



# DEPARTMENT OF MANAGEMENT BIRLA INSTITUTE OF TECHNOLOGY

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## Academic Department: 3.4.6 / 3.4.6.1:

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#### Department/Section: Management

3.4.6 Number of books and chapters in edited volumes published per teacher during the year 1st July 2019 to 30th June 2020. (15)

3.4.6.1: Total number of books and chapters in edited volumes / books published, and papers in national/international conference-proceedings year wise during the last year

Sl. No.	Name of the teacher	Title of the book/chapters published	Title of the paper	Title of the proceedings of the conference	Name of the conference	National / International	Year of publication	ISBN/ISSN number of the proceeding	Affiliating Institute at the time of publication	Name of the publisher
1	Roy, S., Kumar, K. & Devim, P.	Soft Computing for Engineering Optimization CRC Press				International	2019	13-978-0-367-14861-4.		CRC Press
2	Jha, R. & Shivani, S.	Adoption of E-Governance in India				National	2020	978-81-946587-3-3		
3	Preeti, Supriyo Roy & Kaushik Kumar		Radial Data Envelopment Analysis Approach to Performance Measurement: Study on Indian Banking System.	Supply Chain Intelligence: Application and Optimization - Management and Industrial Engineering', Springer Nature		International	2020			
4	Singh S.K., Roy, Supriyo.		Internet of Things (IoT) Based Green Logistics Operations for Sustainable Development in the Indian Context. In: Nath V., Mandal J.K. (eds.) Nanoelectronics, Circuits and Communication Systems. NCCS 2018			International	2020			
5	Ghosh, S. and Dutta, S.		Foreign Direct Investments: Concepts, Methodologies, Tools and Applications, M&A Deals and Corporate Governance Framework: A Study in Indian Telecom Sector			International				
6	Sujata Priyambada Dash		'Emotional Intelligence: Key to Business Success'.			National	2020	978-93-88805-95-7		
7	Preeti & Supriyo Roy		Data Envelopment Analysis: Application to Manufacturing Sector. Published: 'Optimization Using Evolutionary Algorithms and Meta-heuristics: Application in Engineering			International	2019	13978-0-367-26044-6		
8	Supriyo Roy & K. Kumar		Strategic Planning of Cold Supply Chain towards Good Manufacturing Practices: Issues and Challenges in Indian Market			International	2019	978179980-9456		

*Shradha Sinar*  
Head of Department

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# Optimization

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Science, Technology, and Management

## Soft Computing Techniques for Engineering Optimization

Kaushik Kumar  
Supriyo Roy  
J. Paulo Davim



CRC Press  
Taylor & Francis Group

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# Soft Computing Techniques for Engineering Optimization

Kaushik Kumar, Supriyo Roy, and  
J. Paulo Davim



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Boca Raton London New York

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## Soft Computing Techniques for Engineering Optimization

This book covers the issues related to optimization of engineering and management problems using soft computing techniques with an industrial outlook. It covers a broad area related to real life complex decision making problems using a heuristics approach. It also explores a wide perspective and future directions in industrial engineering research on a global platform/scenario. The book highlights the concept of optimization, presents various soft computing techniques, offers sample problems, and discusses related software programs complete with illustrations.

### Features

- Explains the concept of optimization and relevance to soft computing techniques towards optimal solution in engineering and management
- Presents various soft computing techniques
- Offers problems and their optimization using various soft computing techniques
- Discusses related software programs, with illustrations
- Provides a step-by-step tutorial on how to handle relevant software for obtaining the optimal solution to various engineering problems

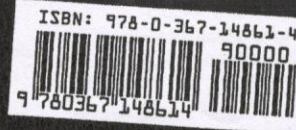
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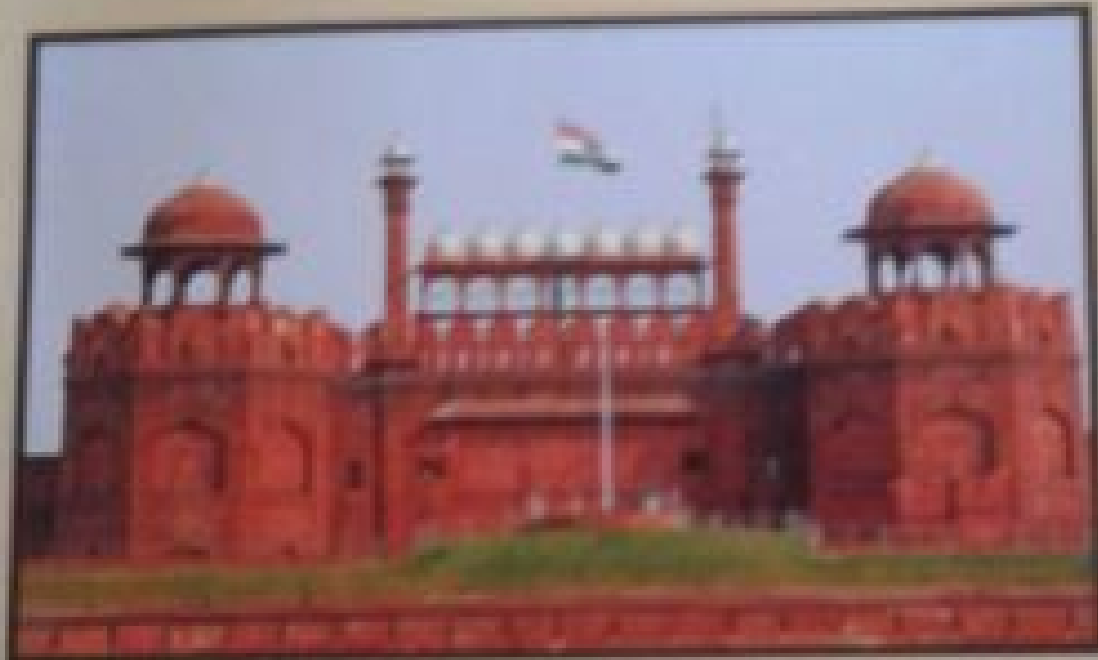
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# Adoption of e-Governance in India



**Dr. Rohini Jha and  
Dr. Shradha Shivani**

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# Radial Data Envelopment Analysis Approach to Performance Measurement: Study on Indian Banking System

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Chapter

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## Abstract

Altering customer demands with augmented competitive pressures significantly change the operating environment of Indian banks. Being competitive, banks are continuously keeping themselves on a platform of performance as set by them. Traditional methods for evaluation of performance are not working properly due to different issues as floated in this sector. Considering all the above issues, performance measurement is very complex as well as critical in terms of banks long-term sustainability. This study adopts a non-traditional method of measuring performance via Data Envelopment Analysis; a frontier-based radial approach to measure performance between public and private sector banks for last five years (2015–2019). Using non-parametric test, this study also tests the hypothesis that *'there exist no statistical efficiency differences between the public and private sector banks'*. Analyses show a significant result that: *no bank is found to be overall technically efficient with all banks scoring less than one, and the private sector banks is 1.5% more technically efficient than public sector banks*. Most significantly, strong ownership effect is proofed to be significant on the performance of Indian banking system.

