with complexities and challenges including the risk of forecasts going way off the mark.

3.3.6 In an oft-cited paper, Rodrik (2005) had pointed out some significant limitations of cross-country empirical studies. Cross-country empirical studies of privatisation also have to contend with a major problem emanating from data comparability and consistency. Accounting standards and the quality of financial reporting varies widely across countries. In particular, quality and reliability of accounting reports of the relatively less developed countries and also of countries in transition would have to be taken care of in such studies. This could also be another source of selection bias in the cross-country studies as pointed out in Megginson and Netter (2001). Since developed countries usually had better availability and reliability of data, more so for the firms performing better in these countries, better performing firms of the developed counties were possibly disproportionately represented in the early cross-country empirical studies of privatisation, somewhat blunting their external validity vis-à-vis the less developed countries. Single country studies are, however, less susceptible the problems arising on account of data comparability.

Section-4 : Empirical Studies of Privatisation- Key Takeaway

Keeping in view the advantages and limitations of the alternate methods and

other methodological issues, discussed in Sub-section 3.3, some of the salient takeaway from the studies covered in this survey are briefly discussed below.

4.1 Firstly, does privatisation *per se* automatically lead to improvements in the enterprise performance? This, indeed, is a cross-cutting research question addressed in several studies. Logically, one should expect strongest empirical support for privatisation in the more developed countries from which the contemporary wave of privatisation actually originated. Contrarily, however, in both the studies relating to UK (Martin & Parker, 1995; Boussofiane et el 1997), in three of the four studies relating to Spain (Villalonga, 2000; Garcia & Anson 2007; and Bachiller, 2009), in Alexandre and Charreaux (2004)'s study of France and in Fraquelli and Erbetta (1999)'s study of Italy we do not find statistically significant and robust evidence of efficiency gains from divestiture. As such, even in some of the more favourable institutional ecosystems of the developed countries, with admittedly better corporate governance and regulatory institutions, dilution of public ownership in the SOEs alone does not seem to be sufficient for bringing about the expected performance improvements.

4.2 Secondly, why does privatisation by itself does not boost the efficiency of the divested enterprises? This question – which logically flows from the first one raised in the preceding sub-para- has been fairly well researched in Villalonga (2000), Wu (2007) and Arcas and Bachiller (2010). Findings of these studies emphatically show that post-privatisation performance of the firms is significantly contingent on complementary contextual, institutional and organizational factors. Among other things, competition policy, appropriate regulatory regimes for monopolistic / oligopolistic industries, sectoral deregulation, trade liberalization, development of capital markets, corporate governance norms and mechanisms and business cycles are some of the factors which may explain the variance in the observed enterprise-level performance outcomes in the post-privatisation period.

4.3 Thirdly, does the assessment of efficiency gains from privatisation depend on the choice of performance measures used? Evidence gleaned from Dewenter and Malatesta (2001) suggests that it does. In that study two alternate measures of profitability – net income-based measures and EBIT (earnings before interest and taxes) based measures were used both in the univariate analysis and in the multivariate regression. In both cases, profitability was found to have significantly improved in the post-privatisation period in terms of the net income-based measures; but

not when EBIT- based measures were used. A similar inconsistency is also found in Chibber and Gupta (2017 a). Regression equations estimated in that study to determine the impact of Memorandum of Understanding (MoU) on the profitability of the SOEs indicated its significantly positive impact when Return on Capital (RoC) was used as the proxy; but not when Return on Assets (RoA) was used. The question of appropriate choice of the performance measures has also been dealt in Frydmanetal (1999)'s study of privatisation in the transition economics of Central Europe. In the initial stages of post-communist transition-which is the period analysed in that study – the accounting systems were still in a state of flux; disclosure standards and mechanisms were very imperfect and there were no dependable measures of the "cost of capital'. In view of these difficulties, the researchers considered profits as an unreliable measure of performance for the purpose of their study. Accordingly, instead of profitability, the study focused on its two components – revenues and costs for which more reliable, comparable data of consistent quality were available. Thus, findings of the empirical studies may well be sensitive to the choice of the performance indicators/proxies used.

4.4 Fourthly, does the extent of divestiture – i.e. whether 'revenue' or 'control' privatisation[8] matter? Findings of the three seminal cross-country studies MNR (1994), B&C (1998) and D&M (1999)- indicate that 'control' privatisations bring about significantly greater performance improvements than 'revenue' privatisations. Multi-country study of Aussenegg and Jelic (2007) also found that higher government shareholding after privatisation was associated with significantly lower efficiency[9]. However, Naceur et al. (2007)'s study of Middle East and North African (MENA) countries indicated somewhat mixed results in this regard – though sub samples of control privatisations performed significantly better in terms of operating efficiency and output; significant increase in profitability was observed only for the subsample of revenue privatisations, but not for control privatisations.

Results from the country-specific studies on this issue are also mixed. Studies of Procianoy and Sobrinho (2001), Wei et al. (2003) confirm that firms in which majority stake was transferred experienced significantly higher efficiency gains. A contrarian result was, however, found in Jiang et al. (2009)'s study of China in which difference between the subsamples of control and revenue privatisations was statistically not significant[10]. Wu (2007)'s study of Taiwan also indicated that the extent of government's shareholding after

privatization had no significant effect on performance.

Thus, while empirical evidence generally validates stronger impact of control privatisation on enterprise performance in the developed countries; in case of the less developed countries the findings appear to be mixed and inconsistent.

4.5 Fifthly, does the time-period covered by the study matter? Timing of privatisation of a SOE can have significant effects in case the transaction is carried out during a business cycle. Its short-run performance after divestiture would depend on whether the change of ownership was effected during a recessionary phase or a boom phase. Also, sometimes there is a considerable time-lag between the announcement of government's intent to privatise a particular SOE and its actual execution (in case of British Airways the time lag was as long as 6 years). Furthermore, the management of the firms, after privatisation, require sufficient time to carry out organizational, business portfolio and HR restructuring, to provide new strategic orientation as well as to make necessary investment to achieve improvement in productivity and efficiency. For these reasons, longitudinal coverage of the empirical studies of privatisation should be sufficient both in respect of the pre-privatisation and the post-privatisation periods so as to control the business cycle effects, capture its 'temporal effects' – the 'announcement effect' and its short-term and long-term effects. Besides, it should be long enough to assess if the efficiency gains from privatisation are sustained or tapper off over time. If the time horizon selected by the study is too short, efficiency effects of privatisation may not be observed. Villa longa (2000)'s study empathically brings out this point. For the sample of Spanish firms considered in that study, the positive effects of privatisation were found to be statistically significantly only 7-8 years after the event. Alexandre and Charreaux (2001)'s study of French privatisational socorroborated this finding. Besides, in Garcia and Anson (2007)'s study significant improvement in performance was found in the long-run; but not in the short-run.

4.6 Sixthly, does performance improvement precede the actual event of divestiture in case of the privatised SOEs? Strong evidence of the 'announcement effect' was found in two major studies – Martin and Parker (1995), Boussofiane et al. (1997) and Dewenter and Malatesta (2001). Significant evidence of such performance improvement – 'preparation / announcement effect' – prior to actual divestiture has also been found in the studies of Ghosh (2008), Chibber and Gupta (2017 & 2019) and Gunasekar and Sarkar (2014) relating

to India. Interestingly, Dewenter and Malatesta (2001) actually went on to further probe whether the performance improvement observed in the period just before privatisation represented real efficiency gains or 'creative accounting' or 'earnings management'[11] by the Government. Examining long-run market-adjusted stock returns of the privatised firms, the study confirmed that the improvement in enterprise performance observed during the period before privatisation represented 'real' and substantive and not due to systematic manipulation of their financial reports.

Keeping in view the findings of the studies cited above, it would be instructive to probe significance of the 'preparation/ announcement effect' in firm level empirical studies of privatisation.

4.7 Seventhly, how sensitive is the assessment of privatisation to the method used? We examine this issue with reference to the studies of Spanish privatisation included in this review. In Garcia and Anson (2007)'s study – which considered a sample of SOEs privatised during 1985-2000, performance of firms before and after privatisation was not found to be significantly different when industry adjusted averages were used and the standard MNR (1994) method was applied over the 'three years before and three years after' (t-3 to t+3) window. In contrast, performance improvement after divestiture was found to be significant for the sample when the same method was applied to the unadjusted averages of the proxies. In Villalonga (2000)'s longitudinal study- which used data panel data regression models-changes in both the level and growth rate of efficiency after privatisation was found to be statistically insignificant. Accordingly, the hypothesis that privatisation increases firm efficiency was rejected. However, Arocena and Olivera's (2012) study which examined the technical efficiency of a sample of SOEs, privatised during 1994-2002, vis-à-vis their closest private sector competitors, applying two stage DEA, found significant increase in the efficiency of the SOEs after privatisation; while no significant improvement was observed in case of their private competitors during the same post-privatisation period. Accordingly, their study found some support for the claim that efficiency of the SOEs gets significantly enhanced after divestiture. Thus, conclusions of the empirical studies of privatisation may substantially vary, even with respect to the SOEs privatised more or less during the same period in the same country, depending on the method used in the analysis.

4.8 Eighthly, what happens to employment and the workers in the privatised SOEs? Unarguably, perhaps, this is

the most politically sensitive dimension of privatisation as a public policy tool. Evidence with regard to employment in the SOEs after privatisation is quite mixed. In the earliest empirical study of privatisation by Galal et al. (1992), workers were found to have gained in ten out of the twelve cases analysed – either from appreciation of shares offered to them or from higher wages. Findings of the three seminal cross-country studies, however, differ in this respect. While MNR (1994) and Boubakri and Cosset (1998) found significant increase in employment, D'Souza and Megginson (1999) found significant decline in employment after divestiture. Evidence from some other multi-country studies a real so mixed. For example, Aussenegg and Jelic (2007), Cook and Uchida (2004) indicate significant decline in employment after privatisation; whereas Mathur and Banchuenvijit (2007) found no significant change either for the subsample of the developed countries or of the emerging markets. Claessens and Djankov (2000) had observed lower down-sizing of labour in the firms which had been privatised for more than 3 years as compared to the state owned firms. On the other hand, Frydman et al. (1999) found a contrarian result that privatisation had actually led to improvement in the employment performance of the divested firms.

