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Precedence of Managerial to Technical Efficiency in Longitudinal Performance of Private versus Public Banks in India

Ramadhar Singh

Amrut Mody School of Management, Ahmedabad University, Ahmedabad, 380015, India

ORCID ID: 0000-0002-1766-2743; email: singhr@ahduni.edu.in

Biresh K. Sahoo

Xavier Institute of Management, XIM University, Bhubaneswar 751 013, India

ORCID ID: 0000-0002-7964-9536; e-mail: biresh@xim.edu.in

Ranjan K. Mohanty

Xavier Institute of Management, XIM University, Bhubaneswar 751 013, India

ORCID ID: 0000-0002-4902-3209; email: ranjankumar@xim.edu.in

Ahmedabad University, Amrut Mody School of Management, Central Campus, Navrangapura, Ahmedabad 380009, Gujarat, India. Email: workingpaper@ahduni.edu.in

ABSTRACT

The authors tested the hypothesis that the performance of private, relative to that of public, banks in India remained more stable over the high-growth (2004–2010), pre-Insolvency and Bankruptcy Code (pre-IBC) (2011–2016), and post-IBC (2017-2021) periods because of their corresponding better stability in managerial efficiency (ME) than in technical efficiency (TE). We obtained the hypothesized Ownership × Period effects on three objective criteria of bank performance, namely, net profit margin, return on equity, and return on assets, and on two putative mediators of ME and TE estimated. Supporting the property rights hypothesis, the private banks (*ns* = 17-21), compared to the public ones (*n* = 12), showed greater resistance to inefficiency over the periods studied. The hypothesized moderated sequential-mediation model that placed ME before TE represented the interaction effects on bank performance more suitably than did the alternative models. Findings empirically distinguished the estimated ME from TE underlying the input-output transformation and illustrated the precedence of ME to TE in bank performance. We discuss the theoretical, methodological, and practical implications of the findings along with suggestions for future research. No of words = 178

Keywords**:** *Criteria of bank performance; bank restructuring; managerial efficiency; moderation and mediation; property rights; technical efficiency*

In the research reported in this article, the present authors sought answers to four questions that have heretofore been vexing economists:

1. Have the private banks been performing better than the public ones over time in India (e.g., Bhaumik & Dimova, 2010; Sarkar, Sarkar, & Bhaumik,1998)?
2. Is it correct to view a bank as a mere transformer of inputs into outputs (e.g., Berger & Humphrey, 1992; Berger & Mester, 1997) without delving into the processes underlying the input-output transformation?
3. Should we treat all inputs alike regardless of whether they pertain to the firm's technical or managerial features (e.g., Demerjian, Lev, and McVay, 2012; Leibenstein & Maital, 1992)?
4. Should the estimated technical efficiency (Farrell, 1957) or the X-efficiency (Leibenstein, 1966)--often used interchangeably in the literature (e.g., Shapiro & Müller, 1977; Timmer, 1971)--remain the measure of the firm performance when other objective criteria exist (e.g., Chatterjee & Hanbrick, 2007; Chen & Hanbrick, 2012; Chung & Luo, 2013)?

We are afraid that the practice of viewing a firm as a technical unit converting a set of inputs into a set of outputs with little reference to its internal structure as in neo-classical economics (e.g., Arrow, Chenery, Minhas, & Solow, 1961; Tone & Sahoo, 2003) cannot satisfactorily answer the questions we posed above. Considering all inputs alike and the X-efficiency as the sole mechanism underlying the input-output transformation cannot enable us to "fairly" evaluate the property rights hypothesis (e.g., De Alessi, 1980). Thus, we appeal to economic scientists in general and all those interested in banking in particular to replace their established input-output approach with the contemporary conditional process approach of psychologists (Hayes, 2018). The virtue of this regression-based approach to testing hypotheses lies in classifying inputs into the predictor or cause (*what*), mediator (*how*), and moderator (*when*) categories before placing them into a causal network of output/criterion (e.g., Kang & Kim, 2022; Liu, Fisher, & Chen, 2018).

Of the studied inputs of banks, we can conceptualize the years of operation and the ownership types (e.g., Bhaumik & Dimova, 2010) as the *predictor* and the *moderator*, respectively. Further, we can more appropriately attribute the technical inefficiency that is routinely attributed to the managerial inefficiency (e.g., Lucas, 1978; Mundlak, 1961; O'Donnell & Griffiths, 2006; Rosen, 1981) to the external (e.g., age, size, market share, international operations, and the government

regulations) as well as internal (commitment to excellence, efforts, ethics, and skills of people within the firm) factors of bank performance. Whereas the internal factors (Singh, 1983; Singh, Gupta, & Dalal, 1979) contribute to the managerial efficiency (ME), both the internal and external factors included within the neoclassical view on the technical efficiency (TE) underlie the input-output transformation in firms. The central purpose of our research was to draw the attention of economic and management scientists to the potential of this contemporary conditional process approach (Hayes, 2018; Singh & Rai, 2021) by illustrating how useful we found it to be in investigating the dynamics underlying the longitudinal performance of private *versus* public banks in India.

THEORETICAL AND METHODOLOGICAL BACKGROUNDS AND HYPOTHESES

The Property Rights Hypothesis

According to public choice theory (Buchanan & Tullock, 1962), the government owns public firms and the officers hired run them as per the rules. While doing so, those government officials usually serve the interests of the pressure groups, pursue their self-interests, and/or ignore the interests of the public at large (Niskanen, 1975). The going gets worse when the government itself tries to accommodate the conflicting interests of the diverse pressure groups by compromising with the firm's original objectives (Estrin & Perotin, 1991; Shleifer & Vishny, 1994). Under such circumstances, the managers/officers themselves remain resilient (Vickers & Yarrow, 1991) but the firms suffer from considerable inefficiency (Levy, 1987).

In contrast, the ownership and the management of privately owned firms often overlap. The owners enjoy undisputed property rights, feel free to hire and retain personnel who can and/or serve the firm and the stakeholders well, and remain themselves vigilant to any vulnerability to takeovers and/or loss of jobs (Manne, 1965; Fama, 1980). Managers resist inefficiency by initiating innovations and implementing them at the minimum cost (Nickell, 1996). Thus, the proponents of the property rights hypothesis argues for better efficiency of the privately-owned firms than the government-owned ones over the years (e.g., De Alessi, 1980).

Two acknowledged environmental factors affecting the productivity of firms are competition (e.g., Nickell, 1996) and capital market (Bhaumik & Dimova, 2004; Sarkar et al., 1998). Competition pressurizes firms to direct their managerial efforts toward initiating innovative activities and minimizing costs and organizational slacks. Financial sector reforms in India after

1992 increased such competition between banks. In developed economies (Coffee, 1986; Jarrell, Brickley, & Netter, 1988), there is a strong positive relation between control of the capital markets and the efficiency of private firms. Although market control in a developing country like India might not have been similar until 2002 (Bhaumik & Dimova, 2004; Sarkar et al., 1998), the control has undoubtedly increased post-2002. Can, then, we expect the private banks to have outperformed their public counterparts after the rapid financial sector reforms in India? Findings of the studies of private and public banks in India appeared to be at odds with our expectation!

In Table 1 of the Supplementary Material (Appendix A-1), we summarize the salient features of the past 22 studies of banks in India. Notably, the authors listed in the first column of Table 1 studied the early years of financial sector reforms in the banking industry in India. Although they collected data from 2 to 18 years, they used time (T) as an input or predictor of productivity in only 3 studies.[1] They used TE (n = 14) more frequently as the criterion of bank performance than cost efficiency (CE, n = 4), return on assets (ROA, n = 2), TE and cross efficiency (n = 1), or CE and profit efficiency (PE, n = 1). For data analyses, they relied on data envelopment analysis (DEA, n = 14) more often than either stochastic frontier analysis (SFA, n = 6) or regression analysis (RA, n = 2). Despite using TE as the criterion and DEA in analyses, Tandon, Tandon, and Malhotra (2014) found equality between public and private banks during 2020-12, the flag end and initial years of the high-growth (2004–2010) and pre-IBC (2011–2016) periods, respectively (see, e.g., Appendix A-2 and A-3 of the supplementary material on the financial sector reforms and government programs in India, respectively).

The foregoing divergence in criteria, analytic methods, data transformations, and/or periods of financial sector reforms across 22 studies might have been the reasons for portraying more public (n = 17) than private (n = 4) banks as better performers, $\chi^2(1) = 8.05$, $p = .005$. Das and Ghosh (2006) attributed more cases of better-performing public (n = 6) than private (n = 3) banks until 2004 to the recapitalization among public banks at the onset of banking reforms in 1992. To us, the structural deregulation[2] from 1992 to 1997 allowed open competition, the prudential

[1] While T was a contextual variable in most of the past studies, it is of prime interest to us.

[2] Structural deregulation was characterized by several policy instruments (e.g., the removal of entry restrictions to private ownership, branch delicensing, liberalization of interest rates on deposits and lending, etc.).

deregulation[3] from 1998 onward brought the long-run stability in the banking system, and all banks came under the same prudential norms and standard regulations. We further regarded the years 2004 through 2021 as important because they represented the three successive periods of high growth (2004-2010), pre-IBC (2011-2016), and post-IBC (2017-2021) in the economy of India. Hence, we used period as the predictor and ownership as the moderator of bank performance to provide a "fair" test of the property rights hypothesis.

Findings reported in Table 1 led us to envisage six patterns of differences between the longitudinal performance of private versus public banks in India. Across the graphs displayed in Figure 1, we list the predictor of period on the horizontal axis, the moderator of ownership as the curve parameter, and the criterion of performance on the vertical axis. The less the magnitude of the period effect on the productivity, the greater is the bank's resistance to inefficiency. Given the implied superiority of ME of the private firms to that of the public ones presumed in the property rights hypothesis, we portray the period effect on the performance of private banks as either constant as in the top three graphs or meagre as in the bottom three graphs of Figure 1. By contrast, we present the very same period effect on performance of public banks to be fluctuating across all the six graphs of Figure 1. Such conceptualizations of the performance of public banks presumed perpetual shifts in the motivation of the government in power and/or the bureaucrats running the public firms (Estrin & Perotin, 1991; Niskanen, 1975; Shleifer & Vishny, 1994).

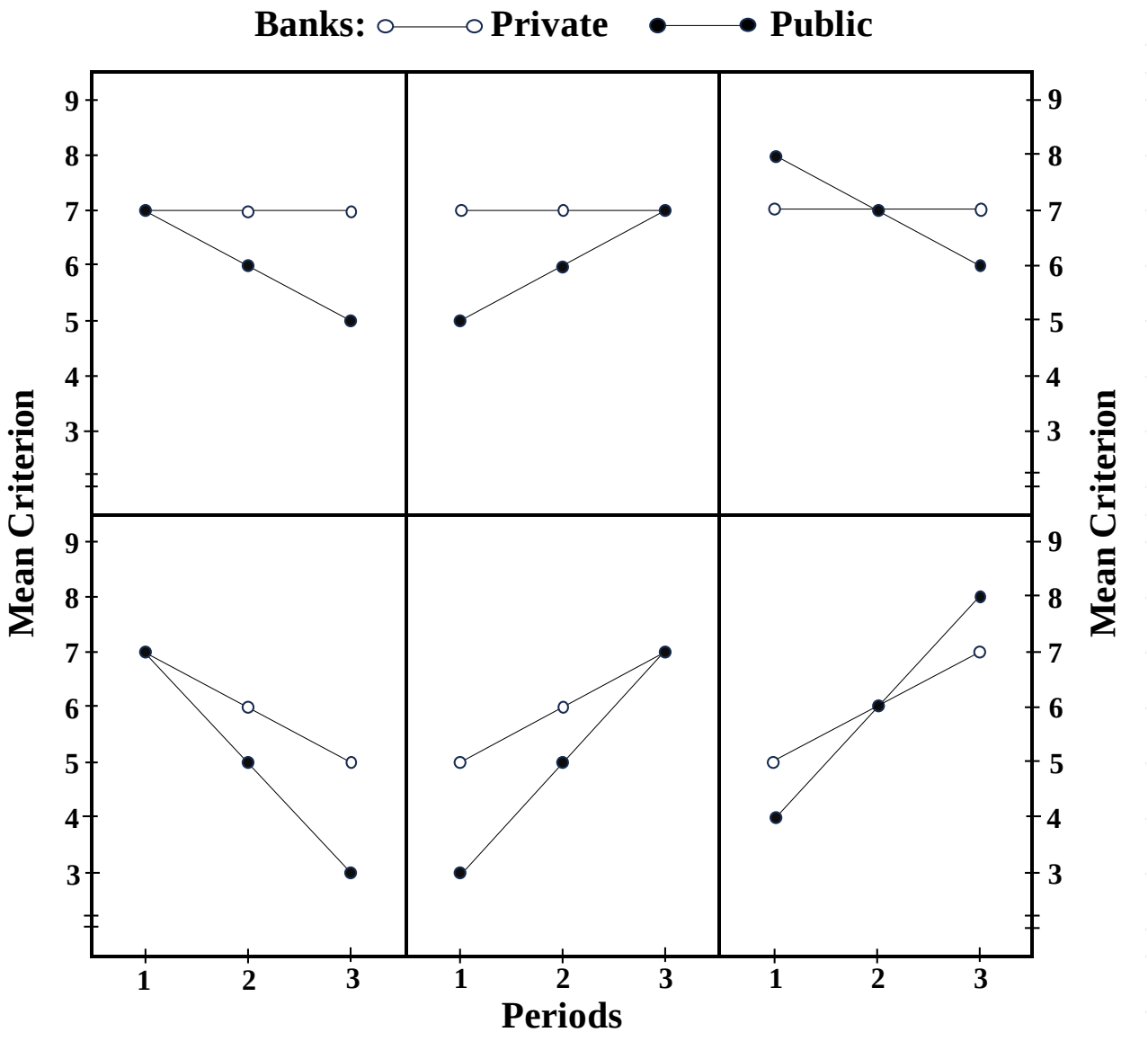
In our conceptualizations, the evidence for *no difference*, *superiority*, or *inferiority* of private over public banks or vice versa depends upon the periods studied. More important, the loci of the superior performance of private over public banks in the previous 4 instances may have been in the poor performance of public banks rather than in the good performance of private banks. Likewise, the loci of the superior performance of public over private banks in the previous 17 cases might have been in the sporadic good performance of public banks in the period of high growth rather than in the perpetual poor performance of private banks. To us, therefore, the crucial predictions of the property rights hypothesis are (a) that ownership should moderate the period effects on the criterion of bank performance, and (b) that the interaction in ME and TE should mediate the interaction in the criterion.