# Keywords

Operational efficiency Radial model Data envelopment analysis  
Performance measurement Indian banking system Super-efficiency  
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# Appendix

No.	Full name	Code No.	Full name	Code No.	Full name	Code
1	Allahabad Bank	ABB 18	Dhanlaxmi Bank Limited	DBL 35	Punjab National Bank	PNB
2	Andhra Bank	AB 19	Federal Bank Limited	FB 36	Pure Technical Efficiency	PTE
3	Axis Bank Limited	ABL 20	HDFC Bank Limited	HDFC 37	Public sector bank	PSB
4	Bank of Baroda	BoB 21	ICICI Bank Limited	ICICI 38	Private sector bank	PB
5	Bank of India	BoI 22	IDBI Bank Limited	IDBI 39	RBL Bank Limited	RBL
6	Bank of Maharashtra	BoM 23	Indian Bank	IB 40	Return to scale	RTS
7	Banker, Cooper and Rhodes	BCC 24	Indian Overseas Bank	IOB 41	Scale efficiency	SE

8	Canara Bank	CB	25	Indusind Bank Limited	IBL	42	South Indian Bank Limited	SIB
9	Catholic Syrian Bank Ltd.	CSB	26	Jammu & Kashmir Bank Ltd.	JKB	43	State Bank of India	SBI
10	Central Bank of India	CBI	27	Karnataka Bank Limited	KB	44	Syndicate Bank	SB
11	Charnes, Cooper and Rhodes	CCR	28	Karur Vysya Bank Ltd.	KVB	45	Tamilnad Mercantile Bank Ltd.	TMB
12	City Union Bank Ltd.	CUB	29	Kotak Mahindra Bank Limited	KMB	46	UCO Bank	UCO
13	Corporation Bank	CPB	30	Lakshmi Vilas Bank Ltd.	LVB	47	Union Bank of India	UB
14	Data Envelopment Analysis	DEA	31	Nainital Bank Limited	NB	48	United Bank of India	UBI
15	DCB Bank Limited	DCB	32	Oriental Bank of Commerce	OBC	49	Variable return to scale	VRS
16	Decision Making Unit	DMU	33	Overall Technical Efficiency	OTE	50	Vijaya Bank	VB
17	Dena Bank	DB	34	Punjab & Sind Bank	PS	51	YES Bank Limited	YES

## References

Agarwal, S. (2016). DEA-neural networks approach to assess the performance of public transport sector of India. *Opsearch*, 53(2), 248–258.  
Google Scholar (<https://scholar.google.com/scholar?q=Agarwal%2C%20S.%20%282016%29.%20DEA-neural%20networks%20approach%20to%20assess%20the%20performance%20of%20public%20transport%20sector%20of%20India.%20Opsearch%2C%2053%282%29%2C%20248%E2%80%93258>.)

Alhassan, A. L., & Tetteh, M. L. (2017). Non-interest income and bank efficiency in Ghana: A two-stage DEA bootstrapping approach. *Journal of African Business*, 18(1), 124–142.  
CrossRef (<https://doi.org/10.1080/15228916.2016.1227668>)  
Google Scholar ([http://scholar.google.com/scholar\\_lookup?title=Non-interest%20income%20and%20bank%20efficiency%20in%20Ghana%3A%20A%20two-stage%20DEA%20bootstrapping%20approach&author=AL.%20Alhassan&author=ML.%20Tetteh&journal=Journal%20of%20African%20Business&volume=18&issue=1&pages=124-142&publication\\_year=2017](http://scholar.google.com/scholar_lookup?title=Non-interest%20income%20and%20bank%20efficiency%20in%20Ghana%3A%20A%20two-stage%20DEA%20bootstrapping%20approach&author=AL.%20Alhassan&author=ML.%20Tetteh&journal=Journal%20of%20African%20Business&volume=18&issue=1&pages=124-142&publication_year=2017))

Andersen, P., & Petersen, N. C. (1993). A procedure for ranking efficient units in data envelopment analysis. *Management Science*, 39(10), 1261–1264.  
zbMATH (<http://www.emis.de/MATH-item?0800.90096>)  
CrossRef (<https://doi.org/10.1287/mnsc.39.10.1261>)  
Google Scholar ([http://scholar.google.com/scholar\\_lookup?title=A%20procedure%20for%20ranking%20efficient%20units%20in%20data%20envelopment%20analysis&author=P.%20Andersen&author=NC.%20Petersen&journal=Management%20Science&volume=39&issue=10&pages=1261-1264&publication\\_year=1993](http://scholar.google.com/scholar_lookup?title=A%20procedure%20for%20ranking%20efficient%20units%20in%20data%20envelopment%20analysis&author=P.%20Andersen&author=NC.%20Petersen&journal=Management%20Science&volume=39&issue=10&pages=1261-1264&publication_year=1993))

Azad, M. A. K., Munisamy, S., Masum, A. K. M., Saona, P., & Wanke, P. (2017). Bank efficiency in Malaysia: A use of malmquist meta-frontier analysis. *Eurasian Business Review*, 7(2), 287–311.  
CrossRef (<https://doi.org/10.1007/s40821-016-0054-4>)  
Google Scholar ([http://scholar.google.com/scholar\\_lookup?title=Bank%20efficiency%20in%20Malaysia%3A%20A%20use%20of%20malmquist%20meta-frontier%20analysis&author=MAK.%20Azad&author=S.%20Munisamy&author=AKM.%20Masum&author=P.%20Saona&author=P.%20Wanke&journal=Eurasian%20Business%20Review&volume=7&issue=2&pages=287-311&publication\\_year=2017](http://scholar.google.com/scholar_lookup?title=Bank%20efficiency%20in%20Malaysia%3A%20A%20use%20of%20malmquist%20meta-frontier%20analysis&author=MAK.%20Azad&author=S.%20Munisamy&author=AKM.%20Masum&author=P.%20Saona&author=P.%20Wanke&journal=Eurasian%20Business%20Review&volume=7&issue=2&pages=287-311&publication_year=2017))

Banker, R. D., Charnes, A., & Cooper, W. W. (1984). Some models for estimating technical and scale inefficiencies in data envelopment analysis. *Management Science*, 30(9), 1078–1092.  
zbMATH (<http://www.emis.de/MATH-item?0552.90055>)  
CrossRef (<https://doi.org/10.1287/mnsc.30.9.1078>)  
Google Scholar ([http://scholar.google.com/scholar\\_lookup?title=Some%20models%20for%20estimating%20technical%20and%20scale%20inefficiencies%20in%20data%20envelopment%20analysis&author=RD.%20Banker&author=A.%20Charnes&author=WW.%20Cooper&journal=Management%20Science&volume=30&issue=9&pages=1078-](http://scholar.google.com/scholar_lookup?title=Some%20models%20for%20estimating%20technical%20and%20scale%20inefficiencies%20in%20data%20envelopment%20analysis&author=RD.%20Banker&author=A.%20Charnes&author=WW.%20Cooper&journal=Management%20Science&volume=30&issue=9&pages=1078-)

1092&publication\_year=1984)

Berger, A. N., & Humphrey, D. B. (1997). Efficiency of financial institutions: International survey and directions for future research. *European Journal of Operational Research*, 98(2), 175–212.

zbMATH (<http://www.emis.de/MATH-item?0923.90018>)

CrossRef ([https://doi.org/10.1016/S0377-2217\(96\)00342-6](https://doi.org/10.1016/S0377-2217(96)00342-6))

Google Scholar ([http://scholar.google.com/scholar\\_lookup?title=Efficiency%20of%20financial%20institutions%3A%20International%20survey%20and%20directions%20for%20future%20research&author=AN.%20Berger&author=DB.%20Humphrey&journal=European%20Journal%20of%20Operational%20Research&volume=98&issue=2&pages=175-212&publication\\_year=1997](http://scholar.google.com/scholar_lookup?title=Efficiency%20of%20financial%20institutions%3A%20International%20survey%20and%20directions%20for%20future%20research&author=AN.%20Berger&author=DB.%20Humphrey&journal=European%20Journal%20of%20Operational%20Research&volume=98&issue=2&pages=175-212&publication_year=1997))

Bhatia, A., & Mahendru, M. (2015). Measurement and evaluation of cost, revenue and profit efficiency of public sector banks in India. *International Journal of Behavioural Accounting and Finance*, 5(3–4), 298–313.