Megginson and Netter (2001)'s survey had also found singular lack of unanimity of the empirical studies of privatisation regarding its impact on employment levels in the divested SOEs. Out of 10 studies reviewed in that survey, three had documented significant increases, in two studies the observed change was insignificant; whereas the remaining five studies had documented significant decline in employment.

Findings of the single country studies also appear to be conflicting and inconsistent in this regard. Bhaskar and Khan (1995)'s study of privatisation of jute mills in Bangladesh is possibly one of the most insightful contribution in this regard. Results from its 'difference-in-difference' (DID) estimation had found compelling evidence of significant decline in "white collar employment" ("clerical and managerial") and "permanent manual workers"; whereas employment of casual / temporary manual workers was found to have increased significantly. La Porta and Lopez-de-Silanes (1999) had found significant decline in the industry-adjusted measure of total employment as well as employment of both white and blue-collar workers. Okten and Arin (2006)'s study of Turkey also provides evidence of significant decline in employment. In contrast, Wei et al. (2003)'s study of China and Garcia and Anson (2007)'s study of Spain document no significant change

in employment. Similarly, estimates of a computable general equilibrium (CGE) model used by Chisari et.al. (1999) indicate that privatisation did not seem to be a major contributor of the significant increase in unemployment in Argentina during 1993-95.

Thus, evidence from the empirical studies covered in this survey with regard to the impact of privatisation on employment is fairly mixed. This could be because of the interplay of countervailing forces which emanate from labour force restructuring and rationalisation that usually follows privatisation. As a result of this, overall employment might expectedly decline in the initial years. But if the new management succeeds in the initial turn-around efforts, it might invest and expand output or even diversify, creating more employment opportunities. Thus, after a time lag, overall employment might be restored to the pre-divestiture level or even higher.

A substantive point, however, that emerges from these apparently inconsistent and inconclusive findings is that while analysing the impact of privatisation on employment, the approach needs to be more granular. Instead of simply comparing the aggregate employment levels before and after divestiture; it may be useful also to examine changes in its composition (i.e. mix of permanent and casual/temporary workers, white and blue collar workers).

Section-5 : Concluding Observations

To conclude, evidence from empirical studies of privatisation, covering developed as well as developing countries, tend to favour a more nuanced view of its efficiency effects. Nevertheless, these studies provide valuable guidance for designing future privatisation programmes in countries of South Asia and Africa, where SOEs still have a significant economic presence, in particular about what to privatise (i.e. selection of the sectors and enterprises), how to privatise (i.e. the process and method of divestiture), when to privatise (i.e. timing and sequencing of stake sale) and above all, about the complementary reforms to be undertaken to achieve the desired goals. Given the high political sensitivity of privatisation programmes in liberal, open democracies, evidence from empirical research is likely to contribute, in no small measure, to the public policy in this field.

Having said that, this survey also brings out the 'grey areas' relating to empirical privatisation studies which merit further research. First, impact of privatisation on employment, particularly in the context of labour surplus developing countries, needs to be explored further

in the light of mixed evidence provided by the studies covered in this survey. Does it result in an overall reduction in employment in the firm or lead to more 'casualisation' and recourse to contracting and outsourcing? Does it worsen labour standards and conditions of employment? More evidence based research on these issues is likely to generate valuable insights and inputs for providing appropriate safeguards in the privatisation programmes in the developing countries, which would not only be perceived 'fair' in terms of its welfare consequences; but also likely to elicit stronger political 'buy-in'.

Secondly, more empirical studies are also needed on the distributional impact of the privatisation programmes in the developing countries, particularly of the utilities and infrastructure sectors. Does privatisation of firms in these sectors have adverse effects on the welfare of the consumers in terms of higher prices and service quality, even though it might have had positive impact on their financial and operating performance? Does it affect equitable access to services? Does privatisation yield 'positive-sum outcomes' for the major stakeholders? Again robust empirical evidence on these contentious and politically sensitive issues would contribute substantially towards our understanding of the likely equity-efficiency tradeoffs of the divestiture programmes.

Third, there is a need for more case studies, of both 'successful' and 'failed' privatisation, in order to deepen our understanding of when privatisation 'works' and when it does not; where (sectors and industries) it 'works' and where it does not; and why and how it 'works' in some cases and not in other cases. Also, does privatisation work more effectively in the developing countries in sectors and industries that are less "institutions-intensive" as compared to sectors where existence of strong and empowered autonomous regulatory institutions is critical? While econometric studies produce evidence that enables derivation of more generalizable findings; they often tend to miss out rich institutional details which emerge from in depth case studies. For instance, why privatisation of Hindustan Zinc- a Central Public Sector Enterprise (CPSE) of India privatised in 2002-03 is acknowledged to be a 'success' and why sale of Jessop & Co. another CPSE privatised around the same time in the same economic environment- did not 'succeed'? Case study approach is arguably well suited to answer and explain many such issues which have critical policy implications.

Further research to explore these issues is not merely of academic interest; it has more substantive value from the

public policy perspective to enlighten responsible policy makers more holistically not only about the efficiency effects of privatisation; but also about its equity and welfare consequences.

Notes :

1. Privatisation Barometer, an agency which provides privatisation data to OECD and World Bank, defines privatisation as "a transfer of ownership or voting rights from the 'state' to the private sector".

2. As reported in in The Telegraph, April 8th, 2013. Also see Edwards (2017) on Mrs. Thatcher's privatisation legacy.

3. Megginson (2016) in The PBR 2015/16.

4. Extracted from Para 99 of the speech of the Union Finance Minister presenting Union Budget for FY 2019-20. Para 97, 98 and 100 of the speech also reaffirm the renewed policy thrust of the Government of India to scale up strategic disinvestment of the Central Public Sector Enterprises (CPSEs).

5. For "Agency/Property Rights Theory" please refer to Alchian (1965), De Alessi (1980), Shapiro and Willig (1990) and Laffont and Tirole (1993). For "Public Choice Theory" see Zeckhouser and Horn (1989) and Haskel and Szymanski (1992). For "Organisation Theory" see Perry and Rinsey (1988) and Walker and Vasconcellos (1997).

6. Galal et al. (1994) is the only study covered in this survey which has used case study method.

7. Chisari et al. (1999) have used a Computable General Equilibrium (CGE) model to estimate the macroeconomic and distributional effects of privatisation of privatisation of utilities in Argentina.

8. Megginson et. al.(1994) distinguish between 'revenue' and 'control' privatisation. 'Control' privatisation refers to sale shares by the Government of a SOE to private entities which lowers its stake below 50 per cent thereby ceding control of management. 'Revenue' privatisation refers to cases where government 'simply sold a minority stake to private investors" primarily to raise revenue without having to cede control rights.

9. Results of Boardman and Vining (1989) similarly suggest that partial privatisation may not be the optimal strategy for governments which wish to reduce dependence on SOEs.

10. As explained in the study of Jiang et. al. (2009), however, even in the firms of their sample in which government diluted its ownership below 50 per cent, it still remained as the largest and 'controlling' shareholder. Thus, in their sample there was, in effect, no difference between the 'revenue' and 'control' privatisation in terms of government's control rights in the divested firms, which might be a probable explanation of why the extent of divestiture did not make a difference in their study.

11. The study examined whether government might have resorted to manipulation of the financial reports of the firms selected for privatisation – inflating their earnings before privatisation systematically in order to mislead the prospective investors and make the firms 'attractive' for sale.

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The Journal of Institute of Public Enterprise, July-Dec, Vol. 42, No. 2
ISSN : 0971-1864, © 2019.

Corporate Governance Practices and its Impact on Non-Performing Assets of Selected Commercial Banks in India

S.K.Chaudhury* & Devi Prasad Misra**

When India is marching ahead for larger market presence with the liberalized business, the Indian banks are today facing greater challenge of realization of Non-Performing Assets (NPAs). Due to enormous increase in the NPAs level of banks, i.e. non-performance of a portion of loan portfolio, has becomes a daunting task before them to recover the same. As a result, not only the performance of banks goes awry but also has an adverse effect on the Indian economy. NPAs are now considered as burden on the Indian banking industry. Hence, the methods/procedure of managing NPAs and keeping them within the tolerance level is the need of the hour. This research study tries to focus on the Corporate Governance aspect as an appropriate tool to bring down the mounting NPAs in Indian banks. For this purpose, the statistical tools such as correlation and regression analysis are used to i) ascertain whether there exists the correlation between corporate governance measures and NPA ratio of public and private sector banks in India and ii) to determine the impact of corporate governance practices on NPAs in Indian public and private sector banks. The findings of the study reveal that there is no correlation between corporate governance measures and NPA ratio in public sector and private sector banks. Further, the regression analysis reveals that there is no impact of corporate governance practices on NPAs in public sector and private sector banks.

Keywords : Asset Quality, Bad Loans, Corporate Governance, Non-Performing Assets

Introduction

The evaluation of the Indian banking industry during the pre-liberalization era revealed the presence of several short-comings such as reduced productivity, deteriorated asset quality and efficiency and increased cost structure due to technological backwardness. Among these deficiencies, policy makers identified the erosion of asset quality as the most significant obstacle for the development of a sound and efficient banking sector. In fact, the various practices that were followed during pre-liberalization period that includes asset classification

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using health code system, accrual basis used to book interest in bank accounts etc., concealed the gravity of asset quality issues of the banking sector. The asset quality is a prime concern and impacts various performance indicators, i.e., profitability, intermediation costs, liquidity, credibility, income generating capacity and overall functioning of banks. The reduction in asset quality results in accumulation of non-performing assets.

In the recent past, non-performing assets has become a matter of great concern for the Indian bankers. The banking sector's asset quality was worsened in the recent years, with Gross Non-Performing Assets (GNPAs) ratio crawling to 4.45 per cent as on March 2015, as against 4.1 per cent in March 2014[1], as per the latest data released by the Reserve Bank of India. Both gross and net NPAs ratios[2] are strong indicators of the asset quality of a bank; the higher the gross/net NPA ratio, the lower its asset quality and vice-versa. In this context, private sector banks remain within the controlled limits, and importantly, seem to have provision enough to keep net NPAs within 1 per cent. But the public sector banks, sadly, have not[3].