[3] Prudential deregulation was characterized by asset classification, income recognition, provisioning, risk-based capital adequacy, and informational disclosure.

To "fairly" evaluate the possibilities just raised, we collected data from 18 years: 2004 to 2021, a duration as long as that in Casu et al. (2013) and Badunenko and Kumbhakar (2017). Whereas our initial 7 years of high-growth period overlapped with those in these studies, our novelty lied in adding years of the pre-IBC and those of the post-IBC not studied so far.

Figure 1

Six Possible Patterns of Period × Ownership Effect on Criteria of Bank Performance



Note. The less the variation over time, the greater is the resistance to (or tolerance of) inefficiency. The shallower slope of the six curves for private than for those of public banks implies a more stable performance of private than public banks as in the property rights hypothesis.

Importantly, Tondon et al. (2014) reported no difference between public and private banks toward the end of the high-growth period. Therefore, we reasoned that the performance of the high-growth period could be an ideal base for investigating how private and public banks resisted inefficiency

over the pre-IBC and post-IBC periods characterized by their own unique set of prospects of and obstacles to fiscal growth in India (Rangarajan, 2023; Subbarao, 2016). Consistent with our conceptualizations displayed in Figure 1, we hypothesized, therefore:

Hypothesis 1. The longitudinal performance of public banks should be more variable than that of private banks, resulting in the Ownership × Period effect.

Partitioning of the X-Efficiency into TE and ME

The common efficiency frontier (Bhattacharyya, Lovell, & Sahay, 1997) initially served as the base and frame for estimating the X-efficiency of banks. The assumptions underlying such use were that (a) all banks are homogenous, (b) they rely on the same technology, and (c) the outputs below the frontier come from managerial inefficiency. Even within each ownership type, however, there existed enough intra-bank heterogeneities regarding age, size, market share, positive free cash flow, and area of operations that might have prevented managers from deploying their ability and efforts optimally.

One solution to the foregoing threats to the invalidity of the TE estimate was to construct different efficiency frontiers for different ownership types (Bos & Schmiedel, 2007; Kontolaimou & Tsekouras, 2010). That made interbank comparisons difficult. Worse, there was no justice with ME arising out of managerial practices. Although managerial inputs to productivity undoubtedly differ across the globe (Bloom & Reenen, 2010), they do account for about 20 and 17 per cent of the variance in productivity of American (Bloom et al., 2019) and Indian (Bloom, Eifert, Mahajan, McKenzie, & Roberts, 2013) firms, respectively. So, including ME within TE in the estimation of the X-efficiency of banks was an obvious oversight on the part of the past investigators. To test our causal model of bank performance, we decided to split the X-efficiency by estimating managerial efficiency and technical efficiency separately.

As Table 1 shows, DEA and SFA were the often-used approaches to the X-efficiency of banks in past studies. We preferred DEA to SFA for four reasons. First, DEA avoids the choices of specific functional forms and stochastic structures for the underlying production function and one-sided inefficiency terms (Sahoo & Tone, 2022). Second, DEA is a full-fledged statistical method that treats the X-efficiency as a stochastic variable, allowing formal statistical tests of the predictions (Banker, 1993). Third, DEA estimates capture the TE of an individual firm and can serve as benchmarks for the efficiency of other banks. Finally, and following Demerjian et al.

(2012), we also regarded *residuals* of the TE from RA as valid estimates of the ME for two reasons. First, a precise and valid measure of managerial efficiency is useful in answering the conceptual and methodological questions that we posed. Second, their approach was suitable for unpacking the X-efficiency into the TE coming from the bank-specific external factors and the ME coming from the manager-specific internal factors.

If the estimated TE and ME from information about the banks operating in India from 2004 to 2021 by DEA and RA do represent the two envisaged components of the X-efficiency underlying the input-output transformation, then there should be a three-way Ownership × Period × Mediator effect on the estimates. Therefore, we hypothesized:

Hypothesis 2. The addition of the mediators of TE and ME to the design should result in a statistically significant Ownership × Period × Mediator effect on the estimates.

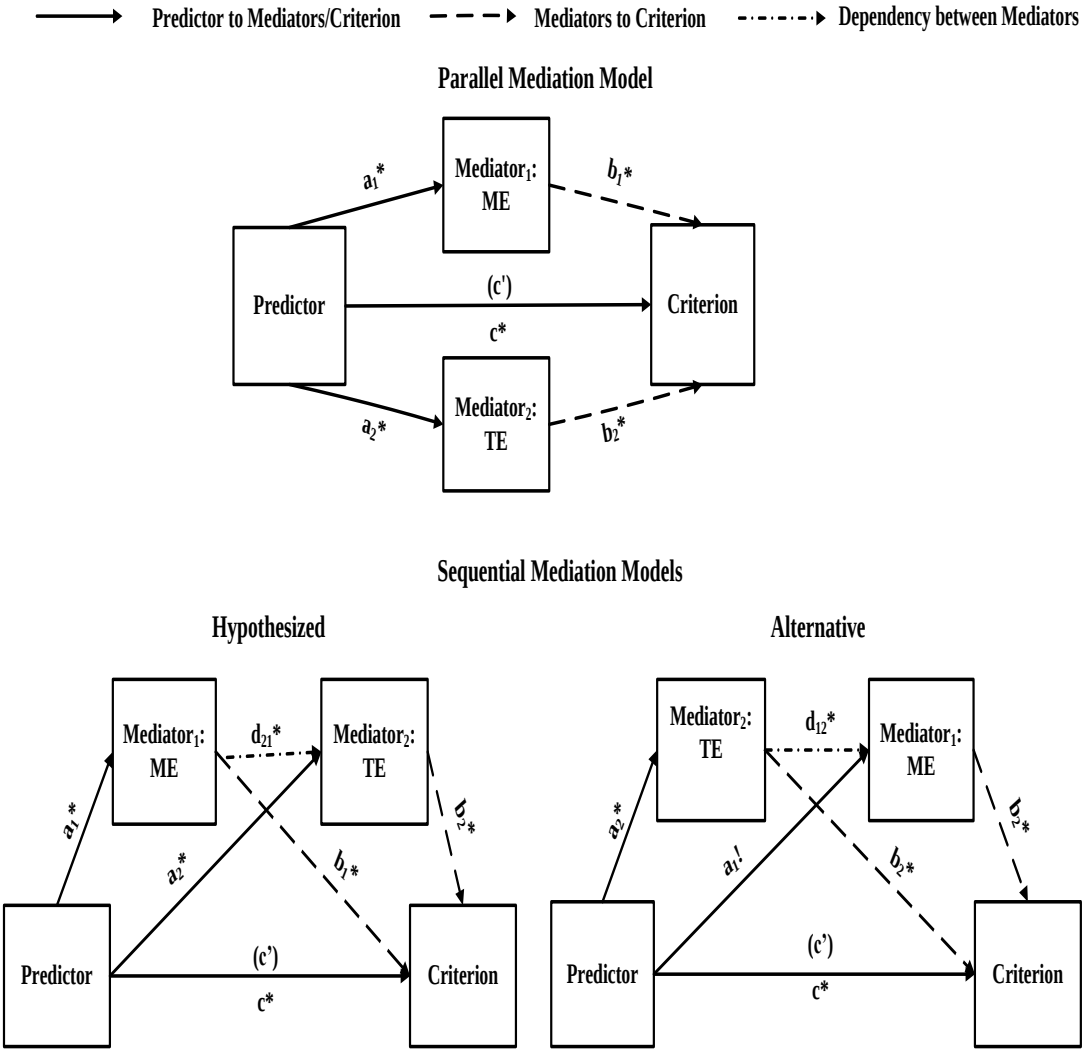
From the property rights hypothesis, the hypothesized triple interaction should stem from a greater discrepancy between TE and ME of public banks than that of private banks. Consistent with the possible negative consequences of a *huge human capital defici*t among public banks toward the end of the high-growth period (Khandelwal, 2010), moreover, the ME of public, compared to private, banks should be at least lower in the post-IBC period.

ME and TE as the Sequential Mediators

When there are two putative mediating variables (MVs) of a predictor-criterion relation, there can be three possible causal networks of them (Hayes, 2018). In Figure 2, we portray those networks in three separate diagrams. The top diagram of Figure 2 presents the parallel mediation model in which both the MVs are equally *close* to and *distal* from the predictor as well as the criterion. Also, the MVs are independent transmitters of the predictor effects to the criterion. An indirect effect (*IE*) of the predictor via a mediator (i.e., the mediation effect) is the product of the regression coefficients for the predictor effects on that MV (i.e., Path *a*) and for that very same MV effects on the criterion when both the predictor and that MV are designated as simultaneous predictors of the criterion (i.e., Path *b*). Thus, the *IE*s of the predictor via the respective MV_1: ME and MV_2: TE are a_1b_1 and a_2b_2, respectively. The total and direct effects of the predictor on the criterion are *c* and c' ($c - a_1b_1 + a_2b_2$) in order. To be acceptable as a MV, both Paths *a* and *b* coefficients of a MV must be statistically significant as indicated by the asterisk sign (∗) on the diagram, and the 95% confidence interval (*CI*) of its *IE* must be greater than zero (Hayes, 2018).

Figure 2

The Causal Paths from the Predictor to the Mediators (a) and the Criterion (c), the Dependency between the Mediators (d), and the Mediators to the Criterion (b)



Note. *Expected significant path. Total effect of the predictor on the criterion: *c*; Indirect effect (*IE*) of the predictor on the criterion via a mediator: *ab*; Direct effect of the predictor on the criterion: *c'* (i.e., *c* – *ab*); Sequential dependency between the mediators: d_{21} or d_{12}; and *IE* via Mediator$_1$→Mediator$_2$: $a_1 d_{21} b_2$. In the sequential model, $a_1 d_{21} b_2 + a_2 b_2$ = the *IE* of MV$_2$.

Given our prediction of the precedence of ME to TE in the predictor-criterion relation, we present the hypothesized and alternative sequential mediation models in the bottom left and right diagrams of Figure 2, respectively. In the bottom left diagram, we portray the respective ME and TE as the *distal (*MV$_1$*)* and *proximal* (MV$_2$) variables to the criterion. Hence, both the predictor and the preceding MV affect the succeeding MV in the causal network. Such sequential dependency of MV$_2$ on MV$_1$ (i.e., d_{21}) allows partitioning of the *IE* via MV$_2$: TE from the parallel

mediation model into MV_1: ME → MV_2: TE (i.e., $a_1d_{21}b_2$) and MV_2: TE. (i.e., a_2b_2). The virtue of the sequential mediation model lies in retaining the distal MV_1: ME as the mediator even if its own *IE* is zero. Put simply, the nonzero *IE* via MV_1: ME → MV_2: TE is sufficient for retaining MV_1 as the mediator (Singh et al., 2017).In the alternative right diagram in Figure 2, we have reversed the order of the two MVs. If this sequence of mediation is correct, then all the features we mentioned about the hypothesized model above would hold in the path coefficients of the diagram and in the three *IE*s. Given its incorrectness, however, we raise doubt about the significance of the coefficient for Path a_1 to MV_1: ME placed after TE. If our doubt does prevail, the three *IE*s would be causally illogical. Specifically, the incorrectly designated distal MV_1: ME as a variable proximal to the criterion should fail to be the mediator (Singh & Rai, 2021; Singh et al., 2017). Our Hypotheses 3 and 4 were as follows.