CrossRef (<https://doi.org/10.1504/IJBAF.2015.075338>)

Google Scholar ([http://scholar.google.com/scholar\\_lookup?title=Measurement%20and%20evaluation%20of%20cost%2C%20revenue%20and%20profit%20efficiency%20of%20public%20sector%20banks%20in%20India&author=A.%20Bhatia&author=M.%20Mahendru&journal=International%20Journal%20of%20Behavioural%20Accounting%20and%20Finance&volume=5&issue=3%E2%80%934&pages=298-313&publication\\_year=2015](http://scholar.google.com/scholar_lookup?title=Measurement%20and%20evaluation%20of%20cost%2C%20revenue%20and%20profit%20efficiency%20of%20public%20sector%20banks%20in%20India&author=A.%20Bhatia&author=M.%20Mahendru&journal=International%20Journal%20of%20Behavioural%20Accounting%20and%20Finance&volume=5&issue=3%E2%80%934&pages=298-313&publication_year=2015))

Bhatia, A., & Mahendru, M. (2018). Measurement of revenue efficiency of scheduled commercial banks across ownership in India. *IUP Journal of Bank Management*, 17(2), 20–49.

Google Scholar ([http://scholar.google.com/scholar\\_lookup?title=Measurement%20of%20revenue%20efficiency%20of%20scheduled%20commercial%20banks%20across%20ownership%20in%20India&author=A.%20Bhatia&author=M.%20Mahendru&journal=IUP%20Journal%20of%20Bank%20Management&volume=17&issue=2&pages=20-49&publication\\_year=2018](http://scholar.google.com/scholar_lookup?title=Measurement%20of%20revenue%20efficiency%20of%20scheduled%20commercial%20banks%20across%20ownership%20in%20India&author=A.%20Bhatia&author=M.%20Mahendru&journal=IUP%20Journal%20of%20Bank%20Management&volume=17&issue=2&pages=20-49&publication_year=2018))

Google Scholar ([http://scholar.google.com/scholar\\_lookup?title=Measurement%20of%20revenue%20efficiency%20of%20scheduled%20commercial%20banks%20across%20ownership%20in%20India&author=A.%20Bhatia&author=M.%20Mahendru&journal=IUP%20Journal%20of%20Bank%20Management&volume=17&issue=2&pages=20-49&publication\\_year=2018](http://scholar.google.com/scholar_lookup?title=Measurement%20of%20revenue%20efficiency%20of%20scheduled%20commercial%20banks%20across%20ownership%20in%20India&author=A.%20Bhatia&author=M.%20Mahendru&journal=IUP%20Journal%20of%20Bank%20Management&volume=17&issue=2&pages=20-49&publication_year=2018))

Bhattacharyya, A., Lovell, C. K., & Sahay, P. (1997). The impact of liberalization on the productive efficiency of Indian commercial banks.

*European Journal of Operational Research*, 98(2), 332–345.

zbMATH (<http://www.emis.de/MATH-item?0930.91024>)

CrossRef ([https://doi.org/10.1016/S0377-2217\(96\)00351-7](https://doi.org/10.1016/S0377-2217(96)00351-7))

Google Scholar ([http://scholar.google.com/scholar\\_lookup?title=The%20impact%20of%20liberalization%20on%20the%20productive%20efficiency%20of%20Indian%20commercial%20banks&author=A.%20Bhattacharyya&author=CK.%20Lovell&author=P.%20Sahay&journal=European%20Journal%20of%20Operational%20Research&volume=98&issue=2&pages=332-345&publication\\_year=1997](http://scholar.google.com/scholar_lookup?title=The%20impact%20of%20liberalization%20on%20the%20productive%20efficiency%20of%20Indian%20commercial%20banks&author=A.%20Bhattacharyya&author=CK.%20Lovell&author=P.%20Sahay&journal=European%20Journal%20of%20Operational%20Research&volume=98&issue=2&pages=332-345&publication_year=1997))

Charnes, A., Cooper, W. W., & Rhodes, E. (1978). Measuring the efficiency of decision making units. *European Journal of Operational Research*, 2, 429–444.

MathSciNet (<http://www.ams.org/mathscinet-getitem?mr=525905>)

zbMATH (<http://www.emis.de/MATH-item?0416.90080>)

CrossRef ([https://doi.org/10.1016/0377-2217\(78\)90138-8](https://doi.org/10.1016/0377-2217(78)90138-8))  
Google Scholar ([http://scholar.google.com/scholar\\_lookup?title=Measuring%20the%20efficiency%20of%20decision%20making%20units&author=A.%20Charnes&author=WW.%20Cooper&author=E.%20Rhodes&journal=European%20Journal%20of%20Operational%20Research&volume=2&pages=429-444&publication\\_year=1978](http://scholar.google.com/scholar_lookup?title=Measuring%20the%20efficiency%20of%20decision%20making%20units&author=A.%20Charnes&author=WW.%20Cooper&author=E.%20Rhodes&journal=European%20Journal%20of%20Operational%20Research&volume=2&pages=429-444&publication_year=1978))

Davidovic, M., Uzelać, O., & Zelenovic, V. (2019). Efficiency dynamics of the Croatian banking industry: DEA investigation. *Economic research-Ekonomska istraživanja*, 32(1), 33–49.

CrossRef (<https://doi.org/10.1080/1331677X.2018.1545596>)  
Google Scholar ([http://scholar.google.com/scholar\\_lookup?title=Efficiency%20dynamics%20of%20the%20Croatian%20banking%20industry%3A%20DEA%20investigation&author=M.%20Davidovic&author=O.%20Uzelac&author=V.%20Zelenovic&journal=Economic%20research-Ekonomska%20istra%20BEivanja&volume=32&issue=1&pages=33-49&publication\\_year=2019](http://scholar.google.com/scholar_lookup?title=Efficiency%20dynamics%20of%20the%20Croatian%20banking%20industry%3A%20DEA%20investigation&author=M.%20Davidovic&author=O.%20Uzelac&author=V.%20Zelenovic&journal=Economic%20research-Ekonomska%20istra%20BEivanja&volume=32&issue=1&pages=33-49&publication_year=2019))

Defung, F., Salim, R., & Bloch, H. (2016). Has regulatory reform had any impact on bank efficiency in Indonesia? A two-stage analysis. *Applied Economics*, 48(52), 5060–5074.