Statement of the Problem

The need for corporate governance which emerged as a result of corporate failures/bank failures as well as wide spread dissatisfaction in the way many such institutions function, has become one of the wide and deep discussions across the globe. Non-performing assets is a key concern for banks in India. NPA is said to be an important indicator to judge the health of the banking industry. During the last one decade, the public sector banks have displayed excellent performance and are one step ahead of private sector banks in financial operations. However, the only problem with public sector banks is the increasing level of NPA year after year. In this connection, the application of corporate governance can be a potential tool to contain NPAs of banks because the corporate governance primarily centres on complete transparency, integrity and accountability of the management. Further, it focuses on investors' protection and public interest. Apart from that, corporate governance is concerned with the values, vision and visibility. In view of the above issues, a thought provoking ideas need to be diagnosed and implemented for better governance and to make the banking sector more dynamic and vibrant so that it can take care of the interest of various stakeholders. In this research article, an attempt has been made to examine whether there exist any correlation between corporate governance practices and the NPAs of banks and also to find out the impact of corporate governance practices on NPAs of banks.

Review of Select Literature

The review of literature is an integral part of the research work. Review of past studies primarily reveals the research works done by individual researchers and institutions and also facilitates to create the base for further research. Various studies related to corporate governance, particularly in banking sector have been carried out by many scholars on different aspects at national and international level. However, some of the notable research works carried out in this area is noted below.

Indian Context

Balasubramaniam (2001) in his work on non-performing assets and profitability of commercial banks in India stressed on the point that the level of NPAs is high with all banks and the banks are supposed to bring it down. He suggested that effective internal control systems, good credit appraisal procedures, along with the improvement in asset quality in the balance sheets have the potential to bring down NPA in banking sector. Bhabani and Veena (2011) reveals that the public sector banks, which are perceived as the foundation of the Indian banking system, are unfortunately burdened with excessive NPAs, huge manpower and lack of advanced technology. Chaudhary and Sharma (2011) in their comparative study on the performance of Indian public and private sector banks stated that it is high time to take appropriate and stringent measures to get rid of NPA problem. An efficient Management Information System (MIS) should be developed whose task is mainly to train the bank staff involved in sanctioning the loans and advances with proper documentation and charge of securities. The bank staff should be motivated to take methods to prevent advances turning into NPA. Moreover, they suggested that public sector banks should pay adequate attention on their functioning to compete with private sector banks. Zafar, Maqbool and Khalid (2013) opine in their study that in Indian banking system, public sector banks are worst affected by NPAs. NPAs reflect the poor performance of banks and its failure adversely affects their banking sector's health. Joseph and Prakash (2014) suggested that financial institutions particularly the banks should be proactive to adopt a practical and structured non-performing assets management system where prevention of NPA should be accorded the top priority. They also added that the NPA level is much higher in public sector banks in India as compared to the private banking sector and foreign banks. They also suggested that the public sector banks should take utmost care and avoid loan/advances leading to NPA by taking suitable preventive

measures in an efficient way. Goel and Sahu, et al. (2017) point out that the main reason of poor performance of many banks in recent past was the non-performing assets of the banks. They further add that corporate governance and non-performing assets are inter-related and serious research should be done to find out the relation between corporate governance and non-performing assets.

Global Context

Berger *et al.* (2005) in their study viewed that state-owned banks have poor long-term performance (static effect), those undergoing privatization had particularly poor performance beforehand (selection effect), and these banks dramatically improved following privatization (dynamic effect), although much of the measured improvement is likely due to placing non-performing loans into residual entities. Ennobakhare (2010) inspected the relationship between corporate governance practices and its impact on profitability and found that there was a significant relationship between banks operation and the corporate governance practices. They also proved that the ownership style of banks has significant impact on the size of NPA in banks.

Bebeji (2010) conducted a study to find out the impact of different credit management strategies on NPA and suggested that poor management, ineffective monitoring of debts in addition to liberal credit policy are having good relation with corporate governance practices. They are also significantly related to non-performing loans. Nyor and Mejabi (2013) in their research on the effect of corporate governance practices on non-performing loans of Nigerian banks concluded that corporate governance variables like board size, board composition, composition of audit committee and power separation do not have significant impact on NPA. Moreover, they say that these variables cannot be relied upon to solve the problem of NPA management. They suggested that the banks should shift the focus from the explanatory variables to other corporate governance related variables like transparency, insider abuse, disclosure practices and accountability. HifzaInam and Aqeel Mukhtar (2014) stated that good corporate governance aids in improving the quality of assets. As the operational efficiency of a bank is appraised in terms of amount of non-performing assets and default loans, the banks are required to effectively manage its non-performing loans. Good corporate governance helps to efficiently manage non-performing assets of a

bank. Thus, there is positive link between corporate governance and operational efficiency. Paul and Simon (2014) stated that the corporate governance variable like board size, board composition, composition of audit committee and power separation are not the factors responsible for the rising figure of non-performing assets of Nigerian Banks. Hence, they suggested giving focus on the key variables like insider abuse, transparency and accountability and so on for better performance of the banks.

Objectives and Scope of the Study

The study outlines the following objectives for the present research work.

- To examine whether there is any improvement in the corporate governance practices of selected Indian banks over the last five years and if yes, then does it have any impact on the NPA of such banks?
- To explore the relationship between corporate governance practices and NPA ratios in selected Indian public and private sector banks.
- To assess the impact of corporate governance practices on non-performing assets in Indian public and private sector banks.

The scope of the study is limited to public and private sector banks only. The foreign banks are excluded from the study.

Hypotheses of the Study

In the backdrop of above objectives, following hypotheses have been formulated by the researchers.

1. H_0 = There is no significant correlation between corporate governance and NPA of public sector banks.
2. H_0 = There is no significant correlation between corporate governance and NPA of private sector banks.
3. H_0 = There is no significant impact of corporate governance practices on NPA ratio in Indian public sector banks.
4. H_0 = There is no significant impact of corporate governance practices on NPA ratio in Indian private sector banks.

Methodology

The study is empirical in nature. Data pertaining to the study were collected from secondary sources and analysed through SPSS package version (21). For this purpose 12 sample banks, 6 each from public and private sectors are randomly selected. Public sector banks include State Bank of India, Bank of Baroda, Punjab National Bank, Bank of India, Central Bank of India and United Bank of India. Similarly,

private sector banks namely, Federal Bank, ICICI bank, HDFC bank, Kotak Mahindra Bank, IndusInd Bank and Axis Bank are included as samples for the study. The period of study covers 6 years i.e. from 2010-11 to 2015-16.

Net NPA ratios are calculated using relevant data collected from RBI reports. To calculate the average weighted corporate governance score of the sample banks, 59 point rating scale was compiled referring different score cards used by different researchers, committees on corporate governance and its practices as mentioned in the annual reports of Indian public and private sector banks. Binary feeding method was adopted to assign scores against each of the items in the scale. In other words, if a particular practice mentioned in the scale is followed by the concerned bank and the same is reflected in its annual report then '1' was assigned otherwise '0' was assigned. Then sum was calculated and then divided by 59 to obtain the weighted corporate governance score. Further, statistical tools namely correlation analysis and regression analysis were applied to find out i) whether there exists the correlation between corporate governance measures and NPA ratio of selected public and private sector banks in India and ii) the impact of corporate governance practices on NPAs such banks.

Data Analysis and Interpretation

Net NPA ratio of the sample banks are sourced from the RBI reports. Corporate governance scores of public and private sector banks are calculated by using the 59 point scale as discussed in the methodology. The weighted corporate governance score close to 'one' indicates higher corporate governance measures taken up by the bank and score closer to 'zero' indicates low corporate governance measures taken up by sample banks in both the groups.

The compiled data (net NPA ratios and weighted corporate governance scores) are presented in the Tables in the next page. Table-1 and Table-2 present the computed data pertaining to weighted average corporate governance score and net NPAs ratio of sample public sector and private sector banks respectively.

Relationship between Mean Net NPAs and Average Weighted Corporate Governance Scores

With a view to ascertaining the relationship between net NPA ratios and weighted average corporate governance scores, correlation analysis has been performed separately for both public and private sector banks and they are presented in the succeeding section.

Table-1 : Net NPA Ratios and Weighted Average Corporate Governance Scores of Public Sector Banks

Name of the Bank	SBI		BoB		PNB		BoI		CB		UBI		Avg. NPA Ratio (Sample Banks)	Avg. Weighted CG Score (Sample Banks)
Year	Net NPA Ratio	Weighted CG Score	Net NPA Ratio	Weighted CG Score	Net NPA Ratio	Weighted CG Score	Net NPA Ratio	Weighted CG Score	Net NPA Ratio	Weighted CG Score	Net NPA Ratio	Weighted CG Score		
2010-11	1.63	0.627	0.35	0.593	0.85	0.678	0.91	0.559	1.10	0.610	1.19	0.780	1.005	0.641
2011-12	1.82	0.661	0.54	0.610	1.52	0.695	1.47	0.576	1.46	0.627	1.70	0.797	1.418	0.661
2012-13	2.10	0.678	1.28	0.644	2.35	0.746	2.06	0.610	2.18	0.644	1.61	0.797	1.930	0.686
2013-14	2.57	0.695	1.52	0.627	2.85	0.746	2.00	0.593	1.98	0.644	2.33	0.814	2.208	0.686
2014-15	2.12	0.695	1.89	0.644	4.06	0.763	3.36	0.610	2.65	0.644	2.71	0.831	2.798	0.698
2015-16	3.81	0.695	5.06	0.644	8.61	0.763	3.35	0.610	6.42	0.644	5.25	0.831	5.416	0.697

Source : RBI reports (NPA) and Authors' compilation (Corporate Governance scores) from Annual reports of banks.