Hypothesis 3. ME precedes TE in mediating the predictor-criterion relation as envisaged in the hypothesized sequential mediation model.

Hypothesis 4. Sequencing ME and TE incorrectly, as in the alternative sequential mediation model, is unsuitable to account for the predictor-criterion relation.

METHODS

Database and Sampled Banks

In January 2022, we extracted information about the input, output, and contextual variables of all the banks operating in India from the database maintained by the CMIE ProwessIQ (https://prowessiq.cmie.com/). During our study period of 2004[4] to 2021, we found information about 253 banks, including 43 merged ones. We consolidated the relevant pieces of information about the merged banks with those of the acquiring ones (N = 210).[5]

We noticed a few cases of misclassification of banks by their ownership types. Based on the "Report on Trend and Progress of Banking in India" of the Reserve Bank of India (RBI), therefore,

[4] Our choice of the year 2004 as the starting year had four reasons. First, the union budget of the Government of India (GOI) for the fiscal year 2003-04 allowed foreign direct investment in banking up to 74% as a part of financial sector reforms to enhance efficiency. Second, the two then-leading private banks, namely, Kotak Mahindra Bank and YES Bank, were founded around 2004. Third, the data on the contextual variables of our interest have been available since 2004. Finally, India had an extremely high sustainable economic growth of 8% from 2004 to 2010 except for 2008 (the global financial crisis year).

[5] If Bank M was merged with Bank N in 2007, for example, then we consolidated the previous information about the former with that about the latter over the years studied.

we reclassified the qualifying banks as public, private, foreign, or others. The "others" category consisted of cooperatives, small finance, and payment banks. The needed pieces of information about the inputs, outputs, or contextual variables of 98 banks over the years studied were unavailable from the archival records. Consequently, we relied on an unbalanced sample of 112 banks (12 public, 21 private, 39 foreign, and 40 others) to draw 1264 observations from 2004-2021.[6] Of those initial observations, 216, 349, 361, and 338 came from the public, private, foreign, and others banks, respectively.

Approaches to Evaluation of the Technical Efficiency

Of the different approaches to estimating the X-efficiency or TE in the banking literature (Berger & Humphrey, 1992), the production and intermediate approaches have been the most often used ones in specifying inputs as well as outputs (Berger & Mester, 1997). We adopted the intermediate approach wherein banks serve as intermediaries between the providers and the users of funds by converting deposits into loans (Mester, 1997). There were three stages in our analyses of the TE and the ME of banks selected.

At the first stage of estimating the TE, we conceptualized banks as profit-maximizing units (Leightner & Lovell, 1998); interest expenses (*INTEXP*) and non-interest expenses (i.e., other operating expenses (*OOEXP*)) as the two input variables; and interest income/revenue (*INTREV*) and non-interest income/revenue (i.e., other operating revenue (*OOREV*)) as the two output variables (Mester, 1997). At the second stage, we regressed the TE on the various contextual variables of year (*YR*), capital adequacy ratio (*CAR*), net non-performing assets as a percent of net advances (NPA_R), total assets (*TA*), nationwide operation (*NB*), the number of branches (*BR*), the number of automatic teller machines (*ATM*s), and mergers and acquisitions (*M&A*), using the ordinary least squares (OLS) method. As in Demerjian et al. (2012), we regarded residuals of the TE estimated from the second stage RA as unobserved estimates of the ME.

At the second stage of RA, we added the variable *YR* (i.e., the number of years that had passed since 2004) to capture the continual increase in the degree of competition in the banking industry. Further, we included the term *YR*-squared (i.e., $YR^{sq.}$, the quadratic transform) to capture the non-linear effects and the non-monotonic TE trend during the high-growth phase and the IBC periods.

[6] The numbers of banks in India were 58, 54, 53, 57, 59, 55, 59, 60, 68, 69, 72, 77, 83, 87, 90, 92, 91, and 80 for the respective 18 years of 2004, 2005, … and 2021).

The banks across ownership types had maintained an extremely high *CAR* (higher than Basel III norms) and gone through *M&A* over the years studied (see Appendix A-4 of the Supplementary Material). Hence, we entered both *CAR* and *M&A* in our RA.

To capture the impact of size (scale and scope economies) on the TE, we included the *TA* of the selected banks in RA. Also, we added crucial contextual variables of the banks having *NB, BR*, and *ATMs* as the predictors of bank efficiency. For the national operation, we used the dummy variable NB, whose value was 1 if the bank operated across India and 0 if it operated regionally. Expanding banking services nationwide through additional branches and *ATMs* may have enabled a bank to attract new customers and provide them with better services. Nevertheless, such expansion of banks without adequate supporting employees might have diminished efficiency arising out of an increased burden of coordination and management problems. Put simply, the net impact of an expansion required proper empirical checks. Toward this end, we included these variables as the predictors of TE in RA.

Estimation of Technical Efficiency

Banks maximize their service provisions from the disposal resources (Bhattacharyya et al., 1997) and require a service-oriented measure of efficiency. To compute the output TE of each sampled bank in each year, therefore, we first pooled the input-output data of all banks in all years to construct the single efficiency frontier. We then computed the output TE of bank h in year t $(\mathrm{TE}_{ht})_{h\,=\,1,\ldots,n;\;t\,=\,1,\ldots,T}$ by comparing its actual outputs $(INTREV_{ht}, OOREV_{ht})$ with the best-practice outputs achievable with its available inputs $(INTEXP_{ht}, OOEXP_{ht})$. Our idea was to reallocate the bank h's actual inputs $(INTEXP_{ht}, OOEXP_{ht})$ over all the observations $j = 1,2, \ldots, nT$ (n: number of banks and T: number of years), and to run the latter with intensities λ_j to increase its outputs $(INTREV_{ht}, OOREV_{ht})$ by an expansion factor θ_{ht}, computable from the following linear program (Banker, Charnes, & Cooper, 1984):

$$(\mathrm{TE}_{ht})^{-1} = \max \theta_{ht} \qquad (1)$$

subject to

$$\sum_{t=1}^{T}\sum_{j=1}^{n} \lambda_{jt} INTEXP_{jt} \leq INTEXP_{ht},$$

$$\sum_{t=1}^{T}\sum_{j=1}^{n} \lambda_{jt} OOEXP_{jt} \leq OOEXP_{ht},$$

$$-\sum_{t=1}^{T}\sum_{j=1}^{n} \lambda_{jt} INTREV_{jt} + \theta_{ht} INTREV_{ht} \leq 0,$$

$$-\sum_{t=1}^{T}\sum_{j=1}^{n} \lambda_{jt} OOREV_{jt} + \theta_{ht} OOREV_{ht} \leq 0,$$

$\sum_{t=1}^{T}\sum_{j=1}^{n}\lambda_{jt} = 1\,,$

$\lambda_{jt}, \theta_{ht} \geq 0, \quad j = 1, \ldots, n; t = 1, \ldots, T.$

Let θ_{ht}^{*} be the objective function value of the linear program (1). Then, the bank h's potential output vector in year t becomes $(\theta_{ht}^{*} INTREV_{ht}, \theta_{ht}^{*} OOREV_{ht})$, using the best practice technologies. The bank h's TE was then computed as the ratio of actual output to potential output, that is, $\mathrm{TE}_{ht} = \frac{INTREV_{ht}}{\theta_{ht}^{*}\, INTREV_{ht}} = \frac{OOREV_{ht}}{\theta_{ht}^{*}\, OOREV_{ht}} = \frac{1}{\theta_{ht}^{*}}$, which lied between 0 and 1. We solved the linear program (1) once for each bank in each year. Consequently, the TE estimates came from our initial 1264 observations on all banks.

Estimation of Managerial Efficiency

Since our TE measure captured both bank-specific and manager-specific factors, we first purged the TE measure of the bank-specific exogenous factors influencing the bank's TE. As in Demerjian et al. (2012), we then ran the following RA using the OLS method[7] to estimate the ME of bank h at time t:

$$\ln \mathrm{TE}_{ht} = \alpha_0 + \alpha_1\, YR_{ht} + \alpha_2 YR_{ht}^{sq} + \alpha_3\, CAR_{ht} + \alpha_4\, NPA_{R_{ht}} + \alpha_5\, M\&A_{ht} + \alpha_6\, NB_{ht} + \alpha_7\, BR_{ht} + \alpha_8 \ln TA_{ht} + \alpha_9\, ATM_{ht} + \varepsilon_{ht}, \quad (2)$$

where $\ln TE_{ht}$ is the natural logarithm of the TE score of bank h at time t, YR_{ht} is the number of years passed since 2004 for bank h at time t, CAR_{ht} is the capital adequacy ratio of bank h at time t, $NPA_{R_{ht}}$ is the ratio of net NPA to net advances of bank h at time t, BR_{ht} is the total number of branches of bank h at time t, $\ln TA_{ht}$ is the natural logarithm of total assets measured in crores of rupees for bank h at time t, ATM_{ht} is the total number of ATMs for bank h at time t, $M\&A_{ht} = 1$ in the post-merger period, otherwise 0, $NB_{ht} = 1$ if bank h at time t operated nationally, otherwise 0, and ε_{ht} was the error term.

Let $\hat{\alpha}_0$, $\hat{\alpha}_1$, …, and $\hat{\alpha}_9$ be the estimated coefficients of the regression model (2). Using these estimated coefficients, the residuals obtained represented our measure of ME (ME_{ht}), that is,

$$\mathrm{ME}_{ht} = \ln TE_{ht} - \hat{\alpha}_0 - \hat{\alpha}_1\, YR_{ht} - \hat{\alpha}_2 YR_{ht}^{sq.} - \hat{\alpha}_3\, CAR_{ht} - \hat{\alpha}_4\, NPA_{R_{ht}} - \hat{\alpha}_5\, M\&A_{ht} - \hat{\alpha}_6\, NB_{ht} - \hat{\alpha}_7\, BR_{ht} - \hat{\alpha}_8 \ln TA_{ht} - \hat{\alpha}_9\, ATM_{ht}. \quad (3)$$

[7] For yielding the heteroscedasticity-consistent standard errors, we used White's (1980) robust standard errors which are free from spatial and temporal dependencies among the panel data.

Since ME_{ht} is a residual and can take on both positive and negative values, we did the following transformation to normalize the scores (ME_{ht}^{n}) within a range of 0 to 1:

$$\mathrm{ME}_{ht}^{n} = \frac{ME_{ht} - \min\limits_{h,t}(ME_{ht})}{\max\limits_{h,t}(ME_{ht}) - \min\limits_{h,t}(ME_{ht})}. \quad (4)$$

Thus, both the ME and TE scores ranged from 0 (*minimum*) to 1 (*maximum*).

Criteria of Bank Performance

Following the past literature on bank performance, we extracted two financial performance indicators of net profit margin (NPM, Chatterjee & Hanbrick, 2007) and returns on equity (ROE, Chen & Hanbrick, 2012) and one operational performance indicator of returns on assets (ROA, Chung & Luo, 2013) as the criteria of bank performance from the same CMIE database. The higher the score, the higher is the performance of the bank.

Final Sample of Observations for Testing the Hypotheses

Of the 349 initial observations on private banks used in estimating ME and TE jointly by DEA and RA, we found nine missing pieces of information about the criteria of performance of two private banks (i.e., Nainital Bank for eight years: 2007-2014; Tamilnad Mercantile Bank for 2008). Dropping of these two banks enabled us to analyze 340 and 216 observations on all the five variables of private and public banks, respectively (N = 556). While the number of public banks remained constant at 12 over the 18 years studied, that of private banks varied between 17 and 21.