CrossRef (<https://doi.org/10.1080/00036846.2016.1170934>)  
Google Scholar ([http://scholar.google.com/scholar\\_lookup?title=Has%20regulatory%20reform%20had%20any%20impact%20on%20bank%20efficiency%20in%20Indonesia%3F%20A%20two-stage%20analysis&author=F.%20Defung&author=R.%20Salim&author=H.%20Bloch&journal=Applied%20Economics&volume=48&issue=52&pages=5060-5074&publication\\_year=2016](http://scholar.google.com/scholar_lookup?title=Has%20regulatory%20reform%20had%20any%20impact%20on%20bank%20efficiency%20in%20Indonesia%3F%20A%20two-stage%20analysis&author=F.%20Defung&author=R.%20Salim&author=H.%20Bloch&journal=Applied%20Economics&volume=48&issue=52&pages=5060-5074&publication_year=2016))

Emrouznejad, A., & Yang, G. L. (2018). A survey and analysis of the first 40 years of scholarly literature in DEA: 1978–2016. *Socio-Economic Planning Sciences*, 61, 4–8.

CrossRef (<https://doi.org/10.1016/j.seps.2017.01.008>)  
Google Scholar ([http://scholar.google.com/scholar\\_lookup?title=A%20survey%20and%20analysis%20of%20the%20first%2040%20years%20of%20scholarly%20literature%20in%20DEA%3A%201978%E2%80%932016&author=A.%20Emrouznejad&author=GL.%20Yang&journal=Socio-Economic%20Planning%20Sciences&volume=61&pages=4-8&publication\\_year=2018](http://scholar.google.com/scholar_lookup?title=A%20survey%20and%20analysis%20of%20the%20first%2040%20years%20of%20scholarly%20literature%20in%20DEA%3A%201978%E2%80%932016&author=A.%20Emrouznejad&author=GL.%20Yang&journal=Socio-Economic%20Planning%20Sciences&volume=61&pages=4-8&publication_year=2018))

Farrel, M. J. (1957). The measurement of productive efficiency. *Journal of the Royal Statistical Society*, 120(3), 253–290.

CrossRef (<https://doi.org/10.2307/2343100>)  
Google Scholar ([http://scholar.google.com/scholar\\_lookup?title=The%20measurement%20of%20productive%20efficiency&author=MJ.%20Farrel&journal=Journal%20of%20the%20Royal%20Statistical%20Society&volume=120&issue=3&pages=253-290&publication\\_year=1957](http://scholar.google.com/scholar_lookup?title=The%20measurement%20of%20productive%20efficiency&author=MJ.%20Farrel&journal=Journal%20of%20the%20Royal%20Statistical%20Society&volume=120&issue=3&pages=253-290&publication_year=1957))

Ferrier, G. D., & Lovell, C. K. (1990). Measuring cost efficiency in banking: Econometric and linear programming evidence. *Journal of Econometrics*, 46(1–2), 229–245.

CrossRef ([https://doi.org/10.1016/0304-4076\(90\)90057-Z](https://doi.org/10.1016/0304-4076(90)90057-Z))  
Google Scholar ([http://scholar.google.com/scholar\\_lookup?](http://scholar.google.com/scholar_lookup?)

title=Measuring%20cost%20efficiency%20in%20banking%3A%20Econometric%20and%20linear%20programming%20evidence&author=GD.%20Ferrier&author=CK.%20Lovell&journal=Journal%20of%20Econometrics&volume=46&issue=1%E2%80%932&pages=229-245&publication\_year=1990)

Henriques, I. C., Sobreiro, V. A., Kimura, H., & Mariano, E. B. (2018). Efficiency in the Brazilian banking system using data envelopment analysis. *Future Business Journal*, 4(2), 157–178.

CrossRef (<https://doi.org/10.1016/j.fbj.2018.05.001>)

Google Scholar ([http://scholar.google.com/scholar\\_lookup?title=Efficiency%20in%20the%20Brazilian%20banking%20system%20using%20data%20envelopment%20analysis&author=IC.%20Henriques&author=VA.%20Sobreiro&author=H.%20Kimura&author=EB.%20Mariano&journal=Future%20Business%20Journal&volume=4&issue=2&pages=157-178&publication\\_year=2018](http://scholar.google.com/scholar_lookup?title=Efficiency%20in%20the%20Brazilian%20banking%20system%20using%20data%20envelopment%20analysis&author=IC.%20Henriques&author=VA.%20Sobreiro&author=H.%20Kimura&author=EB.%20Mariano&journal=Future%20Business%20Journal&volume=4&issue=2&pages=157-178&publication_year=2018))

title=Efficiency%20in%20the%20Brazilian%20banking%20system%20using%20data%20envelopment%20analysis&author=IC.%20Henriques&author=VA.%20Sobreiro&author=H.%20Kimura&author=EB.%20Mariano&journal=Future%20Business%20Journal&volume=4&issue=2&pages=157-178&publication\_year=2018)

Humphrey, D. B. (1985). Costs and scale economies in bank intermediation'. In R. C. Aspinwall & R. A. Eisenbeis (Eds.), *Handbook for banking strategy* (pp. 745–783). New York: Wiley.

Google Scholar ([http://scholar.google.com/scholar\\_lookup?title=Costs%20and%20scale%20economies%20in%20bank%20intermediation%E2%80%99&author=DB.%20Humphrey&pages=745-783&publication\\_year=1985](http://scholar.google.com/scholar_lookup?title=Costs%20and%20scale%20economies%20in%20bank%20intermediation%E2%80%99&author=DB.%20Humphrey&pages=745-783&publication_year=1985))

title=Costs%20and%20scale%20economies%20in%20bank%20intermediation%E2%80%99&author=DB.%20Humphrey&pages=745-783&publication\_year=1985)

Jayaraman, A. R., & Srinivasan, M. R. (2019). Determinants of Indian banks efficiency: A two-stage approach. *International Journal of Operational Research*, 36(2), 270–291.

CrossRef (<https://doi.org/10.1504/IJOR.2019.102414>)

Google Scholar ([http://scholar.google.com/scholar\\_lookup?title=Determinants%20of%20Indian%20banks%20efficiency%3A%20A%20two-stage%20approach&author=AR.%20Jayaraman&author=MR.%20Srinivasan&journal=International%20Journal%20of%20Operational%20Research&volume=36&issue=2&pages=270-291&publication\\_year=2019](http://scholar.google.com/scholar_lookup?title=Determinants%20of%20Indian%20banks%20efficiency%3A%20A%20two-stage%20approach&author=AR.%20Jayaraman&author=MR.%20Srinivasan&journal=International%20Journal%20of%20Operational%20Research&volume=36&issue=2&pages=270-291&publication_year=2019))

title=Determinants%20of%20Indian%20banks%20efficiency%3A%20A%20two-stage%20approach&author=AR.%20Jayaraman&author=MR.%20Srinivasan&journal=International%20Journal%20of%20Operational%20Research&volume=36&issue=2&pages=270-291&publication\_year=2019)

Kluczek, A. (2017). Assessing measures of energy efficiency improvement opportunities in the industry. *LogForum*, 13(1).

<http://dx.doi.org/10.17270/J.LOG.2017.1.3>

(<http://dx.doi.org/10.17270/J.LOG.2017.1.3>).