Table-2 : Net NPA Ratios and Weighted Average Corporate Governance Scores of Private Sector Banks

Name of the Bank	FB		ICICI		HDFC		KMB		INDUS IND		AXIS		Avg. NPA Ratio (Sample Banks)	Avg. Weighted CG Score (Sample Banks)
Year	Net NPA Ratio	Weighted CG Score	Net NPA Ratio	Weighted CG Score	Net NPA Ratio	Weighted CG Score	Net NPA Ratio	Weighted CG Score	Net NPA Ratio	Weighted CG Score	Net NPA Ratio	Weighted CG Score		
2010-11	0.60	0.763	1.11	0.678	0.19	0.678	0.59	0.576	0.28	0.814	0.26	0.695	0.505	0.701
2011-12	0.53	0.780	0.73	0.695	0.18	0.695	0.51	0.593	0.27	0.847	0.25	0.712	0.412	0.720
2012-13	0.98	0.780	0.64	0.712	0.20	0.712	0.55	0.610	0.31	0.847	0.32	0.712	0.500	0.729
2013-14	0.74	0.814	0.82	0.695	0.27	0.695	0.88	0.610	0.33	0.847	0.44	0.729	0.580	0.732
2014-15	0.73	0.797	1.40	0.695	0.25	0.695	0.79	0.627	0.31	0.831	0.46	0.712	0.678	0.726
2015-16	1.64	0.797	2.67	0.695	0.28	0.712	0.93	0.627	0.36	0.831	0.73	0.712	1.101	0.726

Source : RBI reports (NPA) and Authors' compilation (Corporate Governance scores) from Annual reports of banks.

Table-3 : Public Sector Banks

		Mean Net NPA Ratio of Sample Public Sector Banks	Weighted Average CG Score of Sample Public Sector Banks
Mean Net NPA Ratio of Sample Public Sector Banks	Pearson Correlation	1	.722
	Sig. (2-tailed)		.106
	N	6	6
Average Weighted CG Score of Sample Public Sector Banks	Pearson Correlation	.722	1
	Sig. (2-tailed)	.106	
	N	6	6
* Correlation is significant at the 0.05 level (2-tailed).			

From Table-3, it is evident that Pearson's r = 0.722 (p value = 0.106) which is not significant and hence, the null Hypothesis 1 is accepted. It indicates that there is no significant relationship between net NPA ratio and weighted average corporate governance score of public sector banks. Even though the correlation is not significant but they have positive relationship.

From Table-4, it is seen that Pearson's r = 0.269 (p value = 0.606) which is not significant and hence, null Hypothesis 2 is accepted. It implies that there is no statistically significant relationship

Table-4 : Private Sector Banks

		Mean Net NPA Ratio of Sample Private Sector Banks	Weighted Average CG Score of Sample Private Sector Banks
Mean Net NPA Ratio of Sample Private Sector Banks	Pearson Correlation	1	.269
	Sig. (2-tailed)		.606
	N	6	6
Average Weighted CG Score of Sample Private Sector Banks	Pearson Correlation	.269	1
	Sig. (2-tailed)	.606	
	N	6	6

between NPA ratio and weighted average corporate governance score of private sector banks. In this case also, even though the correlation is not significant but they have positive relationship.

Impact of Corporate Governance Practices on Net NPAs Ratio

To examine the impact of corporate governance practices on net NPA ratio of banks, regression analysis is used by considering mean net NPA ratio of sample banks as dependent variable and weighted average corporate governance score of sample banks as independent variable. Regression analysis is performed separately for both public and private sector banks and the results are mentioned below.

Regression Analysis : Public Sector Banks

The value of R^2 equals 0.521 (Table-5), indicates that 52.1 percent of the variations in net NPA ratio in public sector banks is accounted for its weighted average corporate governance score. In other words, net NPA ratio in public sector banks is moderately influenced by weighted average corporate governance score. However, the value of R^2 equals 0.521 is not significant (at 5 per cent level) as indicated by p value (0.106) of F statistics[4] as obtained in Anova Table. It indicates poor goodness of fit of the model. Hence, Hypothesis 3 is accepted. It means there is no significant impact of corporate governance practices on NPAs in selected public sector banks in India.

Table-5 : Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.722[a]	.521	.401	1.2190847

a. Predictors : (Constant), Weighted average corporate governance score of sample public sector banks.

Table-6 : Anova[a]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	6.445	1	6.455	4.343	.106[b]
	Residual	5.945	4	1.486		
	Total	12.399	5			

a. Dependent Variable : Mean Net NPA ratio of sample public sector banks.

b. Predictors : (Constant), Weighted average CG score of sample public sector banks.

Table-7 : Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	-31.678	16.390		-1.933	.125
	Weighted Average CG Score of Sample Public Sector Banks	50.343	24.156	.722	2.084	.106

a. Dependent Variable: Mean net NPA ratio of sample public sector banks

The estimated regression equation as obtained in Table-7 may be written as :

Net NPA ratio = -31.678 + 50.343*AWCG

t = (-1.933) (2.084)

Regression Analysis : Private Sector Banks

The value of R^2 equals 0.072 (Table-8), which indicates that only 7.2 per cent of the variations in net NPA ratio is accounted for weighted average corporate governance score in private sector banks. In other words, net NPA ratio in private sector banks is not significantly influenced by its weighted average corporate governance score. The value of R^2 equals 0.106 is not significant (at 5 per cent level) as indicated by p value (0.606) of F statistics[5] and obtained in Anova Table. It also indicates low goodness of

Table-8 : Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.269[a]	.072	-.159	.2666751

a. Predictors : (Constant), Weighted average corporate governance score of sample public sector banks.

Table-9 : Anova[a]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	.022	1	.022	.313	.606[b]
	Residual	.284	4	.071		
	Total	.307	5			

a. Dependent Variable : Mean Net NPA ratio of sample public sector banks.
b. Predictors: (Constant), Weighted average CG score of sample public sector banks.

Table-10 : Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	-3.677	7.704		-.477	.658
	Weighted Average CG Score of Sample Public Sector Banks	5.962	10.664	.269	.559	.606

a. Dependent Variable: Mean net NPA ratio of sample public sector banks.

fit of the model. Hence, Hypothesis 4 is accepted. That means there is no significant impact of corporate governance practices on NPAs in selected private sector banks in India.

The estimated regression equation as obtained in Table-10 may be written as :

Net NPA Ratio = -3.677 + 5.962AWCG

t = (-0.477) (0.559)

From the foregoing analysis, it is revealed that there is no statistically significant relationship between the net NPAs ratio and weighted average corporate governance score of both the selected public and private sector banks. Similarly, the regression analysis indicates that weighted average corporate governance practices do not have any impact on NPAs in both public and private sector banks. It is quite surprising that the implementation of corporate governance measures is not resulting in minimization of NPAs ratio[6] in Indian public and private sector banks.

Limitation and Future Scope of the Study

So far as the limitations are concerned, the sample size taken for this research work is limited to six public and six private sector banks. The foreign banks are excluded from the study. The data considered for the study is only six years only. Study conducted with large sample size and data long time period may yield different results. Further, the scale developed to measure corporate governance score is limited to 59 point scale. Inclusion of more items in corporate governance score card may produce different results.

Future studies may be conducted by including more public, private and foreign banks in the list of sample size. Apart from this, NPA data of a long time frame say 10-15 years may be taken up for obtaining accurate result and inference.

Suggestions and Conclusion

In the last few years, Indian banking sector has witnessed high volume of NPAs. Now managing bad loans and controlling and keeping them at lower level has become imperative for the banking industry. The analysis reveals that corporate governance measures did not bring any desired result in controlling the NPA in Indian commercial banks. To reduce the level of NPAs in the loan portfolio, comprehensive preventive monitoring mechanism has to be explored. Further, there should a mechanism to maintain a sound and healthy loan portfolio. The approach to NPA management by the banks has to be multipronged, necessitating varied strategies suitable to different stages of the passage of credit. Every commercial bank has to embark upon strategic plan to prevent/control the occurrence of the NPAs. An enduring solution to the problem of NPAs can be attained only by adopting clear-cut policy guidelines in respect of credit appraisal with minute, proper assessment of credit and risk management mechanism along with credit rating of the potential borrower. Indian bankers may go for the above suggestive measures in order to achieve and maintain a lower NPA ratio.

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The Journal of Institute of Public Enterprise, July-Dec, Vol. 42, No. 2
ISSN : 0971-1864, © 2019.

Persistence in Performance of Indian Mutual Fund Schemes : An Evaluation

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Persistence refers to the ability of a fund to maintain its relative performance ranking over time In the prospectus pertaining to mutual funds is very common to found the phrase that "past performance is not an indicator of future performance". On the other hand, investors expect a consistent return on their investments and persistence of performance is of course a great concern for them. The fund managers also try to maintain their good performance and try to improve it when it is below satisfactory level. This is because, on the one hand, it is related to their compensation package and on the other, it is extremely difficult to sell a mutual fund scheme that has poor track record. From an academic perspective, the existence of performance persistence actually challenges semi-strong form of the Efficient Market Hypothesis (Fama, 1970). In this backdrop, the present study attempts to address the issue of 'persistence' in equity mutual funds in India across two different time horizons with respect to three different performance measures applying a non-parametric contingency table approachand the Spearman rank correlation coefficient (SRCC) test. The results indicate that though there is some evidence of short-run performance persistence in the Indian mutual funds marketthere is no long-run performance persistence during the period under consideration. Thus, on the whole this analysis suggests that past performance of mutual funds cannot be used as indicators of future performance.

Keywords : Mutual Funds, Performance Persistence, Contingency Table, Efficient Market, Spearman Rank Correlation Coefficient (SRCC) Test

Introduction

In the performance evaluation literature, persistence refers to the ability of a fund to maintain its relative performance ranking over time. In the mutual funds prospectus it is very common to found the phrase that "past performance is not an indicator of future performance". However, investors expect a

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consistent return on their investments and persistence of performance is of course a great concern for them. Patel, Zeckhauser and Hendricks (1992) have shown that investors keep their money to funds which are superior performers in recent times. Both individual and institutional investors are looking into the performance evaluation methods which will ultimately help them to select those funds which are superior performers. The fund managers also try to maintain their good performance and try to improve it when it is below satisfactory level. This is because, on the one hand, it is related to their compensation package and on the other, it is extremely difficult to sell a mutual fund scheme that has poor track record. From an academic perspective, the existence of performance persistence actually challenges semi-strong form of the Efficient Market Hypothesis (Fama, 1970). This form of market efficiency states that history of past prices cannot be used to predict future performances, while persistence in performance actually means predictive ability of the fund managers. According to Grossman and Stiglitz (1980) security prices should not reflect the full information possessed by the informed individuals. There must be a reward for the investors for their costly endeavor of seeking new information. In the context of mutual fund performance evaluation some mutual fund managers are expected to have an informational advantage. Berk and Green (2004), however has shown theoretically that such an informational advantage will be temporary when the investors direct their capital to recent winners, thus making the industry competitive. The objective of this study is to determine empirically if such managerial ability persists over a time horizon.