RESULTS

Preliminary Analyses

We first performed a one-way analysis of variance (ANOVA) to detect variations, if any, over 18 years in each of the five variables of private and public banks. In private banks, the mean ME was stable over years, $F(17, 322) = 1.25$, $p = .23$, partial eta square (η_p^2) = .06, power > .82, but those of TE, NPM, ROE, and ROA were significantly variable, Fs(17, 322) = 2.53, 1.82, 2.63, and 1.68, respectively, ps < .04, η_p^2s = .12, .09, .12, and .08, powers > .94. In public banks, the means of ME, TE, NPM, ROE, and ROA were all highly variable over years, Fs(17, 198) = 8.85, 12.88, 19.98, 28.82, and 20.35, respectively, ps < .001, η_p^2s = .43, .53, .68, .71, and .64, powers > .99. Clearly, fluctuations in the respective ME, TE, NPM, ROE, and ROA measures over years were 7, 4, 8, 6, and 8 times larger for public than private banks,

We adjudged the temporal stability in ME of private banks as evidence against the commonly present threats of *attrition*, *regression toward the mean*, or *change in operationalization of measures* over time to any causal inference from the longitudinal data from field settings (see, e.g., Cook & Campbell, 1979). Moreover, we regarded the larger η_p^2s of the time effects on the variables of the public banks (i.e., less resistance to or higher tolerance of inefficiency over period) than those of the private ones as highly encouraging for further tests of the property rights hypothesis.

For simplicity in analyses of the data, interpretation of the results, and exposition of the findings, we averaged the estimates of years 2004 to 2010, 2011 to 2016, and 2017 to 2021 into three composite estimates for the respective periods of high growth, pre-IBC, and post-IBC. That made our design Ownership (private [1) *vs*. public [0]) × Period (high growth [-1] *vs*. pre-IBC [0] *vs*. post-IBC [1]) factorial, with unequal *n*s across six cells. We regarded the means as significantly different from each other only when their respective 95% CI did not overlap. Moreover, we adjudged the resistance to inefficiency over periods by the size of η_p^2 of the period effect on the measure. The smaller the size of η_p^2, the greater is the resistance to inefficiency over periods in banks as conceptualized in Figure 1.

Tests of the Property Rights Hypothesis

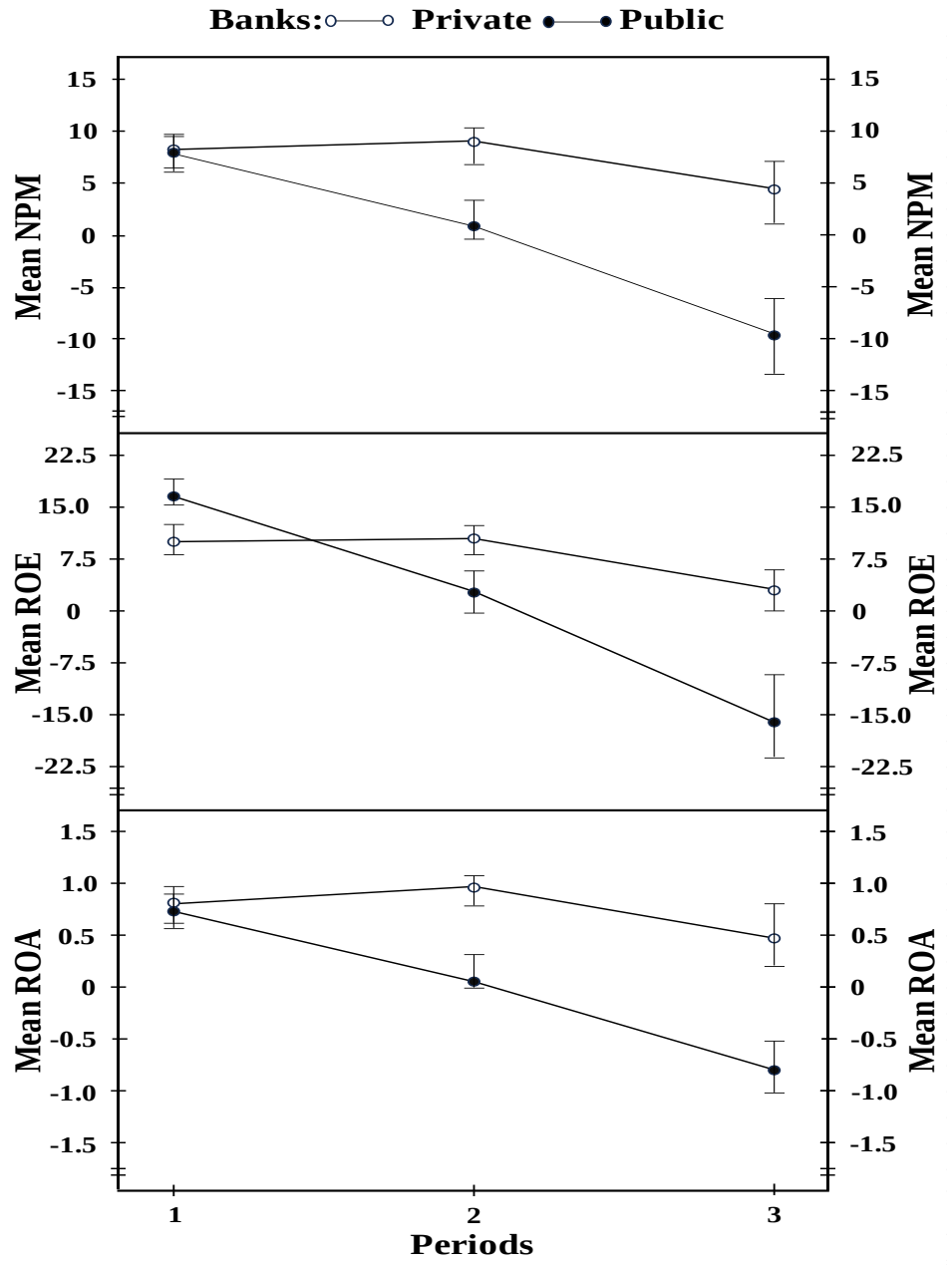
As predicted, the Ownership × Period effects were significant, *F*s(2, 250) = 20.11, 34.78, and 15.82 for NPM, ROE, and ROA, respectively, *p*s < .001, η_p^2s = .07, .11, and .05, powers > .99. In Figure 3, we display mean performance as a function of the predictor of period listed on the horizontal axis and the moderator of private *versus* public banks listed as the curve parameters. The vertical bars around the means exhibit their corresponding 95% CI. Consider the pattern in the NPM, ROE, and ROA criteria of bank performance exhibited on the top, center, and bottom parts of Figure 3, respectively. Two results stand out.

First, the private banks resisted inefficiency over periods more strongly than did their public counterparts. Simple effects of period on NPM, ROE, and ROA of private banks were statistically significant, *F*s(2, 337) = 4.42,[8] 8.51, and 5.53, respectively, *p*s < .01, η_p^2s = .03, .05, and .03, powers

[8] Despite a statistically significant period effect on NPM in ANOVA, the 95% *CI*s of the three means shown in Figure 3 overlapped with each other.

Figure 3

Mean NPM, ROE, and ROA as a Function of the Predictor of Period and the Moderator of Ownership



Note. The vertical bar around the mean is the corresponding 95% CI.

> .76, .99, and .99; so were simple effects of period on NPM, ROE, and ROA of public banks, *F*s(2, 213) = 59.90, 81.24, and 62.43, respectively, *p*s < .004, η_p^2s = .36, .43, and .37, powers > .99.

Second, there was no ownership difference in either NPM or ROA in Period 1 of high growth. The mean ROE of public banks was higher than that of private banks. In Period 2 of pre-IBC and Period 3 of post-IBC, however, the performance of public banks was lower than that of private banks. In fact, there was a steady decline in the performance of public banks from Period 1 to Period 3. So, the locus of ownership difference was in the inferior performance of public banks over the years, supporting Hypothesis 1.

Tests of Construct Distinction

To distinguish the estimated ME and TE constructs empirically, we first performed a 2 × 3 × 2 ANOVA, with repeated measurements on the third factor of mediators. Supporting Hypothesis 2, the three-way interaction was statistically significant, $F(2, 550) = 10.74$, $p < .001$, $\eta_p^2 = .04$, power > .99; as were the Ownership × Period effects on the ME and TE estimates, $F(2, 550) = 28.73$ and 21.23, respectively, ps < .001, η_p^2s = .09 and .07, power > .99. In Figure 4, we display the ME means by dashed curves and the TE means by solid curves as a function of the predictor of period listed on the horizontal axis and the moderator of ownership listed as the curve parameters (open circle for private banks; filled circle for public banks).

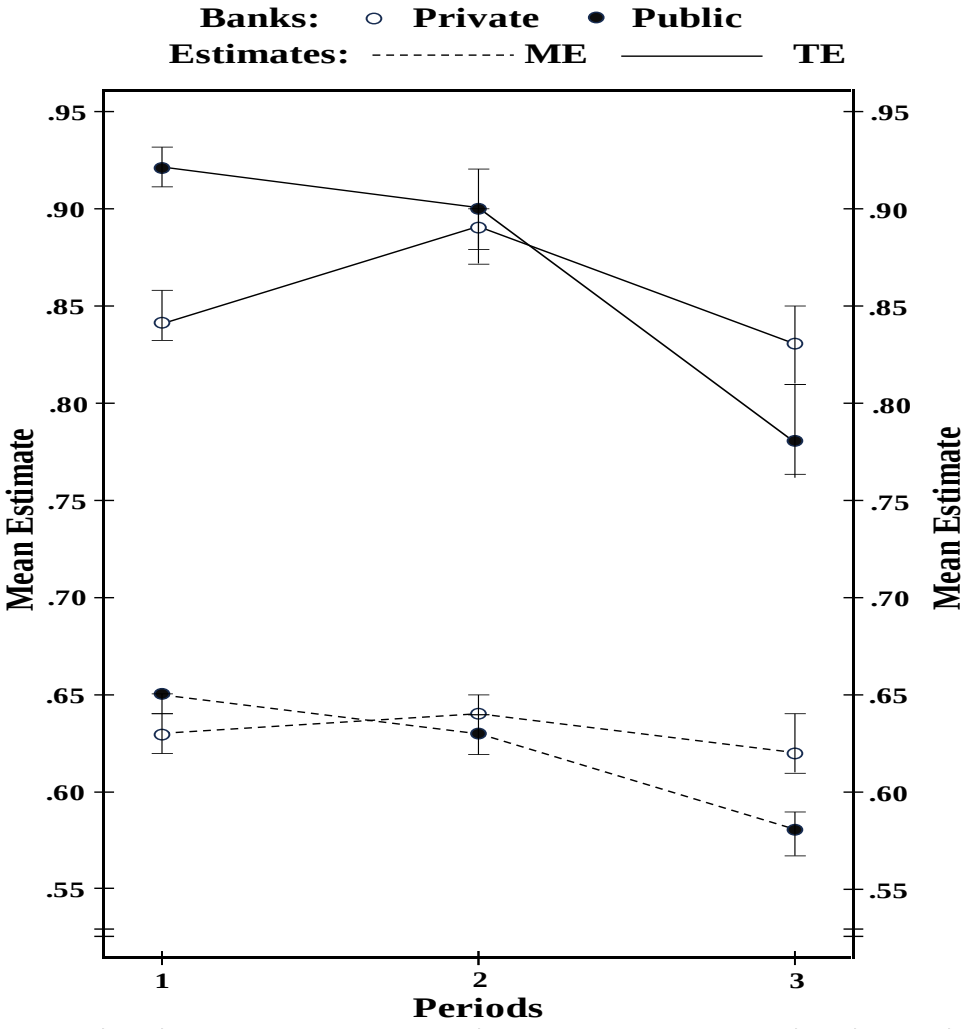
As in the three criteria of performance shown in Figure 3, fluctuations in the ME and TE means over periods are broader for public than private banks. Indeed, fluctuations in ME over periods were 9 times larger for public banks (i.e., dashed curve with open circles), $F(2, 213) = 40.02$, $p < .001$, $\eta_p^2 = .27$, power > .99, than those for private banks (i.e., dashed curve with filled circles), $F(2, 237) = 5.01$, $p < .007$, $\eta^2_p = .03$, power > .81. The corresponding fluctuations in TE were 6 times larger for public banks (i.e., solid curve with filled circles), $F(2, 213) = 56.16$, $p < .001$, $\eta_p^2 = .35$, power > .99, than those for private banks (i.e., solid curve with open circles), $F(2, 337) = 11.38$, $p < .001$, $\eta_p^2 = .06$, power > .99. Put simply, private banks resisted inefficiency more vehemently than did public banks, replicating the trends present in the bank performance.

There are two other lines of evidence for the construct distinction in Figure 4. First, the two curves with filled circles form the Mediator (TE *versus* ME) × Period effect for public banks, $F(2, 213) = 50.35$, $p < .001$, $\eta_p^2 = .32$, power > .99, and those with the open circles form the same interaction effect for private banks, $F(2, 337) = 9.48$, $p < .001$, $\eta_p^2 = .05$, power > .98. That the TE-

ME distinction over periods was 6 times larger for public banks than that for private banks agrees with the property rights hypothesis that posits difference in motivation of people running private versus public firms.

Figure 4

Mean ME and TE as a Function of the Predictor of Period and the Moderator of Ownership



Note. The vertical bar around the mean is the corresponding 95% CI.