Kumar, M., Charles, V., & Mishra, C. S. (2016). Evaluating the performance of Indian banking sector using DEA during post-reform and global financial crisis. *Journal of Business Economics and Management*, 17(1), 156–172.

CrossRef (<https://doi.org/10.3846/16111699.2013.809785>)

Google Scholar ([http://scholar.google.com/scholar\\_lookup?title=Evaluating%20the%20performance%20of%20Indian%20banking%20sector%20using%20DEA%20during%20post-reform%20and%20global%20financial%20crisis&author=M.%20Kumar&author=V.%20Charles&author=CS.%20Mishra&journal=Journal%20of%20Business%20Economics%20and%20Management&volume=17&issue=1&pages=156-172&publication\\_year=2016](http://scholar.google.com/scholar_lookup?title=Evaluating%20the%20performance%20of%20Indian%20banking%20sector%20using%20DEA%20during%20post-reform%20and%20global%20financial%20crisis&author=M.%20Kumar&author=V.%20Charles&author=CS.%20Mishra&journal=Journal%20of%20Business%20Economics%20and%20Management&volume=17&issue=1&pages=156-172&publication_year=2016))

title=Evaluating%20the%20performance%20of%20Indian%20banking%20sector%20using%20DEA%20during%20post-reform%20and%20global%20financial%20crisis&author=M.%20Kumar&author=V.%20Charles&author=CS.%20Mishra&journal=Journal%20of%20Business%20Economics%20and%20Management&volume=17&issue=1&pages=156-172&publication\_year=2016)

Mohapatra, S., Jena, S. K., Mitra, A., & Tiwari, A. K. (2019). Intellectual capital and firm performance: Evidence from Indian banking sector. *Applied*

*Economics*, 51(57), 6054–6067.

CrossRef (<https://doi.org/10.1080/00036846.2019.1645283>)

Google Scholar ([http://scholar.google.com/scholar\\_lookup?title=Intellectual%20capital%20and%20firm%20performance%3A%20Evidence%20from%20Indian%20banking%20sector&author=S.%20Mohapatra&author=SK.%20Jena&author=A.%20Mitra&author=AK.%20Tiwari&journal=Applied%20Economics&volume=51&issue=57&pages=6054-6067&publication\\_year=2019](http://scholar.google.com/scholar_lookup?title=Intellectual%20capital%20and%20firm%20performance%3A%20Evidence%20from%20Indian%20banking%20sector&author=S.%20Mohapatra&author=SK.%20Jena&author=A.%20Mitra&author=AK.%20Tiwari&journal=Applied%20Economics&volume=51&issue=57&pages=6054-6067&publication_year=2019))

Paradi, J. C., Rouatt, S., & Zhu, H. (2011). Two-stage evaluation of bank branch efficiency using data envelopment analysis. *Omega*, 39(1), 99–109.

Google Scholar (<https://scholar.google.com/scholar?q=Paradi%2C%20J.%20C.%2C%20Rouatt%2C%20S.%2C%20%26%20Zhu%2C%20H.%20%282011%29.Two-stage%20evaluation%20of%20bank%20branch%20efficiency%20using%20data%20envelopment%20analysis.%20Omega%2C%2039%281%29%2C%2099%E2%80%93109.>)

q=Paradi%2C%20J.%20C.%2C%20Rouatt%2C%20S.%2C%20%26%20Zhu%2C%20H.%20%282011%29.Two-stage%20evaluation%20of%20bank%20branch%20efficiency%20using%20data%20envelopment%20analysis.%20Omega%2C%2039%281%29%2C%2099%E2%80%93109.)

Reserve Bank of India. (2018). *Report on trend and progress of banking in India 2017–18*. Retrieved from <https://www.rbi.org.in>

(<https://www.rbi.org.in>).

Samanta, S., & Chakraborty, T. (2018). An analysis of capital adequacy in select Indian commercial banks: A frontier approach. *IUP Journal of Management Research*, 17(2).

Google Scholar (<https://scholar.google.com/scholar?q=Samanta%2C%20S.%2C%20%26%20Chakraborty%2C%20T.%20%282018%29.%20An%20analysis%20of%20capital%20adequacy%20in%20select%20Indian%20commercial%20banks%3A%20A%20frontier%20approach.%20IUP%20Journal%20of%20Management%20Research%2C%2017%282%29.>)

q=Samanta%2C%20S.%2C%20%26%20Chakraborty%2C%20T.%20%282018%29.%20An%20analysis%20of%20capital%20adequacy%20in%20select%20Indian%20commercial%20banks%3A%20A%20frontier%20approach.%20IUP%20Journal%20of%20Management%20Research%2C%2017%282%29.)

Sathye, M. (2015). Technical efficiency of large bank production in Asia and the Pacific. *Multinational Finance Journal*, 9(1), 1–22.

Google Scholar ([http://scholar.google.com/scholar\\_lookup?title=Technical%20efficiency%20of%20large%20bank%20production%20in%20Asia%20and%20the%20Pacific&author=M.%20Sathye&journal=Multinational%20Finance%20Journal&volume=9&issue=1&pages=1-22&publication\\_year=2015](http://scholar.google.com/scholar_lookup?title=Technical%20efficiency%20of%20large%20bank%20production%20in%20Asia%20and%20the%20Pacific&author=M.%20Sathye&journal=Multinational%20Finance%20Journal&volume=9&issue=1&pages=1-22&publication_year=2015))

title=Technical%20efficiency%20of%20large%20bank%20production%20in%20Asia%20and%20the%20Pacific&author=M.%20Sathye&journal=Multinational%20Finance%20Journal&volume=9&issue=1&pages=1-22&publication\_year=2015)

Sathye, S., & Sathye, M. (2017). Do ATMs increase technical efficiency of banks in a developing country? Evidence from Indian Banks. *Australian Accounting Review*, 27(1), 101–111.

CrossRef (<https://doi.org/10.1111/auar.12110>)

Google Scholar ([http://scholar.google.com/scholar\\_lookup?title=Do%20ATMs%20increase%20technical%20efficiency%20of%20banks%20in%20a%20developing%20country%3F%20Evidence%20from%20Indian%20Banks&author=S.%20Sathye&author=M.%20Sathye&journal=Australian%20Accounting%20Review&volume=27&issue=1&pages=101-111&publication\\_year=2017](http://scholar.google.com/scholar_lookup?title=Do%20ATMs%20increase%20technical%20efficiency%20of%20banks%20in%20a%20developing%20country%3F%20Evidence%20from%20Indian%20Banks&author=S.%20Sathye&author=M.%20Sathye&journal=Australian%20Accounting%20Review&volume=27&issue=1&pages=101-111&publication_year=2017))

See, K. F., & He, Y. (2015). Determinants of technical efficiency in Chinese banking: A double bootstrap data envelopment analysis approach. *Global Economic Review*, 44(3), 286–307.