Several studies have examined persistence in fund performance and have found a 'hot hands' phenomenon. For example, Hendricks et al. (1993) and Goetzmann and Ibbotson (1994) have shown that past mutual fund returns predict future returns. This type of evidence is not only inconsistent with efficient markets, which advocates that past performance cannot be a guide to future performance, but also influences investors by suggesting that they may realize superior returns by purchasing funds which have performed well recently. Malkiel (1995) found evidence of persistence in the 1970s which were disappearing in the 1980s. However, Gruber (1996) found very strong evidence of persistence looking at equity mutual funds from 1985 to 1994 and argued that persistence affected the growth of active mutual funds during this period. Studies of Brown and Goetzmann (1995), Wermers (1997), Carhart (1997) and Droms and Walker

(2001) found evidence of short-term persistence in mutual funds. Otten and Bams (2002) evaluated the performance persistence of 506 funds of five European countries such as U.K., France, Germany, Italy and Netherlands. Their results indicated that most European funds provide only weak evidence of persistence in performance, except U.K. Babalos et al. (2008) examined the performance persistence of domestic equity funds in Greece. They argued that persistence is evident for specific periods and it was not significant for the overall sample period. Grinblatt and Titman (1992), Elton et al. (1996), Volkman and Wohar (1996), Allen and Tan (1999), Filip (2011) observed persistence over longer periods. On the other hand, Jensen (1968), Kritzman (1983), Dunn and Theisen (1983), Elton et.al (1990), Bauer et al. (2006), Casarin et al. (2008), Barras (2010), Fama and French (2010), Busse et al. (2010) had evidence of little or no evidence of persistence in the performance of mutual funds. Thus, the available studies mentioned earlier present contrasting results and hence at best, be called inconclusive.

The issue of performance persistence of Indian mutual funds is not adequately addressed in the academic literature. While Roy and Deb (2003) found significant evidence of persistence, the study made by Guha Deb (2006) revealed moderate evidence of short-term performance persistence. Sehgal and Jhanwar (2008) showed no evidence of persistence for monthly data but found evidence of persistence using daily data for only one model. However, the study of Mondal and Khan (2014) has shown no evidence of persistence for both short-run and long-run time periods. Thus, there is no conclusive evidence so far on the issue of performance persistence of mutual funds in different economies including India. In this backdrop, the present study has made an attempt to examine the issue of performance persistence for the Indian mutual fund schemes during 2000-2012.

Data and Methodology

Data

The present study uses a sample of 80 mutual fund schemes. The details of these schemes are given in Table-A- 1.1 in Appendix-I. Out of eighty schemes the sample comprises of sixty six growth schemes and fourteen equity linked savings schemes (ELSS). Since balanced schemes of the sample are basically equity oriented they are also treated as equity schemes. The data used in the study mainly comprise of weekly Net Asset Values (NAV) for the eighty mutual funds schemes during May 2000 to March 2012. These NAV data are collected from www.mutualfundsindia.com.

This study has used Sensex as the market proxy. Sensex data in weekly frequency are collected from BSE website. In this study, weekly yield on 91 days treasury bills of Government of India (GoI) is used as a proxy for risk-free return. These data are collected from RBI website.

Study Methodology

The present study evaluates the issue of 'persistence' for equity mutual funds in India across two different time horizons with respect to three different performance measures. Different choices of time horizons are needed to check the impact (if any) of the length of the time horizon on the persistence of a scheme. In order to test the persistence of mutual fund schemes this study has adopted a non-parametric contingency table approach. According to this method the measurement of fund performance requires two consecutive time periods : first one is the current period and the second one is the test period. This study has used two different time periods of six months and one-year just to explore the issue of persistence over short-term and long-term horizons. So, it has twenty-three pairs of half-yearly time periods of current period - test period and eleven pairs of annual time periods of current period - test period. Within each period the schemes are classified as winners or losers depending on their performance in that period. A fund is said to be winner in the current period if it is above or equal to the median performance of all funds in that period and it is loser if the reverse happens. Similarly, the other categories can be defined.

Once this classification is done, a two-way contingency table is created with elements such as WW (winner in successive periods), LL (loser in successive periods), WL (winner in the current period and loser in the test period) and LW (loser in the current period and winner in the test period) and is given below :

Period(t)	**Period (t+1)**	
	Winner	Loser
Winner	WW	WL
Loser	LW	LL

For each pair of current period and test period, number of funds belonging to each category as mentioned above are obtained for each of the three measures - (i) Benchmark adjusted return (ii) Sharpe ratio and (iii) Jensen alpha. If there is evidence of positive persistence, then we would observe more number of schemes in the WW or LL categories. If there is reversal there would be more cases in the WL or LW categories. Evidence for persistence is statistically tested using repeat winner approach (Malkiel, 1995),

the odds ratio test (Brown & Goetzmann, 1995) Kahn and Rudd's Chi-square (χ^2) test (1995) and the Spearman Rank Correlation Coefficient (SRCC) test.

In the present study returns refer to the average weekly return achieved by the concerned mutual funds due to the change in the net asset value from period t-1 to period t. Income of any associated dividends is assumed to be reinvested thus incorporated in the fund NAV.

The present study has used three different performance proxies for testing persistence which are given below :

(i) **Benchmark adjusted return** :

$$R_e = R_p - R_b \qquad .....(1)$$

(ii) **Sharpe ratio** :

$$S_R = \frac{R_p - R_f}{\sigma_p} \qquad .....(2)$$

(iii) **Jensen's Alpha (α)** :

$$R_p - R_f = \alpha_p + \{\beta_p * (R_m - R_f)\} + \varepsilon_p \qquad .....(3)$$

where,

R_p = the return of the scheme p for the concerned period

R_b = benchmark return

R_f = the risk- free return for the same period

σ_p = the total risk of the scheme p for the same period

R_m = the market return for the same period

β_p = the systematic risk of the scheme p

ε_p = the error term

The null hypotheses of these tests are that there is no evidence of performance persistence i.e., there is no relation between fund performance in current period and in subsequent period or test period.

Malkiel's Z – Test

Malkiel's Z test or repeat winner test shows the percentage of repeat winners (WW) to winner–losers (WL). Let, 'p' be the probability that a winning fund continues to be a winning fund in the next period, then $p = \frac{1}{2}$ if there would be no persistence. Since the random variable Y of the number of persistently winning funds is binomially distributed, a binomial test to see if 'p' > ½ i.e. the test for repeat winner when n is reasonably large ($n \geq 20$) is given as follows :

$$Z = \frac{Y - np}{\sqrt{np(1-p)}} \qquad .....(4)$$

In equation (4) Z will be distributed normally with mean zero and standard deviation one, A percentage of repeat winner above 50 per cent and a Z-statistic above zero show performance persistence.

Brown and Goetzmann's Odds Ratio or Cross Product Ratio (B&G CPR)

Brown and Goetzmann (1995) proposed Cross Product Ratio (CPR) or Odds Ratio which is defined as the number of repeat performers to the number of those that do not repeat and is given as (WW*LL) / (WL*LW). The statistical significance of the CPR can be examined by a Z-statistic which is given as :

$$Z = \frac{\log(CPR)}{\sigma \log(CPR)} \qquad .....(5)$$

In large samples with independent observations, the standard error of the natural log of the cross product ratio is approximated as (Christensen, 1990)

$$\sigma_{\log(CPR)} = \sqrt{\frac{1}{WW} + \frac{1}{WL} + \frac{1}{LW} + \frac{1}{LL}} \qquad .....(6)$$

For large samples, the Z statistic is normally distributed with mean zero and standard deviation one. A CPR above one and a positive Z statistic indicate persistence in fund performance.

Kahn and Rudd's Chi-square (χ^2) Test

This study has also used Chi-square (χ^2) test of Kahn and Rudd (1995) for performance persistence and is given as :

$$\chi^2 = \sum \frac{(O_{ij} - E_{ij})}{E_{ij}}$$

$$i, j = 1, 2 \ldots . n \qquad .....(7)$$

where, O_{ij} = actual frequency of the i^{th} row and j^{th} column in the contingency table.

E_{ij} = expected frequency of the i^{th} row and j^{th} column in the contingency table.

However, the χ^2 test suffers from one serious limitation: though the deviations from expected frequencies are considered by the test, no definite conclusions are drawn in terms of persistence or mean reversion properties of these deviations. Thus to test persistence this study has also examined the conditional probabilities apart from the significance of the chi-square values.

Spearman Rank Correlation Coefficient (SRCC) Test

Spearman Rank Correlation Coefficient denoted by R_s is defined as follows :

$$R_s = 1 - \frac{6 \sum d_i^2}{n(n^2 - 1)} \qquad .....(8)$$

d_i = difference between rank of a scheme in current period and test period

n = number of observations or number of sample mutual fund schemes

For large samples, the sampling distribution of R_s is approximately normally distributed with mean zero and standard deviation $\frac{1}{\sqrt{n-1}}$. Then the corresponding Z statistic is given as follows :

$$Z = \frac{R_S}{\sqrt{n-1}} \qquad .....(11)$$

If the computed Z value is greater than the critical Z value at chosen level of significance then null hypothesis of no persistence is rejected.

Results and Conclusion

The objective of the study is to figure out whether performance is persistent for the sample equity mutual fund schemes applying a 2x2 non-parametric contingency table approach. Benchmark adjusted return, Sharpe ratio and Jensen Alpha are used as performance proxies to rank all schemes based on the past half-yearly return and annual return during May 2000 to March 2012. The significance of these results are also tested by three different tests of repeat winner approach (Malkiel, 1995), the odds ratio test (Brown & Goetzmann, 1995) and Kahn and Rudd's Chi-square (χ^2) test (1995). Besides, contingency table approach the Spearman rank correlation coefficient (SRCC) test is also used in the study to examine the performance persistence of sample mutual funds. The results are given in Tables A-1.1 to A-1.8 in the Appendix.