Another line of evidence for the construct distinction comes from the private-public differences in the estimated TE and ME exhibited in Figure 4. The very same public banks, which were higher in TE than private banks in Period 1 (see the top left two lines), turned out to be lower in ME in Period 3 (see the bottom right two lines). The same public banks, which scored higher in

TE than private banks but equal in ME in the high-growth period, scored equal in TE but lower in ME in the post-IBC period. Given that there was a steady decline in both TE and ME of the public banks, but not of the private ones, over the three periods, we regarded the two constructs as empirically distinct as posited in Hypothesis 2.

Mediation Analyses

***Correlations between variables*.** In Table 2, we report the coefficients of correlation (*r*s) between the five variables along with the 95% CI of each *r*. Three observations are in order.

Table 2
Correlations Among the Mediating (MV) and Criterion (Crit.) Variables

		Mediating and Criterion Variables			
Variables	Statistics	MV_2: TE	$Crit._1$: NPM	$Crit._2$: ROE	$Crit._3$: ROA
MV_1:ME	*r*	$.81_x$	$.72_x{}^a$	$.75_x{}^b$	$.71_x{}^c$
	95% CI	(.78, .84)	(.63, .81)	(.65, .83)	(.61, .80)
MV_2:TE	*r*		$.64_x{}^a$	$.67_x{}^b$	$.62_x{}^c$
	95% CI		(.56, .72)	(.59, .74)	(.55, .71)
$Crit._1$: NPM	*r*			$.94_y{}^a$	$.98_x{}^a$
	95% CI			(.92, .95)	(.97, .99)
$Crit._2$: ROE	*r*				$.91^b$
	95% CI				(.88, .93)

Note. All *r*s are significant at $p < .001$. The column *r*s with different subscripts (x, y) and row *r*s with different superscripts (a, b, c) differ significantly from each other at $p = .05$. $N = 556$.

First, the *r*s between the three criteria of performance are high, ranging between .91 to .98, as if they were identical indicators of bank performance. Second, the two putative mediating variables correlate moderately and about the same with the three criteria of performance. Finally, the *r* between ME and TE falls in between the preceding two sets of *r*s. That the *r* between ME and TE is no different from those between ME and the criteria (see *r*s in the top row) but different from those between TE and the criteria (see *r*s in the middle row) further points out that ME should be a stronger mediator of the predictor-criterion link than TE.

Moderated sequential mediation. If ownership influenced the longitudinal performance of banks by determining the extent to which they were managerially and technically efficient, then the interaction in ME and that in TE should mediate the interaction in each criterion. To evaluate

this possibility, we first centered the two categorical predictors of ownership (O) and period (P) on their respective means and then took their products to make the centered O × P predictor. In three separate PROCESS Model 6 analyses in SPSS (Hayes, 2018), we then specified the centered O × P term as the predictor, the two centered main effects of O and P as the covariates (Cov.), the estimated ME and TE as the ordered MVs, and NPM, ROE, or ROA as the criterion in our hypothesized moderated sequential mediation models. For yielding 95% CI of (i) the indirect effects (*IE*) of the O × P predictor on a criterion via MV_1, $MV_1 \rightarrow MV_2$, and MV_2 and (ii) the difference between two *IE*s, we set 5,000 bootstrap resamples. In three separate alternative sequential models, we simply reversed the orders of the mediators, that is, MV_2 preceded MV_1. If Hypotheses 3 and 4 are correct, then the path coefficients and the *IE*s should be consistent with the prescriptions of the first sequential model (Hypothesis 3) but inconsistent with those of the alternative sequential model (Hypothesis 4). We display the unstandardized regression coefficients from the respective hypothesized and alternative moderated sequential mediation analyses in the left and right path diagrams of Figure 5. The coefficients from such analyses of the NPM, ROE, and ROA criteria are in the top, center, and bottom parts of Figure 5, respectively.

Consistent with ANOVA results reported earlier, all three causal paths (i.e., the O × P to the ME [$a_1 \rightarrow MV_1$], to the TE [$a_2 \rightarrow MV_2$], and to the criterion [c]) are statistically significant in the three left path diagrams. At odds with ANOVA results, by contrast, the $a_1 \rightarrow MV_1$ path is nonsignificant in the three path diagrams on the right side. That is, sequencing the two putative MVs incorrectly rendered the preceding MV_1 of ME as redundant (Singh & Rai, 2021). Notably, the dependency of the theorized succeeding MV_2 of TE on its predecessor MV_1 of ME (d_{21}) is 3.18 times larger than that of ME on TE (d_{12}). These results jointly argue for the hypothesized model but against the alternative model.

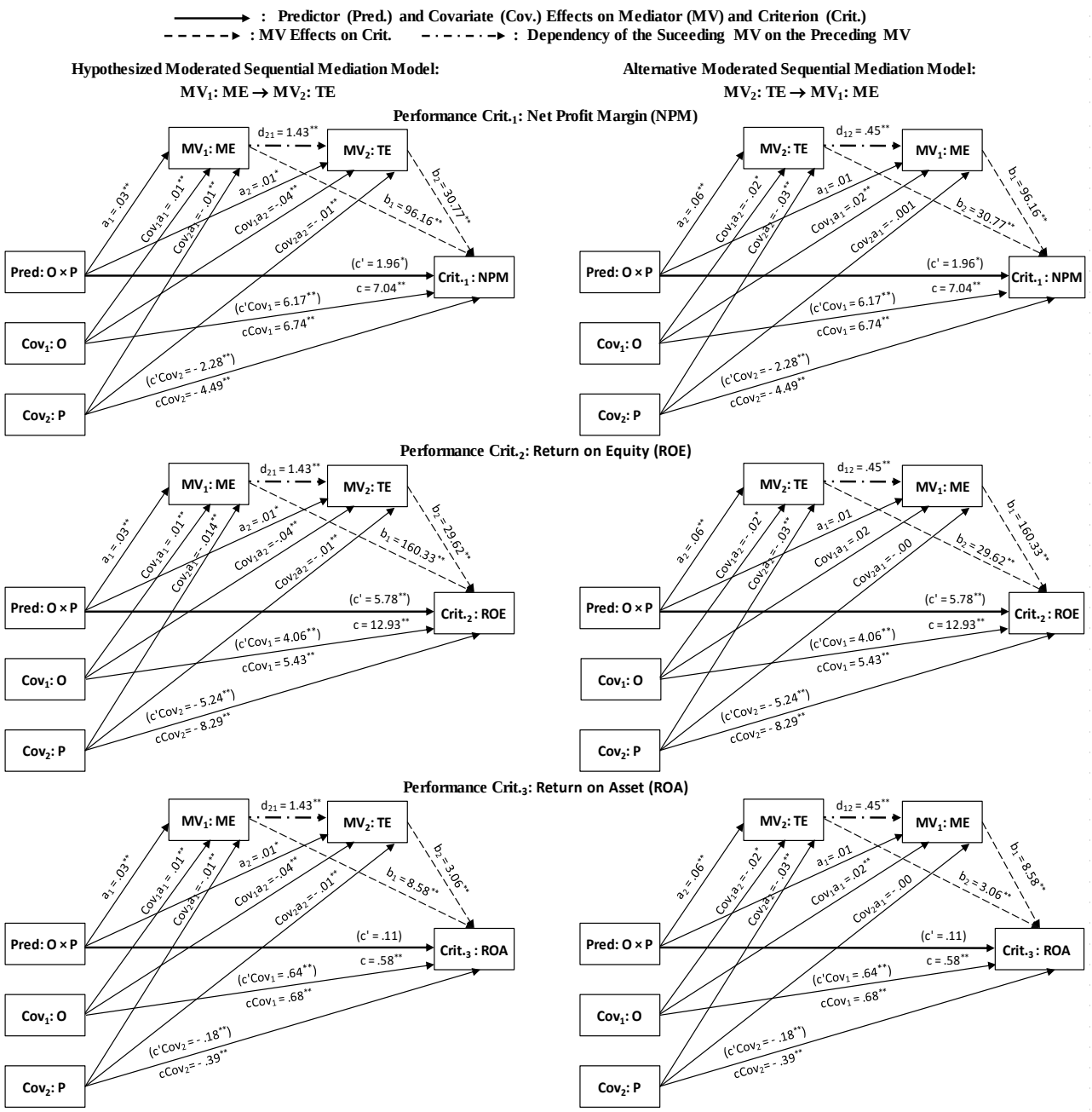
In Table 3, we report three *IE*s and their corresponding 95% *CI*s from the hypothesized and alternative moderated sequential model analyses. Results for the NPM, ROE, and ROA criteria are on the respective left, center, and right sides and those from the hypothesized and alternative models are in the top and bottom parts of Table 3, respectively. We regarded the *IE* and the difference between any pair of *IE*s as statistically significant only if their corresponding 95% *CI*s excluded zero (Hayes, 2018).

Supporting Hypothesis 3, the causal effects of O × P on each criterion of bank performance traveled via MV_1: ME to MV_2: TE. In all three cases, the *IE*s via MV_1, $MV_1 \rightarrow MV_2$, and MV_2 are

significantly greater than zero. Moreover, the *IE* of the O × P predictor on the criterion via ME is not only the largest but also significantly greater than its sequential *IE* via TE and the *IE* via TE. Supporting Hypothesis 3, both the predictor and the preceding ME influenced TE.

Figure 5

The Unstandardized Path Coefficients from the Hypothesized and Alternative Moderated Sequential Mediation Analyses of the Three Criteria of Bank Performance



Note. * $p < .05$, * $p < .01$. No significant path from Pred.: O × P to MV_1: ME in the three right diagrams casts doubt on such ordering of the MVs.

The results from the alternative sequential mediation model reported in the bottom part of Table 3 further confirm Hypothesis 3. Placing MV_2 of TE first in the causal chain detected its sequential effect on MV_1: ME but made it unwanted. Such nullifying of ME, which was proximal to the criterion in the alternative model, makes this causal chain illogical as suspected. Therefore, we accept Hypothesis 4.

Table 3

Indirect Effects of the Ownership × Period Predictor on the Criteria of Bank Performance via Two Mediators from the Hypothesized and Alternative Moderated Sequential Mediation Models

	Criterion of Bank Performance					
	Crit.$_1$: NPM		Crit.$_2$: ROE		Crit.$_3$: ROA	
Sequence of Mediators	*IE*	*95% CI*	*IE*	*95% CI*	*IE*	*95% CI*
	Hypothesized Moderated Sequential Mediation Model: MV_1: ME → MV_2: TE					
MV_1: ME	**3.20**[a]	(1.82, 4.73)	**5.34**[a]	(3.14, 7.69)	**0.29**[a]	(0.17, 0.42)
MV_1: ME → MV_2: TE	**1.47**[b]	(0.76, 2.35)	**1.41**[b]	(0.72, 2.23)	**0.15**[b]	(0.08, 0.23)
MV_2: TE	**0.41**[c]	(0.06, 0.81)	**0.39**[c]	(0.06, 0.79)	**0.04**[c]	(0.01, 0.08)
	Alternative Moderated Sequential Mediation Model: MV_2: TE → MV_1: ME					
MV_2: TE	**1.87**[a]	(1.02, 2.96)	**1.81**[b]	(0.96, 2.85)	**0.20**[a]	(0.10, 0.29)
MV_2: TE → MV_1: ME	**2.65**[a]	(1.44, 3.97)	**4.42**[a]	(2.59, 6.48)	**0.24**[a]	(0.13, 0.36)
MV_1: ME	0.55[b]	(-0.09, 1.15)	0.92[b]	(-0.14, 2.02)	0.05[b]	(-0.01, 0.11)

Note: N = 556. ME: Managerial Efficiency, TE: Technical Efficiency. NPM: Net Profit Margin; ROE: Return on Equity; ROA: Return on Assets. The *IE*s in bold are significantly greater than zero, and those with different row superscripts (a, b, c) differ significantly from each other at p = .05.

Moderated parallel mediation model. For the sake of completeness, we specified ME and TE as the two parallel MVs of the O × P effects on each criterion in PROCESS 4 analyses. In Table 4, we report the two *IE*s and their corresponding 95% *CI*s. Results for the NPM, ROE, and ROA criteria appear on the respective left, center, and right sides of Table 4.

The *IE*s via MV_1: ME → MV_2: TE and MV_2: TE of the hypothesized moderated sequential model of Table 3 sum to the *IE* via TE of the parallel mediation model. Both MVs yielded *IE*s significantly greater than zero. Whereas the two *IE*s of the predictor on NPM or ROA did not differ, the *IE* via ME was greater than that via TE on ROE. These results accord the mediator status to both the ME and TE estimates but caution against treating them as parallel processes. Had we regarded them as two parallel MVs, we would have erroneously concluded for their equal potency and missed out the predicted precedence of ME to TE in bank performance.