CrossRef (<https://doi.org/10.1080/1226508X.2015.1014392>)  
Google Scholar ([http://scholar.google.com/scholar\\_lookup?title=Determinants%20of%20technical%20efficiency%20in%20Chinese%20banking%3A%20A%20double%20bootstrap%20data%20envelopment%20analysis%20approach&author=KF.%20See&author=Y.%20He&journal=Global%20Economic%20Review&volume=44&issue=3&pages=286-307&publication\\_year=2015](http://scholar.google.com/scholar_lookup?title=Determinants%20of%20technical%20efficiency%20in%20Chinese%20banking%3A%20A%20double%20bootstrap%20data%20envelopment%20analysis%20approach&author=KF.%20See&author=Y.%20He&journal=Global%20Economic%20Review&volume=44&issue=3&pages=286-307&publication_year=2015))

Sherman, H. D., & Gold, F. (1985). Bank branch operating efficiency: Evaluation with data envelopment analysis. *Journal of Banking & Finance*, 9(2), 297–315.

CrossRef ([https://doi.org/10.1016/0378-4266\(85\)90025-1](https://doi.org/10.1016/0378-4266(85)90025-1))  
Google Scholar ([http://scholar.google.com/scholar\\_lookup?title=Bank%20branch%20operating%20efficiency%3A%20Evaluation%20with%20data%20envelopment%20analysis&author=HD.%20Sherman&author=F.%20Gold&journal=Journal%20of%20Banking%20%26%20Finance&volume=9&issue=2&pages=297-315&publication\\_year=1985](http://scholar.google.com/scholar_lookup?title=Bank%20branch%20operating%20efficiency%3A%20Evaluation%20with%20data%20envelopment%20analysis&author=HD.%20Sherman&author=F.%20Gold&journal=Journal%20of%20Banking%20%26%20Finance&volume=9&issue=2&pages=297-315&publication_year=1985))

Singh, R. I., & Kaur, S. (2016). Efficiency and profitability of public and private sector banks in India: Data envelopment analysis approach. *IUP Journal of Bank Management*, 15(1).

Google Scholar (<https://scholar.google.com/scholar?q=Singh%2C%20R.%20I.%2C%20%26%20Kaur%2C%20S.%20%282016%29.%20Efficiency%20and%20profitability%20of%20public%20and%20private%20sector%20banks%20in%20India%3A%20Data%20envelopment%20analysis%20approach.%2C%20IUP%20Journal%20of%20Bank%20Management%2C%20%2815%281%29>.)

Stewart, C., Matousek, R., & Nguyen, T. N. (2016). Efficiency in the Vietnamese banking system: A DEA double bootstrap approach. *Research in International Business and Finance*, 36(1), 96–111.

CrossRef (<https://doi.org/10.1016/j.ribaf.2015.09.006>)  
Google Scholar ([http://scholar.google.com/scholar\\_lookup?title=Efficiency%20in%20the%20Vietnamese%20banking%20system%3A%20A%20DEA%20double%20bootstrap%20approach&author=C.%20Stewart&author=R.%20Matousek&author=TN.%20Nguyen&journal=Research%20in%20International%20Business%20and%20Finance&volume=36&issue=1&pages=96-111&publication\\_year=2016](http://scholar.google.com/scholar_lookup?title=Efficiency%20in%20the%20Vietnamese%20banking%20system%3A%20A%20DEA%20double%20bootstrap%20approach&author=C.%20Stewart&author=R.%20Matousek&author=TN.%20Nguyen&journal=Research%20in%20International%20Business%20and%20Finance&volume=36&issue=1&pages=96-111&publication_year=2016))

Stoica, O., Mehdiian, S., & Sargu, A. (2015). The impact of internet banking on the performance of Romanian banks: DEA and PCA approach. *Procedia Economics and Finance*, 20(2), 610–622.

CrossRef ([https://doi.org/10.1016/S2212-5671\(15\)00115-X](https://doi.org/10.1016/S2212-5671(15)00115-X))  
Google Scholar ([http://scholar.google.com/scholar\\_lookup?title=The%20impact%20of%20internet%20banking%20on%20the%20performance%20of%20Romanian%20banks%3A%20DEA%20and%20PCA%20approach&author=O.%20Stoica&author=S.%20Mehdiian&author=A.%20Sargu&journal=Procedia%20Economics%20and%20Finance&volume=20&issue=2&pages=610-622&publication\\_year=2015](http://scholar.google.com/scholar_lookup?title=The%20impact%20of%20internet%20banking%20on%20the%20performance%20of%20Romanian%20banks%3A%20DEA%20and%20PCA%20approach&author=O.%20Stoica&author=S.%20Mehdiian&author=A.%20Sargu&journal=Procedia%20Economics%20and%20Finance&volume=20&issue=2&pages=610-622&publication_year=2015))

Sufian, F., & Kamarudin, F. (2016). Determinants of efficiency in the Malaysian banking sector: Does bank origins matter? *Intellectual Economics*, 10(1), 38–54.

[CrossRef](https://doi.org/10.1016/j.intele.2016.04.002) (https://doi.org/10.1016/j.intele.2016.04.002)

[Google Scholar](http://scholar.google.com/scholar_lookup?title=Determinants%20of%20efficiency%20in%20the%20Malaysian%20banking%20sector%3A%20Does%20bank%20origins%20matter%3F&author=F.%20Sufian&author=F.%20Kamarudin&journal=Intellectual%20Economic&volume=10&issue=1&pages=38-54&publication_year=2016) (http://scholar.google.com/scholar\_lookup?

title=Determinants%20of%20efficiency%20in%20the%20Malaysian%20banking%20sector%3A%20Does%20bank%20origins%20matter%3F&author=F.%20Sufian&author=F.%20Kamarudin&journal=Intellectual%20Economic&volume=10&issue=1&pages=38-54&publication\_year=2016)

Tamatam, R., Dutta, P., Dutta, G., & Lessmann, S. (2019). Efficiency analysis of Indian banking industry over the period 2008–2017 using data envelopment analysis. *Benchmarking: An International Journal*, 26(8), 2417–2442.

[Google Scholar](https://scholar.google.com/scholar?q=Tamatam%2C%20R.%2C%20Dutta%2C%20P.%2C%20Dutta%2C%20G.%2C%20%26%20Lessmann%2C%20S.%20%282019%29.%20Efficiency%20analysis%20of%20Indian%20banking%20industry%20over%20the%20period%202008%20-%202017%20using%20data%20envelopment%20analysis.%20%26%20Benchmarking%3A%20An%20International%20Journal%2C%2026%288%29%2C%202417%20-%202442.) (https://scholar.google.com/scholar?

q=Tamatam%2C%20R.%2C%20Dutta%2C%20P.%2C%20Dutta%2C%20G.%2C%20%26%20Lessmann%2C%20S.%20%282019%29.%20Efficiency%20analysis%20of%20Indian%20banking%20industry%20over%20the%20period%202008%20-%202017%20using%20data%20envelopment%20analysis.%20%26%20Benchmarking%3A%20An%20International%20Journal%2C%2026%288%29%2C%202417%20-%202442.)

Tan, Y., & Anchor, J. (2017). The impacts of risk-taking behaviour and competition on technical efficiency: Evidence from the Chinese banking industry. *Research in International Business and Finance*, 41(4), 90–104.