Performance Persistence of Benchmark Adjusted Return

According to the results given in Table-A-1.1 for the benchmark adjusted return there is some evidence of persistence in terms of odds ratio test, repeat winner approach and χ^2 test for a time horizon of six months. It is found from Table A-1.1 that among twenty three number of half-year periods there are seven numbers of persistence and three numbers of reversals in terms of odds ratio test and eight numbers of persistence and three numbers of reversals according to repeat winner approach at 5 per cent level of significance. This study has also examined the conditional probabilities apart from the significance of the $\chi 2$ values to determine whether it is persistence or reversal. If it is persistence then there will be higher conditional probabilities for WW and LL than WL and LW. In case of reversals the results will be opposite. Based on these considerations seven cases of persistence and four cases of reversals are reported for χ^2 test at 5 percent level of significance in Table-A-1.1. Thus, for the shorter time horizon (six months) there is some evidence of persistence of performance for the sample mutual funds. Table-A-1.1 also documents some cases of reversals in respect of these tests. However,such short-run performance persistence vanishes when Spearman rank correlation coefficient test (SRCC Test) is used to examine it. The results of this test are given in Tables-A-1.7 to A-1.8.

However, as the time horizon increases to one year the number of persistence

cases is significantly reduced for all the tests (except SRCC test) and disappeared for repeat winner approach as revealed by Table-A-1.2. This actually supports the strong case of market efficiency of the mutual funds industry in the long run.

Performance Persistence of Sharpe Ratio

Table-A-1.3 displays the contingency table and different test results when sample schemes are ranked as winners or losers based on Sharpe ratio. The results show that out of twenty three number of half-yearly periods there are fourteen numbers of persistence and seven numbers of reversals in terms of odds ratio test, fifteen numbers of persistence and seven numbers of reversals according to repeat winner approach and sixteen numbers of persistence and seven numbers of reversals according to χ^2 test at 5 per cent level of significance. Thus, the number of persistent half-yearly periods is much higher for Sharpe ratio than showed by benchmark adjusted return in terms of odds ratio test, Malkiel test (repeat winner approach) and Kahn and Rudd χ^2 test. But, Tables-A-1.7 to A-1.8 reveal that likewise benchmark adjusted return such short-run performance persistence vanishes when Spearman rank correlation coefficient test (SRCC test) is used.

Nevertheless, for annual time horizon though the numbers of persistence and reversal cases are significantly reduced from earlier half-yearly time horizon (except SRCC test), they did not disappear and are equal for odds ratio test and χ^2 test applied in the study. These results are shown in Table-A-1.4.

Performance Persistence of Jensen Alpha

In respect of Jensen Alpha, the type of persistence is almost similar as observed for benchmark adjusted return for the sample mutual fund schemes according to odds ratio Test, Malkiel Test (repeat winner approach) and Kahn and Rudd χ^2 test. The results obtained from Table-A-1.5 indicate that for odds ratio test numbers of persistence are six out of twenty three half-yearly periods and there is only one case of reversal. The corresponding figures for repeat winner approach and χ^2 test are six numbers of persistence and two numbers of reversals and six numbers of persistence and one number of reversal only. Now, as before the number of persistence and reversals are reduced in the case of one year time horizon (Table-A-1.6). Finally, the SRCC test has documented no persistence for both the time horizons.

Thus, in conclusion, this can be argued that though there is some evidence of short-run performance persistence in the Indian mutual funds market there

is no long-run performance persistence during the period under consideration. This actually signifies that mutual funds market in India is efficient in the long-run. This is because market efficiency of any form implies historical performance cannot be used to select funds that will be superior performers in the future. Thus, on the whole this analysis suggests that past performance of mutual funds cannot beused as indicators of future performance. This finding is consistent with the earlier Indian studies of Guha Deb (2006), Sehgal and Jhanwar (2008) and Mondal and Khan (2014) and also with studies of developed capital markets like Jensen (1968), Kritzman (1983), Dunn and Theisen (1983), Elton et.al (1990), Bauer et. al. (2006), Casarin et al. (2008), Barras (2010), Fama and French (2010), Busse et al. (2010).

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Appendix : Results of Performance Persistence Based on Three Performance Measures

Table-A-1.1 : Contingency Table for Performance Persistence of Benchmark Adjusted Return (6 Months Lag)

S. No.	Time Period	WW	WL	LW	LL	Percentage Repeat Winner	Malkiel Z Score	CPR	B &G Z Score	χ^2
1	H1-H2	25 (62.5%)	14 (35%)	16 (40%)	25 (62.5%)	64.10	1.7614097*	2.790179	2.218491*	5.1*
2	H2-H3	22 (55%)	19 (47.5%)	16 (40%)	23 (57.5%)	53.66	0.4685213	1.664474	1.127894	1.5
3	H3-H4	19 (47.5%)	21 (52.5%)	21 (52.5%)	19 (47.5%)	47.5	-0.316228	0.818594	-0.44703	0.2
4	H4-H5	18 (45%)	22 (55%)	22 (55%)	18 (45%)	45	-0.632456	0.669421	-0.89293	0.8
5	H5-H6	16 (40%)	25 (62.5%)	24 (60%)	15 (37.5%)	39.02	-1.405564	0.4	-1.99555*	4.1*
6	H6-H7	27 (67.5%)	13 (32.5%)	13 (27%)	27 (67.5%)	67.5	2.2135944*	4.313609	3.061887*	9.8*
7	H7-H8	19 (47.5%)	21 (52.5%)	21 (52.5%)	19 (21%)	47.5	-0.316228	0.818594	-0.44703	0.2
8	H8-H9	13 (32.5%)	27 (67.5%)	27 (67.5%)	13 (32.5%)	32.5	-2.213594*	0.231824	-3.06189*	9.8*
9	H9-H10	25 (62.5%)	11 (27.5%)	26 (65%)	18 (45%)	69.44	2.3333333*	1.573427	0.955704	7.3
10	H10-H11	26 (65%)	14 (35%)	14 (35%)	26 (65%)	65	1.8973666*	3.44898	2.640912*	7.2*

(Contd...)

11	H11-H12	25 (62.5%)	15 (37.5%)	15 (62.5%)	25 (62.5%)	62.5	1.5811388*	2.777778	2.21194*	5
12	H12-H13	22 (55%)	16 (40%)	19 (47.5%)	23 (57.5%)	57.89	0.9733285	1.664474	1.127894	1.5
13	H13-H14	24 (60%)	16 (40%)	16 (40%)	24 (60%)	60	1.2649111	2.25	1.776659	3.2
14	H14-H15	24 (60%)	16 (40%)	17 (42.5%)	23 (57.5%)	60	1.2649111	2.029412	1.557581	2.5
15	H15-H16	11 (27.5%)	29 (72.5%)	29 (72.5%)	11 (27.5%)	27.5	-2.84605*	0.143876	-3.87154*	16.2*
16	H16-H17	27 (67.5%)	13 (32.5%)	13 (32.5%)	27 (67.5%)	67.5	2.2135944*	4.313609	3.061887*	9.8*
17	H17-H18	18 (45%)	22 (55%)	22 (55%)	18 (45%)	45	-0.632456	0.669421	-0.89293	0.8
18	H18-H19	22 (55%)	12 (30%)	26 (65%)	20 (50%)	64.71	1.7149859*	1.410256	0.737549	5.2*
19	H19-H20	28 (70%)	12 (30%)	12 (30%)	28 (70%)	70	2.5298221*	5.444444	3.472888*	12.8*
20	H20 -H21	19 (47.5%)	21 (52.5%)	21 (52.5%)	19 (47.5%)	47.5	-0.316228	0.818594	-0.44703	0.2
21	H21-H22	14 (35%)	23 (57.5%)	25 (62.5%)	18 (45%)	37.84	-1.479591	0.438261	-1.79819	3.7
22	H22-H23	28 (70%)	8 (20%)	16 (40%)	28 (70%)	77.78	3.3333333*	6.125	3.561713*	14.4*
23	H23-H24	13 (32.5%)	27 (67.5%)	27 (67.5%)	13 (32.5%)	32.5	-2.213594*	0.231824	-3.06189*	9.8*

Source : Calculated.

Figures in the parentheses are conditional probabilities.; * Denotes 5% level of significance.

Table A-1.2 : Contingency Table for Performance Persistence of Benchmark Adjusted Return (1year Lag)

S. No.	Time Period	WW	WL	LW	LL	Percentage Repeat Winner	Malkiel Z Score	CPR	B &G Z Score	χ^2
1	Y1-Y2	20 (50%)	20 (50%)	20 (50%)	20 (50%)	50	0	1	0	0
2	Y2-Y3	21 (52.5%)	19 (47.5%)	19 (47.5%)	21 (52.5%)	52.5	0.3162278	1.221607	0.447027	0.2
3	Y3-Y4	23 (57.5%)	17 (42.5%)	17 (42.5%)	23 (57.5%)	57.5	0.9486833	0.546314	-1.33655	1.8
4	Y4-Y5	23 (57.5%)	17 (42.5%)	17 (42.5%)	23 (57.5%)	57.5	0.9486833	0.546314	-1.33655	1.8
5	Y5-Y6	23 (57.5%)	17 (42.5%)	17 (42.5%)	23 (57.5%)	57.5	0.9486833	0.546314	-1.33655	1.8
6	Y6-Y7	25 (64%)	15 (38%)	14 (34%)	26 (63%)	62.5	1.5811388	3.095238	2.427955*	6.1*
7	Y7-Y8	18 (46%)	21 (54%)	21 (51%)	20 (49%)	46.15	-0.480384	0.816327	-0.45289	0.3
8	Y8-Y9	17 (41%)	22 (54%)	24 (62%)	17 (44%)	43.59	-0.800641	0.547348	-1.33183	1.9
9	Y9-Y10	17 (43%)	24 (60%)	16 (58%)	23 (40%)	41.46	-1.093216	0.492754	-1.55758	2.5
10	Y10-Y11	25 (61%)	15 (37%)	16 (41%)	24 (62%)	62.5	1.581138	2.5	1.995555*	4.1*
11	Y11-Y12	23 (58%)	18 (45%)	17 (43%)	22 (55%)	56.09	0.780868	1.653595	1.115436	1.3

Source : Calculated.