Table 4

Indirect Effects of the Ownership × Period Predictor on the Three Criteria of Bank Performance via the Two Mediators from the Moderated Parallel Mediation Models

	Criterion of Bank Performance					
Mediators of	Ctit.$_1$: NPM		Crit.$_2$: ROE		Crit.$_3$: ROA	
Performance	*IE*	*95% CI*	*IE*	*95% CI*	*IE*	*95% CI*
MV_1: ME	**3.20**[a]	(1.83, 4.72)	**5.34**[a]	(3.11, 7.72)	**.29**[a]	(.17, .41)
MV_2: TE	**1.87**[a]	(1.01, 2.95)	**1.81**[b]	(0.96, 2.81)	**.19**[a]	(.11, .29)

Note. The *IE*s in bold are significantly greater than zero, and those with different column superscripts differ significantly at $p = .05$.

Partial versus complete mediation. The direct effects (*c*'s) of the Ownership × Period predictor on NPM, $t = 2.40$, $p = .02$, and ROE, $t = 5.20$, $p < .001$, were significant, but nonsignificant on ROA, $t = 1.38$, $p = .17$. On this basis, the mediation is partial for NPM and ROE but complete for ROA.

Eliminating reverse-causation. Support for Hypotheses 3 and 4 confirmed our key proposition that ME precedes TE in mediating the Ownership × Period effects on bank performance. However, one may raise the possibility of reverse-causation (Kenny, Kashy, & Bolger, 1998; Singh, Ho, Tan, & Bell, 2007), that is, the criteria themselves might have mediated the Ownership × Period effects on ME and TE. To rule out such reverse-causation, we performed four PROCESS 6 analyses for ME and TE separately, placing NPM, ROE, and ROA in four different orders (Order 1: NPM → ROE → ROA, Order 2: ROE → ROA → NPM, Order 3: ROA → NPM → ROE, and Order 4: ROA → ROE → NPM). We display the regression coefficients of the four path diagrams of TE and ME on the left and right diagrams of Figure 6, respectively (see Figure 6 of Appendix B-1 in the supplementary file). Further, we report the results from such analyses for the TE and ME estimates on the left and right sides of Table 5 of Appendix B-2 in the supplementary file, respectively. Ruling out the reverse-causation, none of the seven causal routes through which the three criteria might have mediated the Ownership × Period effects on TE had an *IE* greater than zero. So, the causation was from TE to the criterion, not vice versa.

For ME, five scattered routes from the four orders of the three criteria had an *IE* greater than zero (i.e., Order 1: Crit.$_1$: NPM → Crit.$_2$: ROE, *IE* = .02, 95% *CI*: [.01, .03]; Order 2: Crit.$_2$: ROE, *IE* = .03, 95% *CI*: [.01, .04], Order 3: $Crit_3$: ROA → $Crit_1$: NPM → $Crit_2$: ROE, *IE* = .02, 95% *CI*: [.01, .03]; and Order 4: Crit.$_3$: ROA → Crit.$_2$: ROE, *IE* = .02, 95% *CI*: [.01, .03], Crit.2: ROE, *IE*

= .01, 95% *CI*: [.01, .02]). The presence of the mediation of the Ownership × Period effects on ME by ROE in these five cases hints at reciprocity among the three criteria in building ROE and between ROE and ME. Nevertheless, none of these significant routes was proximal to ME at any of the four orders. Thus, we dismiss these 5 of the possible 28 sequential routes from the criteria to ME as causally illogical (Singh & Rai, 2021).

When we specified the three criteria as parallel mediators in two separate PROCESS 4 analyses (see Table 6 of Appendix B-3 in the supplementary file), ROE emerged as a mediator of the Ownership × Period effects on ME, *IE* = .03, 95% *CI*: [01, .04]. There was no mediation of TE by any of the three criteria. High returns on equity may have boosted managerial efficiency!

DISCUSSION

Findings enrich the banking literature by providing unambiguous answers to the four key questions we raised at the outset of this article. First, private banks in India resisted inefficiency over the years more strongly than did public banks (Bhaumik & Dimova, 2004; Casu et al., 2013; Kumbhakar, & Sarkar, 2003; Sengupta & Sahoo, 2006). Second, it is indeed better to represent the input-output transformation by two intervening variables of ME and TE (Demerjian et al., 2012) than continuing with the established tradition of representing it by the X-efficiency alone (Berger & Humphrey, 1992; Berger & Mester, 1997). Third, it is more informative to classify the inputs to the production process into *predictor*, *mediator*, and *moderator* categories (Kang & Kim, 2022; Liu et al., 2018) than to continue the tradition of treating them alike (Bhaumik & Dimova, 2004; Debasish, 2006; Sarkar et al., 1998). Finally, and no less important, the NPM, ROE, and/or ROA of banks are undoubtedly better criteria of performance (Chatterjee & Hanbrick, 2007; Chen & Hanbrick, 2012; Chung & Luo, 2013) than the often employed technical or X-efficiency (Shapiro & Müller, 1977; Timmer, 1971). By employing the highly correlated objective indicators of bank performance as the criteria and splitting the X-efficiency into ME and TE through DEA and RA as the mediators, we have demonstrated that ME precedes TE, but not vice versa, in transmitting the Ownership × Period effects to performance of banks in India in ways never done before.

Implications

Theoretical. Of the 15 comparisons across five measures used, seven showed the superiority of private over public banks, six showed the equality between them, and two showed the superiority of public over private banks. Going exclusively by such differences only studied in

past studies, one could also adjudge our findings as mixed! Contrary to such a heuristic view, our framework unambiguously demonstrated that private banks resisted inefficiency over time more vehemently than did public banks. Thus, our demonstration offers a new yardstick to economists and those interested in banking for "fairly" evaluating the property rights hypothesis. Instead of looking out for the difference or the equality in efficiency between private and public banks in a particular period as in the past studies cited, we now recommend evaluating the property rights hypothesis "fairly" against the criterion of resistance to inefficiency over periods.

The property rights hypothesis attributes performance differences between private and public firms to human dynamics (Estrin & Perotin, 1991; Niskanen, 1975; Shleifer & Vishny, 1994). The managerial inefficiency is the often-used explanation for the output falling below the common efficiency (Bhattacharyya et al., 1997). Given that the productivity of firms depends upon their managerial ability (Demerjian et al., 2012; Leibenstein & Maital, 1992) and management practices (Bloom & Reenen, 2010; Bloom et al., 2013, 2019), it is natural to obtain the evidence for supremacy of ME to TE in performance of banks in India as well. By first estimating TE using DEA, then separating ME from TE through RA, and finally demonstrating not only the distinction between them but also the order in which they determined the longitudinal performance of banks empirically, we reiterate the importance that the property rights hypothesis lays on managerial inputs to productivity.

Methodological. In past studies of banks, the most often used criterion of performance and analysis were TE and DEA, respectively. By estimating ME and TE from all the banks in India jointly by DEA and RA, using multiple objective criteria of performance of private and public banks readily available in the public domain, and undertaking the regression-based conditional process analyses, we now offer a novel way of drawing causal inferences about banks from the archival data. Had we employed either ROE or TE as the criterion and studied only the period of high growth (2004-2010) as in most studies summarized in Table 1, we could have also erroneously concluded against the property rights hypothesis. Because of our use of the three objective criteria of performance (Chatterjee & Hanbrick, 2007; Chen & Hanbrick, 2012; Chung & Luo, 2013), the two estimates of efficiency (Demerjian et al., 2012), and the three periods posing diverse kinds of challenges to banks in India (Subbarao, 2016; Rangarajan, 2023), we have reaffirmed the merit of the property rights hypothesis.

Our analysis casts doubt on the prevalent practice of simply regressing any criterion of bank performance on all the inputs available and then drawing causal inferences from how many of them were statistically significant. Such prevalent exploratory (i.e., *I-wonder-what-would-happen-type)* approach to the input-output link can now very well be replaced with the contemporary confirmatory (i.e., *I-bet-this-would-happen-type)* approach in which the inputs are classified into *what, how,* and *when* of a causal link (Kang & Kim, 2022; Liu et al., 2018) as we have also demonstrated.

According to Webb, Campbell, Schwartz, and Sechrest (1970), "If a proposition can survive the onslaught of a series of imperfect measures, with all their irrelevant error, confidence should be placed in it" (p. 3). Our results reinforce the methodological value of such cross-validation of a causal proposition in banking research as well. While the three criteria of objective performance confirmed the reliability of the Ownership × Period effect, the pattern of moderation of the two-way interaction effects in the mediating variables further validated the distinction between ME and TE empirically. To draw a convincing conclusion, moreover, eliminating the rival interpretations of the results was no less important than yielding support for the causal hypothesis. Before concluding for the precedence of ME to TE in the mediation of the predictor-criterion relation, therefore, we ruled out both the alternative sequential and parallel models of the predictor-criterion link. Illustrating such a perspective on generating evidence for the favored hypothesis but against the rival ones is another methodological implication of our findings for research in the banking industry.

Policy-oriented. The 2010 Khandelwal committee reported that public banks in India were undoubtedly at a disadvantage in terms of *employee compensation packages, skill sets, skewed age profiles, restrictive deployment,* and *performance management systems* relative to the rival banks. Put simply, there was a *huge human capital defici*t among public banks to perform optimally in the future. Our findings also showed that the difference between TE and ME over the years grew sharper among public than private banks. Importantly, the very same public banks, which were equal to private banks in ME, NPM, and ROA but higher in TE and ROE in Period 1, lost out to private banks in ME, NPM, ROE, and ROA in Period 3. Thus, adequate attention to human capital and managerial efficiency is always necessary in the banking industry of India.

Before undertaking this research, we wondered in 2021: Why was India, endowed with all natural resources, less prosperous (Per Cap US$2,257) than either Japan (Per Cap US$39,313) or

Singapore (Per Cap US$72, 974) in Asia? Of the multiple reasons, the dynamics of managing the economy of large versus small nations appeared promising to us. Specifically, how Indian firms, including public banks (Khandelwal, 2010), manage productivity are far from ideal! As Bloom et al. (2013) lamented, "Indian firms tend not to collect and analyze data systematically in their factories, they tend not to set and monitor clear targets for performance, and they do not explicitly link pay or promotion with performance" (p. 6). Nonetheless, we felt encouraged by their findings of a field experiment on large textile firms in India (Bloom et al., 2013). Compared to the firms placed in the control condition, those in the experimental condition adopting a standard set of systematic management practices did raise "productivity by 17% in the first year through improved quality and efficiency and reduced inventory, and within three years led to the opening of more production plants" (p. 1).

One may disagree with the foregoing causal conclusion on the grounds of awareness of the interventions among the participants in the experimental condition (Cook & Campbell, 1979). Our highly coherent findings of causation from archival (Webb et al., 1970) instead of experimental data dispel such doubt. In fact, our first purging of ME from TE of all banks in India by RA and then demonstrating the precedence of ME to TE in the mediation of the Ownership × Period effects on the archival data on bank performance bolster the importance of managerial inputs to the productivity of firms in general (Bloom & Reenen, 2010; Bloom et al., 2013, 2019) and banks in particular as posited by the property rights hypothesis.

We now believe that managerial efficiency is the key to turning any group, regardless of whether it is a small housing society or a big nation, into highly productive and prosperous systems across the globe. The success of the National Association of Software and Services Companies (NASSCOM) through managerial efficiency in India is an inspiring story (Mehta, 2022) for boosting economy of the nation. We appeal to economists, government, and public policy experts to regard managerial efficiency as not only important but also necessary for optimum utilization of technological resources. Technology and/or allocation of money alone might not bear the fruits desired by governments and expected by citizens. Therefore, we reiterate the advice of Steve Jobs given toward the end of the 20th century (Kirkpatrick, 1998): "Innovation [is] … about the people you have, how you're led, and how much you get it."

Instead of the private-public distinction that is important in India, the size of banks in the United States determines regulations. Why did then private banks such as First Republic Bank,

Silicon Valley Bank, and Signature Bank of the United States collapse in 2023? There can be many reasons such as the large number of small and mid-sized banks, the rapid increase in interest rates, and the failure of regulations.[9] Nevertheless, President Joe Biden's vouch to take stern actions against those adopting the faulty business model and/or responsible for the downfall does point fingers at the managerial inefficiency in running these banks.[10] Given our consistent findings of the importance of ME in difficult times and of the precedence of ME to TE in the longitudinal performance of banks, we speculate that the successful banks and the recently failed ones in the United States might have also differed more with regard to their managerial (Khandelwal, 2010) than technical inefficiency, an issue open for empirical investigation.