[CrossRef](https://doi.org/10.1016/j.ribaf.2017.04.026) (https://doi.org/10.1016/j.ribaf.2017.04.026)

[Google Scholar](http://scholar.google.com/scholar_lookup?title=The%20impacts%20of%20risk-taking%20behaviour%20and%20competition%20on%20technical%20efficiency%3A%20Evidence%20from%20the%20Chinese%20banking%20industry&author=Y.%20Tan&author=J.%20Anchor&journal=Research%20in%20International%20Business%20and%20Finance&volume=41&issue=4&pages=90-104&publication_year=2017) (http://scholar.google.com/scholar\_lookup?

title=The%20impacts%20of%20risk-taking%20behaviour%20and%20competition%20on%20technical%20efficiency%3A%20Evidence%20from%20the%20Chinese%20banking%20industry&author=Y.%20Tan&author=J.%20Anchor&journal=Research%20in%20International%20Business%20and%20Finance&volume=41&issue=4&pages=90-104&publication\_year=2017)

Thanassoulis, E., Kortelainen, M., Johnes, G., & Johnes, J. (2011). Costs and efficiency of higher education institutions in England: A DEA analysis. *The Journal of the Operational Research Society*, 62(7), 1282–1297.

[Google Scholar](https://scholar.google.com/scholar?q=Thanassoulis%2C%20E.%2C%20Kortelainen%2C%20M.%2C%20Johnes%2C%20G.%2C%20%26%20Johnes%2C%20J.%20%282011%29.%20Costs%20and%20efficiency%20of%20higher%20education%20institutions%20in%20England%3A%20A%20DEA%20analysis.%20The%20Journal%20of%20the%20Operational%20Research%20Society%2C%2062%287%29%2C%201282%20-%201297.) (https://scholar.google.com/scholar?

q=Thanassoulis%2C%20E.%2C%20Kortelainen%2C%20M.%2C%20Johnes%2C%20G.%2C%20%26%20Johnes%2C%20J.%20%282011%29.%20Costs%20and%20efficiency%20of%20higher%20education%20institutions%20in%20England%3A%20A%20DEA%20analysis.%20The%20Journal%20of%20the%20Operational%20Research%20Society%2C%2062%287%29%2C%201282%20-%201297.)

Yeh, Q. J. (1996). The application of data envelopment analysis in conjunction with financial ratios for bank performance evaluation. *Journal of the Operational Research Society*, 47(8), 980–988.

[zbMATH](http://www.emis.de/MATH-item?0864.90082) (http://www.emis.de/MATH-item?0864.90082)

[CrossRef](https://doi.org/10.1057/jors.1996.125) (https://doi.org/10.1057/jors.1996.125)

[Google Scholar](http://scholar.google.com/scholar_lookup?title=The%20application%20of%20data%20envelopment%20analysis%20in%20conjunction%20with%20financial%20ratios%20for%20bank%20performance%20evaluation&author=QJ.%20Yeh&journal=Journal%20of%20the%20Operational%20Research%20Society&volume=47&issue=8&pages=980) (http://scholar.google.com/scholar\_lookup?

title=The%20application%20of%20data%20envelopment%20analysis%20in%20conjunction%20with%20financial%20ratios%20for%20bank%20performance%20evaluation&author=QJ.%20Yeh&journal=Journal%20of%20the%20Operational%20Research%20Society&volume=47&issue=8&pages=980

-988&publication\_year=1996)

Zimková, E. (2014). Technical efficiency and super-efficiency of the banking sector in Slovakia. *Procedia Economics and Finance*, 12, 780–787.

CrossRef ([https://doi.org/10.1016/S2212-5671\(14\)00405-5](https://doi.org/10.1016/S2212-5671(14)00405-5))

Google Scholar ([http://scholar.google.com/scholar\\_lookup?](http://scholar.google.com/scholar_lookup?title=Technical%20efficiency%20and%20super-efficiency%20of%20the%20banking%20sector%20in%20Slovakia&author=E.%20Zimkov%C3%A1&journal=Procedia%20Economics%20and%20Finance&volume=12&pages=780-787&publication_year=2014)

[title=Technical%20efficiency%20and%20super-](http://scholar.google.com/scholar_lookup?title=Technical%20efficiency%20and%20super-efficiency%20of%20the%20banking%20sector%20in%20Slovakia&author=E.%20Zimkov%C3%A1&journal=Procedia%20Economics%20and%20Finance&volume=12&pages=780-787&publication_year=2014)

[efficiency%20of%20the%20banking%20sector%20in%20Slovakia&author=](http://scholar.google.com/scholar_lookup?title=Technical%20efficiency%20and%20super-efficiency%20of%20the%20banking%20sector%20in%20Slovakia&author=E.%20Zimkov%C3%A1&journal=Procedia%20Economics%20and%20Finance&volume=12&pages=780-787&publication_year=2014)

[E.%20Zimkov%C3%A1&journal=Procedia%20Economics%20and%20Finan](http://scholar.google.com/scholar_lookup?title=Technical%20efficiency%20and%20super-efficiency%20of%20the%20banking%20sector%20in%20Slovakia&author=E.%20Zimkov%C3%A1&journal=Procedia%20Economics%20and%20Finance&volume=12&pages=780-787&publication_year=2014)

[ce&volume=12&pages=780-787&publication\\_year=2014](http://scholar.google.com/scholar_lookup?title=Technical%20efficiency%20and%20super-efficiency%20of%20the%20banking%20sector%20in%20Slovakia&author=E.%20Zimkov%C3%A1&journal=Procedia%20Economics%20and%20Finance&volume=12&pages=780-787&publication_year=2014))

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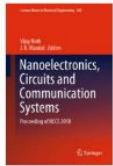
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# Internet of Things (IoT) Based Green Logistics Operations for Sustainable Development in the Indian Context

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## Abstract

The article explores how the implementation of IoT can help the logistics sector make it more

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## Chapter 70

# M&A Deals and Corporate Governance Framework: A Study in Indian Telecom Sector

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### **ABSTRACT**

*The escalating importance of mergers and acquisitions (M&A) has coincided with concerns about corporate governance issues. This article investigates how corporate governance mechanisms along with firm-specific control variables impact performance during M&A deals occurring between 2000-2012 in acquiring Indian telecom companies. In this research, firm performance has been measured via accounting based, market based and qualitative performance dimensions, represented by Return on Capital Employed (ROCE), Tobin's Q and Human Capital Return on Investment (HCROI) respectively. Panel data regression techniques was employed for the analysis. The learning from this study reveals that board size and firm size have significant positive relationships with ROCE and HCROI. Chairperson-CEO duality also has positive significant association with ROCE. Shareholding percentage of institutional investors was found to have a significant negative relationship with HCROI. Board independence, firm size and market share significantly affect Tobin's Q.*

### **INTRODUCTION**

Corporate governance broadly refers to a set of exercises that is designed to govern the behavior of corporate enterprises. It aims to promote healthier corporate practices and check the felonious firms. Board of directors of a firm have the fiduciary duty to play an important role in all vital firm decisions. Board characteristics that affect the effectiveness of the directors can potentially influence firm performance.

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Keeping in view the emerging importance of corporate governance mechanisms in determining firm performance, several corporate governance guidelines have been framed worldwide since the 1990s. Some of the noteworthy reports are Cadbury Committee Report (1992), Market Specific Principles- Japan and Germany (1997), Core Principles and Guidelines- USA (April 1998), Hampel Report on Corporate Governance- UK (January 1998), The Sarbanes-Oxley Act – USA (August 2002) and The Higgs Report- UK (January 2003).