Figures in the parentheses are conditional probabilities; * Denotes 5% level of significance.

Table-A-1.3 : Contingency Table for Performance Persistence of Sharpe Ratio (6 Months Lag)

S. No.	Time Period	WW	WL	LW	LL	Percentage Repeat Winner	Malkiel Z Score	CPR	B &G Z Score	χ^2
1	H1-H2	27 (67.5%)	13 (32.5%)	13 (32.5%)	27 (67.5%)	67.5	2.213594*	4.313609	3.061887*	9.8*
2	H2-H3	30 (75%)	10 (25%)	23 (57.5%)	17 (42.5%)	75	3.162278*	2.217391	1.640491	10.9*
3	H3-H4	20 (50%)	33 (82.5%)	20 (50%)	7 (17.5%)	37.73	-1.78569*	0.212121	-2.96681*	16.9*
4	H4-H5	23 (57.5%)	17 (42.5%)	3 (7.5%)	37 (92.5%)	57.5	0.948683	16.68627	4.137925*	29.8*
5	H5-H6	21 (52.5%)	9 (22.5%)	15 (37.5%)	35 (87.5%)	70	2.19089*	5.444444	3.362609*	18.6*
6	H6-H7	33 (82.5%)	10 (25%)	8 (20%)	29 (72.5%)	76.74	3.507467*	11.9625	4.610247*	24.7*
7	H7-H8	2 (5%)	38 (95%)	38 (95%)	2 (5%)	5	-5.6921*	0.00277	-5.73977*	64.8*
8	H8-H9	3 (7.5%)	37 (92.5%)	39 (97.5%)	1 (2.5%)	7.5	-5.37587*	0.002079	-5.24585*	65*
9	H9-H10	38 (95%)	3 (7.5%)	2 (5%)	37 (92.5%)	92.68	5.466082*	234.3333	5.794969*	61.3*
10	H10-H11	38 (95%)	2 (5%)	2 (5%)	38 (95%)	95	5.6921*	361	5.739768*	64.8*
11	H11-H12	36 (90%)	4 (10%)	4 (10%)	36 (90%)	90	2.213594*	81	5.895772*	51.2*

(Contd...)

12	H12-H13	37 (92.5%)	4 (10%)	3 (7.5%)	36 (90%)	90.24	3.162278*	111	5.895494*	54.5*
13	H13-H14	39 (97.5%)	2 (5%)	2 (5%)	37 (92.5%)	95.12	-1.78569	360.75	5.738994*	64.9*
14	H14-H15	39 (97.5%)	1 (2.5%)	1 (2.5%)	39 (97.5%)	97.5	0.948683	1521	5.115885*	72.2*
15	H15-H16	2 (5%)	39 (97.5%)	38 (95%)	1 (2.5%)	4.878	2.19089*	0.00135	-5.30433*	68.5*
16	H16-H17	39 (97.5%)	1 (2.5%)	1 (2.5%)	39 (97.5%)	97.5	3.507467*	1521	5.115885*	72.2*
17	H17-H18	1 (2.5%)	39 (97.5%)	39 (97.5%)	1 (2.5%)	2.5	-5.6921*	0.000657	-5.11589*	72.2*
18	H18-H19	40 (100%)	0 (0%)	0 (0%)	40 (100%)	100	-5.37587*	undefined	undefined	80*
19	H19-H20	37 (92.5%)	3 (7.5%)	3 (7.5%)	37 (92.5%)	92.5	5.466082*	152.1111	5.9186*	57.8*
20	H20 -H21	37 (92.5%)	3 (7.5%)	3 (7.5%)	37 (92.5%)	92.5	5.6921*	152.1111	5.9186*	57.8*
21	H21-H22	39 (97.5%)	1 (2.5%)	1 (2.5%)	39 (97.5%)	2.5	-6.00833*	0.000657	-5.11589*	72.2*
22	H22-H23	37 (92.5%)	3 (7.5%)	3 (7.5%)	37 (92.5%)	92.5	5.375872*	152.1111	5.9186*	57.8*
23	H23-H24	37 (92.5%)	3 (7.5%)	2 (5%)	38 (95%)	7.5	-5.37587*	0.004267	-5.79497*	61.3*

Source : Calculated.

Figures in the parentheses are conditional probabilities; * Denotes 5% level of significance.

Table-A-1.4 : Contingency Table for Performance Persistence of Sharpe Ratio (1year Lag)

S. No.	Time Period	WW	WL	LW	LL	Percentage Repeat Winner	Malkiel Z Score	CPR	B &G Z Score	χ^2
1	Y1-Y2	3 (7.5%)	37 (92.5%)	37 (92.5%)	3 (7.5%)	7.5	-5.37587*	0.006574	-5.9186*	57.8*
2	Y2-Y3	15 (37.5%)	25 (62.5%)	25 (62.5%)	15 (37.5%)	37.5	-1.58114	0.36	-2.21194*	5*
3	Y3-Y4	17 (42.5%)	23 (57.5%)	23 (57.5%)	17 (42.5%)	42.5	-0.94868	0.546314	-1.33655	1.8
4	Y4-Y5	38 (5%)	2 (95%)	2 (95%)	38 (5%)	95	5.6921*	361	5.739768*	64.8*
5	Y5-Y6	39 (97.5%)	2 (5%)	1 (2.5%)	38 (95%)	95.12	5.778429*	741	5.304327*	68.5*
6	Y6-Y7	35 (87.5%)	5 (12.5%)	5 (12.5%)	35 (87.5%)	87.5	4.743416*	49	5.75608*	45*
7	Y7-Y8	33 (82.5%)	7 (17.5%)	7 (17.5%)	33 (82.5%)	82.5	4.110961*	22.22449	5.26975*	33.8*
8	Y8-Y9	7 (17.5%)	35 (87.5%)	33 (82.5%)	5 (12.5%)	16.66	-4.32049*	0.030303	-5.51654*	39.4*
9	Y9-Y10	4 (10%)	36 (90%)	36 (90%)	4 (10%)	10	-5.05964	0.012346	-5.89577*	51.2*
10	Y10-Y11	36 (90%)	7 (17.5%)	4 (10%)	33 (82.5%)	83.72	4.422459	42.42857	5.58111*	42.5*
11	Y11-Y12	14 (35%)	27 (67.5%)	25 (62.5%)	14 (35%)	34.14	-2.03026	0.29037	-1.95899*	7.3*

Source : Calculated.

Figures in the parentheses are conditional probabilities; * Denotes 5% level of significance.

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Table-A-1.5 : Contingency Table for Performance Persistence of Jensen Alpha (6 Months Lag)

S. No.	Time Period	WW	WL	LW	LL	Percentage Repeat Winner	Malkiel Z Score	CPR	B &G Z Score	χ^2
1	H1-H2	18 (45%)	21 (52.5%)	23 (57.5%)	18 (45%)	46.15	-0.48038	0.670807	-0.88791	0.9
2	H2-H3	19 (47.5%)	22 (55%)	22 (55%)	17 (42.5%)	46.34	-0.46852	0.667355	-0.89904	0.9
3	H3-H4	20 (50%)	21 (52.5%)	20 (50%)	19 (47.5%)	48.78	-0.15617	0.904762	-0.22365	0.1
4	H4-H5	17 (42.5%)	23 (57.5%)	23 (57.5%)	17 (42.5%)	42.5	-0.94868	0.546314	-1.33655	1.8
5	H5-H6	18 (45%)	22 (55%)	22 (55%)	18 (45%)	45	-0.63246	0.669421	-0.89293	0.8
6	H6-H7	24 (60%)	16 (40%)	16 (40%)	24 (60%)	60	1.264911	2.25	1.776659	3.2
7	H7-H8	14 (35%)	27 (67.5%)	26 (65%)	13 (32.5%)	34.15	-2.03026*	0.259259	-2.85319*	8.5*
8	H8-H9	14 (35%)	26 (65%)	20 (50%)	20 (50%)	35	-1.89737*	0.538462	-1.35121	3.6
9	H9-H10	27 (67.5%)	13 (32.5%)	13 (32.5%)	27 (67.5%)	67.5	2.213594*	4.313609	3.061887*	9.8*
10	H10-H11	26 (65%)	14 (35%)	14 (35%)	26 (65%)	65	2.213594*	3.44898	2.640912*	7.2*

(Contd...)

11	H11-H12	20 (50%)	20 (50%)	20 (50%)	20 (50%)	50	0	1	0	0
12	H12-H13	21 (52.5%)	19 (47.5%)	19 (47.5%)	21 (52.5%)	52.5	0.316228	1.221607	0.447027	0.2
13	H13-H14	23 (57.5%)	18 (45%)	17 (42.5%)	22 (55%)	56.09	0.780869	1.653595	1.115436	1.3
14	H14-H15	21 (52.5%)	19 (47.5%)	19 (47.5%)	21 (52.5%)	52.5	0.316228	1.221607	0.447027	0.2
15	H15-H16	16 (40%)	24 (60%)	24 (60%)	16 (40%)	40	-1.26491	0.444444	-1.77666	3.2
16	H16-H17	22 (55%)	19 (47.5%)	17 (42.5%)	22 (55%)	53.66	0.468521	1.498452	0.899041	0.9
17	H17-H18	17 (42.5%)	23 (55%)	23 (55%)	17 (42.5%)	42.5	-0.94868	0.546314	-1.34392	1.8
18	H18-H19	25 (62.5%)	15 (37.5%)	15 (37.5%)	25 (62.5%)	62.5	1.581139	2.777778	2.21194*	5
19	H19-H20	31 (77.5%)	8 (20%)	10 (25%)	31 (77.5%)	79.48	3.682948*	12.0125	4.620145*	24.3*
20	H20-H21	27 (67.5%)	13 (32.5%)	13 (32.5%)	27 (67.5%)	67.5	2.213594*	4.313609	3.061887*	9.8*
21	H21-H22	28	12	11	29	70	2.529822*	6.151515	3.674491*	14.5*
22	H22-H23	25	14	16	25	64.10	1.76141*	2.790179	2.218491*	5.1*
23	H23-H24	18	23	22	17	43.90	-0.78087	0.604743	-1.11544	1.3

Source : Calculated.

Figures in the parentheses are conditional probabilities; * Denotes 5% level of significance.