Limitations and Future Research

Partial versus complete mediation. The direct effects of the Ownership × Period predictor on NPM and ROE were significant but that on ROA was nonsignificant. What can account for this inconsistency? One reason can be the smaller size of the interaction effect on ROA than that on either NPM or ROE. Another reason can be that the predictor has both direct and indirect effects on NPM and ROE. Still another, but more compelling, reason is the possibility of additional mediators of the predictor effects on NPM and ROE.

The performance of firms undoubtedly depends on output in the form of goods and services produced through optimum ME and TE. To explain the predictor-performance relation fully, then, the intermediate mediator of output may be also necessary in the causal model. Given our central goal of highlighting the importance of ME in performance, we did not consider output as a MV. Future investigators can remove this limitation of our research by using ME, TE, and output as sequential mediators.

Refinement of the ME measure. Evidence for the mediation of the Ownership × Period effect on the putative ME via the criterion of ROE was discordant with our hypothesized causal flow, hinting at reciprocation between them. As nothing succeeds like success, it is likely that the frequent feedback on high returns on the equity boosted motivation to excel and morale among managers. It is equally likely that the TE residuals serving as the proxy of our ME measure

[9] https://www.theguardian.com/business/2023/may/04/us-banks-failing-pacwest-western-alliance

[10] https://www.outlookindia.com/business/explainer-why-us-banks-are-collapsing-and-why-the-banking-crisis-is-not-over-yet--news-270005

overlapped with the constituents of ROE reported by banks. If so, the measure of ME might not have been as valid as that of TE.

Given the evidence for both the precedence and the magnitude of ME to that of TE in mediating the Ownership × Period effects on the criteria, we regarded, as did Demerjian et al. (2012), the two estimates as valid measures of efficiency. Nevertheless, further refinements are possible by taking empirical measures on the perceived TE and ME, using items patterned after those used in the assessment of management practices (Bloom et al., 2010, 2013). Such empirical measures on the perception of managers and the estimated ME and TE jointly by DEA and RA as in our research would be of immense value in checking both the c*onvergent* (i.e., high *r* between the same construct but different methods) and *divergent* (i.e., low r between different constructs but the same method) validities (Campbell & Fiske 1959) of the mediators underlying bank performance.

Negative criteria of performance. We employed three positive criteria of bank performance. However, Indian banks suffer from perpetual threats of nonperforming assets and no return on loans taken. How would private versus public banks deal with such threats? We believe that the very same six patterns of differences in Figure 1 should hold with any negative criteria of performance but with exactly reversed positions of private and public banks. That is, we expect private, relative to public, banks to reduce negative outcomes increasingly over time, a possibility worth studying in the future.

Improvement over good times. What we have reported in this article is based on the performance of private and public banks during turbulent periods of rapid financial sector reforms in India (Rangarajan, 2023; Subbarao, 2016). In good times, we again expect reversed positions of private and public banks over time: Improvement in performance over good times would be faster among private than public banks because of the implied better managerial efficiency, another topic of investigation in the future.

Conclusion

In periods of rapid financial sector reforms in India, the private banks, relative to the public ones, showed greater resistance to inefficiency. Importantly, managerial efficiency preceded technical efficiency in the longitudinal performance of banks. These findings support the property rights hypothesis of public choice theory in ways never shown before our research.

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Declaration of Conflicting Interests

No conflict of interest with respect to the research, authorship, and/or publication of this article.

Supplementary Material

Supplementary material is available with this article.

Data Availability

The raw data (N = 1264) used in estimating technical efficiency (TE) and managerial efficiency (ME) and in testing the four hypotheses (N = 556) are available on the **Open Science Framework** platform: https://zenodo.org/deposit/8181405. The authors will publish the raw data files as and when the editor/publisher will so desires.

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Supplementary Materials

APPENDIX A

A-1: Table 1
Summary of Previous Studies of Indian Banks

Author(s)	Period	Years	Criterion	Analysis	Inputs	Outputs	Findings
Bhattacharyya, Lovell, & Sahay (1997)	1986-1991	6	TE	DEA (BCC-O)	IE & OE	EA, D, & I	PUB > PVT
Sarkar, Sarkar, & Bhaumik (1998)	1994-1995	2	ROA	RA	O, T, OT, A, PSA, IIGS, NII, & RB	ROA	PVT > PUB
Mukherjee, Nath, & Pal (2002)	1996-1999	4	TE & Cross efficiency	DEA (CCR-O)	NW, B, OE, E, & BR	D, NP, EA, Net-II & IS	PUB > PVT
Sathye (2003)	1997-1998	1	TE	DEA (CCR-I)	IE & NIE; D & S	Net-II & NII NL & NII	PUB > PVT
Kumbhakar & Sarkar (2003)	1985-1996	12	CE	SFA	L, K, and E&R	FD, SD, CD, I, L&A, RB, U&SUB, & MB	PVT > PUB
Bhaumik & Dimova (2004)	1995-2001	7	ROA	RA	O, T, OT, A, PSA, IIGS, NII, & RB	ROA	PVT > PUB
Shanmugan & Das (2004)	1992-1999	8	TE	SFA	D, B, L, & FA	NIM, C, NII, & I	PUB > PVT
Sensarma (2006)	1986-2000	15	CE	SFA	L & K	D & NL	PUB > PVT
Debasish (2006)	1998-2004	7	TE	DEA (CCR-I)	D, LB, L, K, OE, FA, B, NW, & NPA	NL, I, NP, II, NII, STS, & NIM	PUB > PVT
Das & Ghosh (2006)	1992-2002	11	TE	DEA (CCR-I & BCC-I)	DD, SD, FD, K, & L; L, K, & IE; IE, L, & K	EA and I EA, I, DD, SD, & FD II & NII	PUB > PVT
Sengupta & Sahoo (2006)	1998-2002	5	TE	DEA (BCC-I)	FA, BF, & L	I, PLA, & NII	PUB > PVT (Unadjusted data)
Sengupta & Sahoo (2006)	1998-2002	5	TE	DEA (BCC-I)	FA, BF, & L	I, PLA, & NII	PVT > PUB (Heteroscedasticity-adjusted data)
Sahoo, Sengupta, & Mandal (2007)	1998-2005	8	TE	DEA (BCC-I)	FA, BF, & L	I, PLA, & NII	PUB > PVT (with unadjusted data)
Sahoo & Tone (2009a)	1998-2002	5	TE	DEA (BCC-I)	FA, BF, & L	I, PLA, & NII	PUB > PVT (Unadjusted data)

Sahoo & Tone (2009b)	1998-2005	8	TE	DEA (BCC-I)	FA, BF, & L	I, PLA, & NII	PUB > PVT (with unadjusted data)
Ray & Das (2010)	1997-2003	7	CE, PE	DEA	DOB, L, FA, & E	I, EA, & OI	PUB > PVT
Casu, Ferrari, & Zhao (2013)	1992-2009	18	CE	DEA	TLF & NIE	PLA, OEA, & FBI	PUB > PVT
			CE	SFA	TLF & NIE	PLA, OEA, & FBI	PUB > PVT
Bhattacharyya & Pal (2013)	1989-2009	11	TE	SFA	D, L, K, θ_{inv}(rad), and T	I & L&A	PUB > PVT
Tandon, Tandon, & Malhotra (2014)	2010-2012	13	TE	DEA (CCR-I & BCC-I)	D & A	II & NII	PUB = PVT
Tzeremes (2015)	2004-2012	9	TE	DEA (DDF-I conditioned to time)	FA, E, and D	L&A & OEA	PUB > PVT
Badunenko & Kumbhakar (2017)	1992-2009	18	CE	SFA	TLF & NIE	PLA, OEA, & FBI	PUB > PVT

***Note**: A:* Assets, B: Borrowings, BCC-I: Input-oriented Banker, Charnes, and Cooper Model, BCC-O: Output-oriented Banker, Charnes, and Cooper Model, BF: Borrowed Funds, BR: Branches, C: Credits, CCR-I: Input-oriented Charnes, Cooper, and Rhodes Model, CCR-O: Output-oriented Charnes, Cooper, and Rhodes Model, CD: Current Deposits, CE: Cost efficiency, D: Deposits, DDF-I: Input-oriented Directional Distance Function Model, FD: Fixed Deposits, DD: Demand Deposits, DEA: Data Envelopment Analysis, DOB: Deposits and Other Borrowings, E&R: Equity and Reserves, E: Equity, EA: Earning Advances, FA: Fixed Assets, FBI: Fee-based Income, I: Investments, IE: Interest Expenses, II: Interest Income, IIGS: Investments in Government Securities, IS: Interest Spread, K: Capital, L: Labor, L&A: Loans and Advances, LB: Liabilities, MB: Metropolitan Branches, Net-II: Net-interest Income, NIE: Non-interest Expenses, NII: Non-interest Incomes, NIM: Net Interest Margin, NL: Net Loans, NP: Net Profit, NPA: Non-performing Assets, NW: Net Worth, O: Ownership, OE: Operating Expenses, OEA: Other Earning Assets, OI: Other Income, OT: O × T, PE: Profit Efficiency, PLA: Performing Loan Assets, PSA: Priority Sector Advances, PUB: Public, PVT: Private, RA: Regression analysis, RB: Rural Branches, ROA: Returns on Assets, S: Staffs, SD: Saving Deposits, SFA: Stochastic Frontier Analysis, STS: Short-term Securities, T: Time, TE: Technical Efficiency, θ_{inv}(rad): the polar coordinate angle θ_{inv}(rad) corresponding to the output investment, TLF: Total Loanable Funds, and U&SUB: Urban and Semi-urban Branches.

A-2. Major Financial Sector Reforms in India since 1991

Reforms	**Major high lights**
The Narasimham Committee-I (1991): (Report of the Committee on the Financial System) [a]	➢ Reduction in the cash reserve ratio (CRR) and the statutory liquidity ratio (SLR)
	➢ Recommendations on priority sector lending
	➢ Interest rates deregulation
	➢ Structural reorganization of the bank
	➢ Setting up Asset Reconstruction Companies/funds to tackle NPAs
	➢ Opening of new private sector banks permitted in 1993
	➢ Prudential norms relating to income recognition, asset classification and provisioning
	➢ Simplification in the banking regulation (i.e., via board for financial regulation and supervision)
The Narasimham Committee-II (1998): (Report of the Committee on Banking Sector Reforms) [a]	➢ Merger of stronger banks and development financial institutions (DFIs)
	➢ A 3-tier banking structure
	➢ Higher norms of capital to Risk-Weighted Adequacy ratio (CRAR)
	➢ The Securitization and Reconstruction of Financial Assets and Enforcement of Security Interest (SARFAESI) Act was brought to handle the problem of bad debts.
	➢ Licensing to new private banks
Strategic Debt Reconstructing (2015) [a]	➢ An opportunity to banks to convert debt of companies to 51 per cent equity and sell them to the highest bidders
Scheme for Sustainable Structuring of Stressed Assets (2016) [a]	➢ An independent agency is hired by the banks which decides as how much of the stressed debt of a company is ‘sustainable'

The Financial Sector Legislative Reforms Commission (2011) [b]	➢ To review and rewrite the legal-institutional architecture of the Indian financial sector.
Insolvency and Bankruptcy Code (2016) [c]	➢ The law aims to consolidate the laws relating to insolvency of companies and limited liability entities, unlimited liability partnerships and individuals, presently contained in several legislations, into a single legislation.
Mega merger of public sector banks (2020) [d]	➢ Mega consolidation of 10 Public Sector Banks (PSB) into 4 PSBs

Sources:
[a] Singh, R. 2019. *Indian economy for civil services examinations* (11th ed.). New Delhi, Tata McGraw-Hill Education.
[b] https://dea.gov.in/sites/default/files/fslrc_report_vol1_1.pdf
[c] https://pib.gov.in/newsite/printrelease.aspx?relid=145286
[d] https://pib.gov.in/PressReleasePage.aspx?PRID=1605147