The first formal and exhaustive endeavour to evolve a code of corporate governance for Indian companies was undertaken by Securities and Exchange Board of India (SEBI). Thereafter the Ministry of Corporate Affairs recommended changes in diverse areas of corporate audit and governance and highlighted the role of independent directors. SEBI also made recommendations with respect to financial and non-financial disclosures, independent auditing and board oversight of management. Clause 49 of the Listing Agreement issued by SEBI makes it mandatory for the listed firms to disclose their ownership data of promoters and non-promoters separately. The improvement in corporate governance standards in India during the recent years as a result of numerous initiatives undertaken by the government, has been disclosed in the World Bank's Doing Business Report. Over the past decade, India significantly bettered its rank amongst other nations, with respect to protection of investor and minority rights. According to the report, India ranked seventh among all economies surveyed in 2015 and is ahead of several developed economies. Stringent audit and reporting standards as required by the amended Companies Act, 2013 have increased disclosures in India. Moreover, the market regulator SEBI's tightening of the rules relating to protection of minority shareholders' interests along with an escalation of investor activism have resulted in an improved corporate governance environment in India. It is thus needless to say that this constantly evolving governance framework in a developing nation like India draws academic attention towards examining the role of corporate governance mechanism in Indian corporations and its implications thereof.

The other focus area of this paper are mergers and acquisitions (M&As) which have increasingly become an effective tool for corporate restructuring. M&A decisions are critical to the success of corporations as they are instrumental in achieving greater efficiency by exploiting synergies and growth opportunities. These events are noteworthy not only because of the high levels of financial investment involved but also may be due to their failure rates. No more than 50% of M&As attain the level of success initially predicted (Cartwright & Cooper, 1996). The authors feel that it is important to examine if corporate governance mechanism which entails an effective and suitable board structure along with the role of institutional investors can enhance corporate performance and maximise shareholder value consequent to mergers.

The reason for focusing specially on mergers in the Indian telecom sector requires deliberation. Firstly it needs to be pointed out that India is on a growth trajectory resulting in a rapidly emerging and diversified business environment. In 2017, American Foreign Policy Magazine has ranked India sixth amongst eight great powers in the world. According to The World Bank, Indian economy is expected to grow at 7.9% in 2017-18. The germination of this growth can be traced back to the Liberalisation, Privatisation, Globalisation (LPG) model embarked upon by the Indian government in 1991. This has led to a radical transformation in the business scenario of the nation, enabling the Indian firms to grow extensively as well as drawn the attention of the multinational corporations in India as an investment avenue. The United Nations Conference on Trade and Development (UNCTAD) World Investment Report 2016 announced that India has secured the sixth position as the most preferred investment destination nations, attracting largest FDI inflows across the world in 2015. In fact, the Indian service sector received the highest FDI

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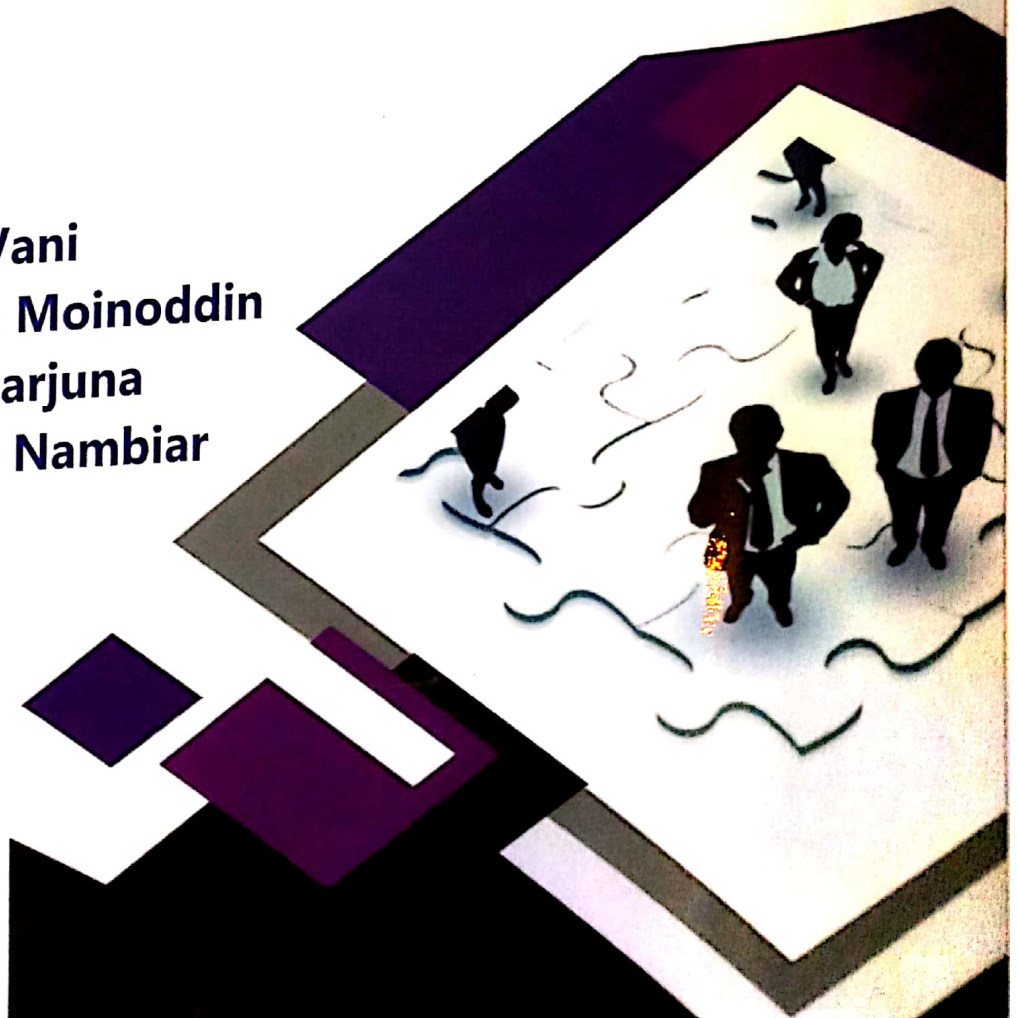
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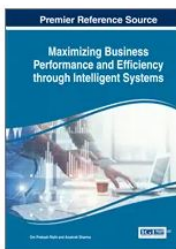
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## Strategic Planning of Cold Supply Chain Towards Good Manufacturing Practices: Issues and Challenges in Indian Market

Supriyo Roy (Birla Institute of Technology, India) and Kaushik Kumar (Birla Institute of Technology, India)

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### Abstract

Cold Chain addresses subset of supply chain involving production, storage and distribution of products that require 'level of temperature control' to retain 'key characteristics and associated value' in terms of life expectancy and perishability. Successful cold chain management is essential for pharmaceutical companies, transportation providers and health care practitioners. With growing population and their demand; especially in retail and pharmaceutical sectors drives Indian cold chain market and it has huge potential to grow in the near future. India's greatest need is for an effective and economically viable cold chain solution that will integrate the supply chains for all commodities from the production centers to the consumption centers; thereby reducing physical waste and loss of value of perishable commodities. This article highlights the importance of cold chain concepts with Indian business scenario. Strategic planning of cold supply chain and their real value towards good manufacturing practices are critically highlighted.

Chapter Preview