Table-A-1.6 : Contingency Table for Performance Persistenceof Jensen Alpha (1 year lag)

S. No.	Time Period	WW	WL	LW	LL	Percentage Repeat Winner	Malkiel Z Score	CPR	B &G Z Score	χ^2
1	Y1-Y2	19 (48%)	22 (55%)	20 (50%)	19 (48%)	46.34	-0.46852	0.820455	-0.44172	0.3
2	Y2-Y3	23 (58%)	17 (43%)	17 (43%)	23 (58%)	57.5	0.948683	1.83045	1.336546	1.8
3	Y3-Y4	18 (45%)	23 (58%)	20 (50%)	19 (48%)	43.90	-0.78087	0.743478	-0.66006	0.7
4	Y4-Y5	23 (59%)	16 (41%)	17 (41%)	24 (59%)	58.97	1.120897	2.029412	1.557581	2.5
5	Y5-Y6	22 (56%)	18 (46%)	18 (44%)	22 (54%)	55	0.632456	1.493827	0.892928	0.8
6	Y6-Y7	19 (49%)	21 (54%)	20 (49%)	20 (49%)	47.5	-0.31623	0.904762	-0.22365	0.1
7	Y7-Y8	19 (49%)	21 (51%)	20 (51%)	20 (49%)	48.71	-0.16013	0.904762	-0.22365	0.1
8	Y8-Y9	20 (50%)	20 (50%)	20 (50%)	20 (50%)	50	0	0.904762	-0.22365	0
9	Y9-Y10	20 (50%)	22 (55%)	20 (50%)	18 (45%)	47.62	-0.30861	1	0	0.4
10	Y10-Y11	27 (66%)	15 (37%)	14 (36%)	24 (62%)	64.29	1.85164	3.085714*	2.41998*	6.3*
11	Y11-Y12	26 (63%)	14 (34%)	14 (36%)	26 (67%)	65	1.897367	3.44898*	2.640912*	7.2*

Source : Calculated.

Figures in the parentheses are conditional probabilities; * Denotes 5% level of significance.

Table-A- 1.7 : Results of Spearman Rank Correlation Coefficient Test (6 Months Lag)

S.No.	Time Period	BAR	Sharpe Ratio	Jensen Alpha
1	H1-H2	Z=0.0274230285837525	Z=0.0393147804479706	Z=0.00198591464931386
2	H2-H3	Z=-0.0184402592669357	Z=-0.00610807214848728	Z=-0.00769838627004937
3	H3-H4	Z=0.00341798855977527	Z=-0.020167714904785	Z=-0.00830761108278711
4	H4-H5	Z=-0.0253500818183332	Z=0.0188912438685727	Z=-0.0210011133499154
5	H5-H6	Z=-0.0205844141273502	Z=0.0178442211384564	Z=-0.0180235600443705
6	H6-H7	Z=0.032848030487655	Z=0.0699949200435459	Z=0.0310572787653653
7	H7-H8	Z=-0.0111401108614897	Z=-0.077039246774379	Z=-0.0429332066084734
8	H8-H9	Z-0.0465226220636077	Z=-0.0888967132595253	Z =-0.0627527930488369
9	H9-H10	Z=0.0578130611256432	Z=0.0893846205770858	Z=0.0619589546564817
10	H10-H11	Z=0.0397842264075693	Z=0.0894874767143013	Z=0.050080389476522
11	H11-H12	Z=0.0238230637812114	Z=0.0792308736981238	Z=0.0181053174867725
12	H12-H13	Z=0.00542763924075423	Z=0.0666006675154357	Z=0.0106759395755943
13	H13-H14	Z=0.016190610932454	Z=0.0819130452762808	Z=0.027106548161551
14	H14-H15	Z=0.0284173045768352	Z=0.0832686364180435	Z=0.0198670585036937

(Contd...)

15	H15-H16	Z=-0.0638947599056136	Z=-0.0908140571506955	Z=-0.0428224384607029
16	H16-H17	Z=0.0404910326838191	Z=0.083690610314312	Z=0.0224621979657453
17	H17-H18	Z=-0.00175910368006952	Z=-0.0900571414742638	Z=-0.0173615884945992
18	H18-H19	Z=-0.0114618659573945	Z=0.0849802680347828	Z=0.0396365355438753
19	H19-H20	Z=0.0568319718168188	Z=0.0855921301843722	Z=0.0776273728923033
20	H20-H21	Z=0.00869266226313214	Z=0.0759658506757459	Z=0.0391565402368699
21	H21-H22	Z=-0.0204446352742113	Z=-0.073668730277934	Z=0.0368910678812781
22	H22-H23	Z=0.0667325343580197	Z=0.0855710314895588	Z=0.0389956626889175
23	H23-H24	Z=-0.0671703322753983	Z=-0.083904234599298	Z=-0.018880694521166

Source : Calculated.

BAR : Benchmark Adjusted Return.

Table-A-1.8 : Results of Spearman Rank Correlation Coefficient Test (1 year Lag)

S.No.	Time Period	BAR	Sharpe Ratio	Jensen Alpha
1	Y1-Y2	Z=-0.00300392667406175	Z=-0.0553471511693238	Z=-0.0174380712632979
2	Y2-Y3	Z=-0.00140042586824125	Z=-0.022103520153917	Z=0.0142679923675804
3	Y3-Y4	Z=0.0147084276218107	Z=-0.00809398679780115	Z=-0.00222854963966829
4	Y4-Y5	Z=0.0248806358587344	Z=0.0785425287798357	Z=0.0393965378903726
5	Y5-Y6	Z=0.0316480422201413	Z=0.0743676245436287	Z=0.0409472919591595
6	Y6-Y7	Z=0.030076189456541	Z=0.0714533673225241	Z=0.0223857151970466
7	Y7-Y8	Z=0.000134504179435599	Z=0.0501885202874408	Z=0.0108816518500253
8	Y8-Y9	Z=-0.014631944853112	Z=-0.0456575755762572	Z=-0.00260305147260663
9	Y9-Y10	Z=-0.0378879812112125	Z=-0.0688133931339939	Z=-0.0202072749575602
10	Y10-Y11	Z=0.0196165115027843	Z=0.0676767009509205	Z=0.044486598014112
11	Y11-Y12	z=0.0228947212094206	Z=-0.00852123536777306	z=0.0249597559642848

Source : Calculated.

BAR : Benchmark Adjusted Return

Table-A-1.8 : Sample Mutual Fund Schemes

S. No.	Name of the Scheme	Aim
1.	Baroda Pioneer ELSS 96	TP
2.	Birla Sun Life 95	G
3.	Birla Sun Life Advantage Fund	G
4.	Birla Sun Life buy India Fund	G
5.	Birla Sun Life Equity Fund	G
6.	Birla Sun Life India Opportunities Fund	G
7.	Birla Sun Life MNC Fund	G
8.	Birla Sun Life New Millennium	G
9.	CanaraRobeco Balance	B
10.	DSP BlackRock Balanced Fund	B
11.	DSP BlackRock Opportunities Fund	G
12.	DSP BlackRock Technology.com Fund	G
13.	Escorts Tax Plan	TP
14.	Franklin India Bluechip	G
15.	Franklin India Opportunity Fund	G
16.	Franklin India Prima Fund	G
17.	Franklin India Prima Plus	G
18.	Franklin India Taxshield	TP
19.	Franklin Infotech Fund	G
20.	FT India Balanced Fund	B
21.	HDFC Balanced Fund	B
22.	HDFC Capital Builder Fund	G
23.	HDFC Equity Fund	G
24.	HDFC Growth Fund	G
25.	HDFC Prudence Fund	B
26.	HDFC Taxsaver	TP

(Contd...)

S. No.	Name of the Scheme	Aim
27.	HDFC Top 200	G
28.	ICICI Prudential Balanced	B
29.	ICICI Prudential FMCG	G
30.	ICICI Prudential Tax Plan	TP
31.	ICICI Prudential Top 100 Fund	G
32.	ICICI Prudential Top 200 Fund	G
33.	ICICI Prudential Technology Fund	G
34.	ING Balanced Fund	B
35.	ING Core Equity Fund	G
36.	JM Balanced	B
37.	JM Basic Fund	G
38.	JM Equity	G
39.	Kotak 50	G
40.	Kotak Balance	B
41.	L&T Opportunities Fund	G
42.	LIC Nomura Equity Fund	G
43.	LIC Nomura MF Growth Fund	G
44.	LIC Nomura Tax Plan	TP
45.	PRINCIPAL Balanced Fund	B
46.	PRINCIPAL Index Fund	G
47.	PRINCIPAL Growth Fund	G
48.	Reliance Growth	G
49.	Reliance Vision	G
50.	Sahara Taxgain	TP
51.	SBI Magnum Balanced Fund	B
52.	SBI Magnum Equity Fund	G
53.	SBI Magnum Global Fund 94	G
54.	SBI Magnum Multiplier Plus 93	G

(Contd...)

S. No.	Name of the Scheme	Aim
55.	SBI Magnum Sector Funds Umbrella – Contra	G
56.	SBI Magnum Sector Funds Umbrella – Pharma	G
57.	SBI Magnum Tax Gain Scheme 93	TP
58.	Sundaram Balanced Fund	B
59.	Sundaram Growth Fund	G
60.	SundaramTaxsaver	TP
61.	Tata Balanced Fund	B
62.	Tata Ethical Fund	G
63.	Tata Life Sciences and Technology Fund	G
64.	Tata Pure Equity Fund	G
65.	Tata Tax Saving Fund	T P
66.	Taurus Bonanza Fund	G
67.	Taurus Discovery Fund	G
68.	Taurus Starshare Fund	G
69.	Taurus Taxshield	TP
70.	Templeton India Growth Fund	G
71.	UTI Balanced Fund	B
72.	UTI Energy Fund	G
73.	UTI Equity Fund	G
74.	UTI Equity Tax Savings Plan	TP
75.	UTI Masterplus Unit Scheme 91	G
76.	UTI MNC Fund	G
77.	UTI Pharma and Healthcare Fund	G
78.	UTI Nifty Fund	G
79.	UTI Top 100 Fund	G
80.	UTI Services Industries Fund	G

G-Growth, B-Balanced, TP- Tax Planning

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