A3. The Government Programs and Demonetization in India

Scheme	Major highlights	Year
MGNREGA (Formerly known as National Rural Employment Guarantee Act (NREGA) [a]	➢ To enhance the livelihood security of rural households. ➢ To guarantee the 'right to work' by providing at least 100 days of wage employment in a financial year to every household whose adult members volunteer to do unskilled manual work. ➢ To create durable assets (such as roads, canals, ponds, wells, etc.) ➢ if the government fails to provide employment within fifteen days of receiving an application, it must provide certain daily unemployment allowances to the applicants. ➢ To disburse daily wages on a weekly basis or in any case not later than a fortnight after the date on which such work was done. ➢ To directly e-transfer 99.7 per cent payment of MGNREGA wages to the Bank/Post office account of the beneficiary.	2005
National Food Security Act (NFSA) [b]	➢ To ensure people's food and nutritional security by assuring access to enough high-quality foods at reasonable prices. ➢ To cover up to 75% of the rural population and 50% of the urban population under Antyodaya Anna Yojana (AAY) and priority households (PH). ➢ To entitle 35 kg of food grains per family per month under AAY and 5 kg per person per month under PHs. ➢ To make food grains of rice, wheat, and coarse grains per kg available at the subsidized prices of Rs. 3, 2, and 1, respectively. [changes from time to time by the Government of India). ➢ To facilitate direct benefit transfers (DBT) under NFSA. {This scheme was optional for States/Union Territories (UTs). The DBT was started in UTs of Chandigarh, Puducherry, and Dadra & Nagar Haveli]	2013
Pradhan Mantri Jandhan Yojana (PMJDY) [c]	➢ To expand financial inclusion of people, banking facilities, namely, opening of savings & deposit accounts, remittance, credit, insurance, and pension were widely accessible ➢ To maintain PMJDY accounts with any minimum balance ➢ To provide Accident Insurance cover of ₹2 lakh with Rupay Debit card ➢ To provide an overdraft (OD) facility up to ₹ 10,000 ➢ To facilitate DBTs of any government's benefits to account holders	2014
Demonetization [d]	➢ To flush out black money, eliminate Fake Indian Currency Notes (FICN), promote digitization of payments, reduce the use of illicit and counterfeit cash to finance terrorism, Naxalite, and illegal financial activities, the GOI cancelled the Legal Tender Status of ₹500 and ₹1000 denomination currency notes and announced issue new ₹500 and ₹2,000 currency notes.	2016

Sources:

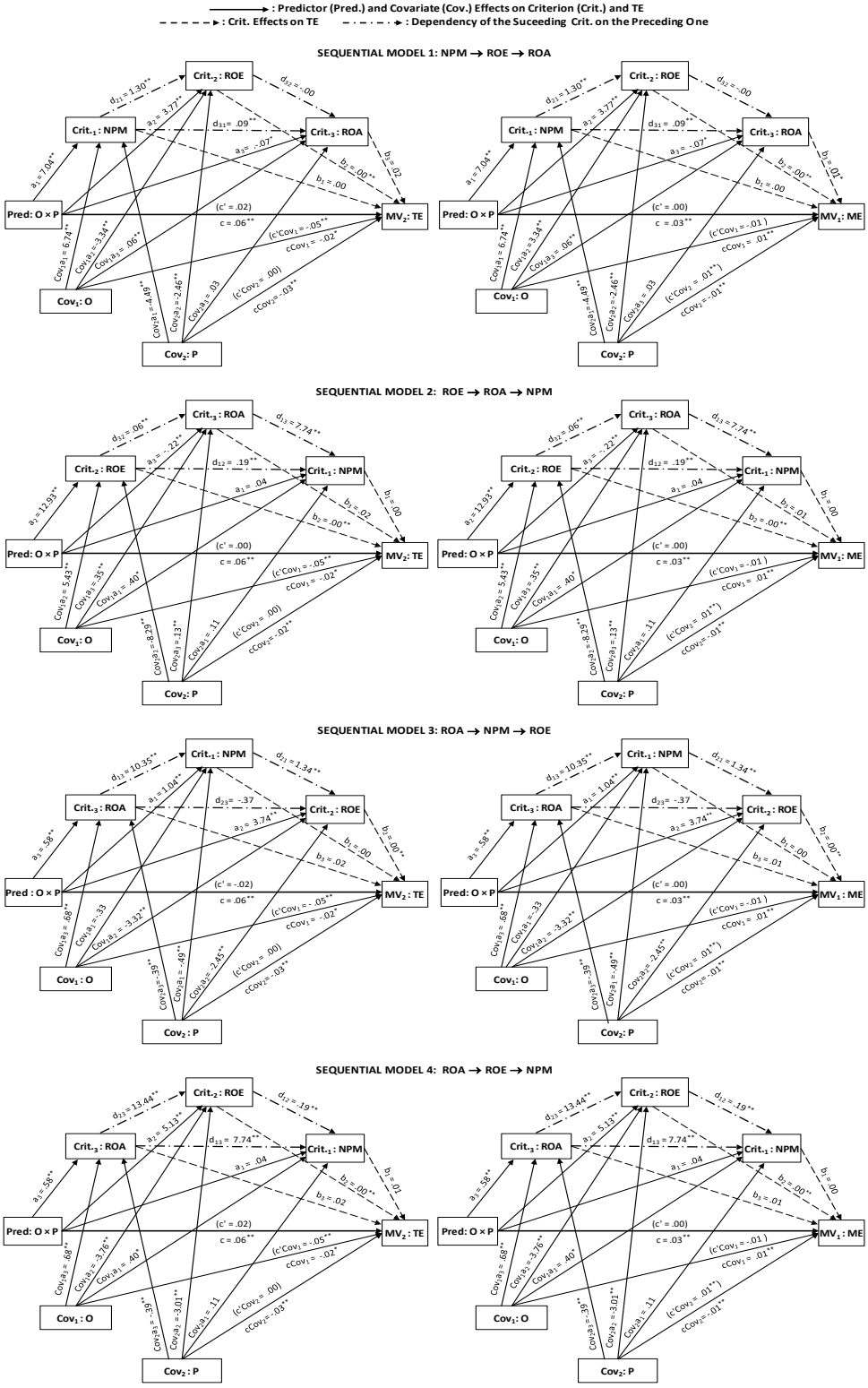
[a] https://rural.nic.in/sites/default/files/nrega/Library/Books/1_MGNREGA_Act.pdf
[a] https://rural.nic.in/en/press-release/997-cent-payment-mgnrega-wages-being-made-through-e-transfer#:~:text=In%20this%20e%2Dtransfer%20system,made%20through%20e%2Dtransfer%E2%80%9D.
[b] https://nfsa.gov.in/portal/nfsa-act
[c] https://pib.gov.in/newsite/printrelease.aspx?relid=170378
[d] https://pmjdy.gov.in/scheme

A-4. Bank Mergers in India

Existing public bank	**Previous public banks merged with the prevailing public bank**	**Year of merger**
State Bank of India	State Bank of Saurashtra	2008
State Bank of India	State Bank of Indore	2010
State Bank of India	State Bank of Bikaner and Jaipur, State Bank of Hyderabad, State Bank of Mysore, State Bank of Patiala, State Bank of Travancore, and Bharatiya Mahila Bank	2017
Bank of Baroda	Dena Bank, and Vijaya Bank	2019
Punjab National Bank	Oriental Bank of Commerce, and United Bank of India	2020
Canara Bank	Syndicate Bank	2020
Indian Bank	Allahabad Bank	2020
Union Bank of India	Andhra Bank, and Corporation Bank	2020
Existing private bank	**Previous private banks merged with the prevailing private bank**	**Year of merger**
Saraswat Co-operative Bank	Maratha Mandir Co-Op. Bank Ltd.	2006
IDBI Bank	United Western Bank Ltd.	2006
Federal Bank	Ganesh Bank of Kurundwad Ltd.	2006
ICICI Bank	Sangli Bank Ltd.	2007
	Bank of Rajasthan Ltd.	2010
HDFC Bank	Lord Krishna Bank Ltd. and Centurion Bank of Punjab Ltd.	2008
Kotak Mahindra Bank	I N G Vysya Bank Ltd.	2014

APPENDIX B

B-1: Figure 6. *The Unstandardized Path Coefficients from the Hypothesized and Alternative Moderated Sequential Mediation Analyses of the Three Criteria of Bank Performance*



B-2: Table 5

Indirect Effects of the Ownership × Period Predictor on the Two Mediators via the Three Criteria of Bank Performance from Four Moderated Sequential Mediation Analyses

Sequence Routes	Mediators of Bank Performance			
	TE		ME	
	IE	*95% CI*	*IE*	*95% CI*
	Order 1: Crit.$_1$: NPM → Crit.$_2$: ROE → Crit.$_3$: ROA			
Crit.$_1$: NPM	.01^a	(-.03, .06)	.00^c	(-.02, .03)
Crit.$_1$: NPM → Crit.$_2$: ROE	.02^a	(.00, .03)	**.02**^{a}	(.01, .03)
Crit.$_1$: NPM → Crit.$_3$: ROA	.02^a	(-.02, .05)	.00^c	(-.02, .03)
Crit.$_1$: NPM → Crit.$_2$: ROE → Crit.$_3$: ROA	.00^a	(-.00, .00)	.00^c	(-.00, .00)
Crit.$_2$: ROE	.01^a	(-.00, 0.02)	.01^b	(.00, .01)
Crit.$_2$: ROE → Crit.$_3$: ROA	.00^a	(-.00, .00)	.00^c	(-.00, .00)
Crit.$_3$: ROA	-.00^a	(-.01, .00)	.00^c	(-.00, .00)
	Order 2: Crit.$_2$: ROE → Crit.$_3$: ROA → Crit.$_1$: NPM			
Crit.$_2$: ROE	.02^a	(-.00, .04)	**.03**^{a}	(.01, .04)
Crit.$_2$: ROE → Crit.$_3$: ROA	.02^a	(-.03, .06)	.00^b	(-.03, .03)
Crit.$_2$: ROE → Crit.$_1$: NPM	.00^a	(-.01, .02)	.00^b	(-.01, .01)
Crit.$_2$: ROE → Crit.$_3$: ROA → Crit.$_1$: NPM	.01^a	(-.03, .05)	.00^b	(-.02, .03)
Crit.$_3$: ROA	-.01^a	(-.02, .01)	-.00^b	(-.01, .01)
Crit.$_3$: ROA → Crit.$_1$: NPM	-.00^a	(-.01, .01)	-.00^b	(-.01, .01)
Crit.$_1$: NPM	.00^a	(-.00, .00)	.00^b	(-.00, .00)
	Order 3: Crit$_3$: ROA → Crit$_1$: NPM → Crit$_2$: ROE			
Crit$_3$: ROA	.01^a	(-.02, .05)	.00^b	(-.02, .02)
Crit$_3$: ROA → Crit$_1$: NPM	.01^a	(-.03, .05)	.00^b	(-.02, .02)
Crit$_3$: ROA → Crit$_2$: ROE	-.00^a	(-.01, .00)	.00^b	(-.01, .00)
Crit$_3$: ROA → Crit$_1$: NPM → Crit$_2$: ROE	.01^a	(.00, .03)	**.02**^{a}	(.01, .03)
Crit$_1$: NPM	.00^a	(-.00, .01)	.00^b	(-.00, .01)
Crit$_1$: NPM → Crit$_2$: ROE	.00^a	(.00, .01)	.00^b	(.00, .00)
Crit$_2$: ROE	.01^a	(.00, .02)	.01^b	(.00, .01)
	Order 4: Crit.$_3$: ROA → Crit.$_2$: ROE → Crit.$_1$: NPM			
Crit.$_3$: ROA	.01^a	(-.02, .05)	.00^b	(-.02, .02)
Crit.$_3$: ROA → Crit.$_2$: ROE	.01^a	(-.00, .03)	**.02**^{a}	(.01, .03)
Crit.$_3$: ROA → Crit.$_1$: NPM	.01^a	(-.02, .03)	.00^b	(-.02, .02)
Crit.$_3$: ROA → Cri.$_2$: ROE → Crit.$_1$: NPM	.00^a	(-.01, .01)	.00^b	(-.01, .01)
Crit.$_2$: ROE	.01^a	(-.00, .02)	**.01**^{a}	(.01, .02)
Crit.$_2$: ROE → Crit.$_1$: NPM	.00^a	(-.00, .01)	.00^b	(-.00, .00)
Crit.$_1$: NPM	.00^a	(-.00, .00)	.00^b	(-.00, .00)

Note: N = 556. ME: Managerial Efficiency, TE: Technical Efficiency. NPM: Net Profit Margin; ROE: Return on Equity; ROA: Return on Assets. The *IE*s in bold are significantly greater than zero, and those with different column superscripts differ significantly from each other at p = .05.

B-3: Table 6

Indirect Effects of the Ownership × Period Predictor on the Two Mediators via the Three Criteria of Bank Performance from Four Moderated Parallel Mediation Analyses

Criterion as Mediator	Mediator as Criterion			
	ME		TE	
	IE	*95% CI*	*IE*	*95% CI*
Crit.$_1$: NPM	.00^b	(-.02, .03)	.01^a	(-.03, .06)
Crit.$_2$: ROE	**.03**^{a}	(.01, .04)	.02^a	(-.00, .04)
Crit.$_3$: ROA	.00^b	(-.02, .02)	.01^a	(-.02, .05)

Note. NPM: Net Profit Margin, ROE: Return on Equity, ROA: Return on Assets, ME: Managerial Efficiency, TE: Technical Efficiency. N = 556. The *IE* in bold is significantly greater than zero, and those with different column superscripts are significantly at p = .05.