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When does privatization of distribution utilities' management reduce electricity losses? Evidence from Rajasthan, India

Rohit Gupta [a,*], Adam Goldstein [a,c], Rahul Tongia [d], Siddharth Upreti [e], Denise L. Mauzerall [a,b,**]

[a] Princeton School of Public and International Affairs, Princeton University, Princeton, NJ, USA
[b] Civil and Environmental Engineering Department, Princeton University, Princeton, NJ, USA
[c] Department of Sociology, Princeton University, Princeton, NJ, USA
[d] Centre for Social and Economic Progress (CSEP), New Delhi, India
[e] O.P. Jindal Global University, Sonipat, Haryana, India

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ABSTRACT

High levels of electricity distribution losses remain a persistent challenge in India's power sector. These losses strain the financial viability of distribution companies, limit their ability to support renewable energy investments and exacerbate economic and environmental challenges. Privatization is often proposed as a solution to reduce electricity losses in developing countries. Yet, there has been limited empirical research on how private electricity distribution firms engage with their external environment and on the factors determining their success in reducing electricity losses. This paper examines the Distribution Franchisee (DF) model, which privatizes management rather than ownership, through a comparative case study of three cities in Rajasthan, India, where the same private firm managed electricity distribution under near-identical 20-year contracts. Despite identical contractual incentives and the same private partner, outcomes diverged sharply within the same timeframe. Using process tracing methodology and drawing on Resource Dependence theory, we show that this divergence is not explained by differences in organizational capacity or infrastructure investment, which were comparable across cities, but by differences in the local political economy. Specifically, the stability of the local political environment and the composition of each DF's consumer revenue base determined its ability to enforce anti-theft measures and sustain technical reforms. These findings suggest that the success of management privatization in electricity distribution is contingent on city-level political economy conditions, with important implications for the design and implementation of private participation models in the electricity sectors of developing countries.

1. Introduction

India's electricity sector, dominated by coal-based power, is a major source of both carbon emissions and air pollution in India (Peng et al., 2020). At the same time, its electricity distribution is also characterized by high losses - approximately 20% of electricity generated (compared to 5% in the United States), and severe financial distress in state-owned distribution companies (Discoms) (Niti Aayog, 2025; Rossow and Singh, 2024). In 2024, total outstanding Discom debt reached approximately 6.8 trillion INR (~79 billion USD) (BusinessLine, 2024). Actual financial losses are even higher than officially declared if we consider cash flow losses, as many losses are transferred onto the books as "future receivables" (Devaguptapu and Tongia, 2023). The International Energy Agency identifies Discoms' financial health as the greatest risk to power sector investments in India (International Energy Agency, 2021). Scholars also highlight inefficient electricity distribution as a key bottleneck in decarbonizing India's grid (Dubash, 2019; Dubash et al., 2018; Tongia and Gross, 2018).

Privatization, i.e., the transfer of electricity services from public to private ownership or control, is often believed to be an effective strategy to enhance Discoms' corporate governance and reduce electricity distribution losses.[1] However, there is no clear theoretical basis for assuming that private enterprises are inherently more efficient, particularly in natural-monopoly settings such as electricity distribution (Okten and Arin, 2006). Any relative advantage of the private sector is

* Corresponding author. 303 Robertson Hall, USA.
** Corresponding author. 303 Robertson Hall, Princeton School of Public and International Affairs, Princeton University, Princeton, NJ, USA.
E-mail addresses: rg21@princeton.edu (R. Gupta), mauzerall@princeton.edu (D.L. Mauzerall).

[1] This paper is focused on the implications of privatization in electricity distribution, and not liberalization (e.g. allowing multiple licensees to operate in the same geographical area). Liberalization in electricity distribution brings its own set of challenges(Singh and Tongia, 2021), which are not addressed in this paper.

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Glossary

AT&C Losses	**Aggregate Technical and Commercial Losses:** a composite measure combining distribution losses (technical losses and electricity theft) and collection efficiency losses (gap between billed and collected revenue)
DF	**Distribution Franchisee**: a private company that manages electricity distribution on behalf of a state-owned Discom under a long-term input-based contract, without acquiring ownership of the distribution assets
Discom	**Distribution Company:** a state-owned electricity distribution utility in India responsible for delivering electricity to end consumers within a designated area
C&I Consumers	Commercial and Industrial Consumers: electricity consumers in the commercial and industrial sectors, characterized by stable billing, higher tariffs, and minimal electricity theft relative to residential consumers
INR	**Indian National Rupees** (1 USD ≈ 86 INR as of April 2025)
PPP	**Public-Private Partnership:** an arrangement in which a private entity delivers a public service or manages public infrastructure, with varying degrees of ownership, risk transfer, and operational responsibility
RDT	**Resource Dependence Theory:** an organizational theory explaining how organizations strategically manage their dependence on external actors (Oliver, 1991; Hillman et al., 2009). In this paper, RDT is used to explain how Distribution Franchisees respond to pressures from consumers, local government, and political actors

likely to depend on factors such as stronger employee performance, effective monitoring and well-designed incentive structures. In addition, competition and the quality of regulatory oversight play a critical role in shaping organizational efficiency that contributes to reducing electricity losses (Newbery, 2000). In this context, some scholars suggest that strengthening institutional oversight, rather than pursing privatization alone, may be more effective in improving efficiency in countries like India with a legacy of central planning (Black et al., 1999; Srivastava and Kathuria, 2020). Empirical evidence also remains inconclusive, with no consistent finding that private enterprises outperform public ones (Okten and Arin, 2006; Omran, 2004). While certain studies report improvements in cost efficiency following privatization (Bacon, 2018; Estache and Rossi, 2005; Muller and Rego,2021; Nepal and Foster, 2015), others find that public utilities perform as well as, or better than, their private counterparts (Bobde and Tanaka, 2018; Jamasb et al., 2021). Some scholars find that urbanization, rather than privatization, is a more important determinant of electricity losses in India, with denser cities experiencing lower losses (Bobde and Tanaka, 2018; G. Srivastava and Kathuria, 2020). These findings highlight the need for nuanced solutions beyond a one-size-fits-all privatization model that account for variations in environmental factors that influence privatization's success. Moreover, most studies on privatization focus on fully privatized distribution utilities, which may not be politically feasible in all contexts. In India, Distribution Franchisees (DF) - which privatize management (rather than privatizing ownership) in specific geographic areas - offer an alternative to full privatization, but there are few systematic studies on DF (Chitnis, 2024).

Leveraging a unique natural experiment, this paper addresses the following research question: *What mechanisms allow private management to reduce electricity distribution losses, and what local political economy conditions determine whether those mechanisms succeed?* To answer this question, we examine the performance of three DFs with private management in Rajasthan, carved out from the public distribution sector in the cities of Kota, Bikaner, and Bharatpur. Electricity distribution management in these three cities was privatized in 2016 and 2017 under 20-year agreements. The structure of DF contracts incentivized loss reduction, yet performance varied: Kota achieved lower reductions in electricity losses than Bikaner and Bharatpur during the first five years following privatization. This variation allows us to identify the factors that can help explain the differential efficacy of privatized DFs across contexts. For this purpose, we employ process tracing - a qualitative causal inference methodology with an established tradition in comparative politics and policy analysis (Bennett and Checkel, 2012; Beach and Pedersen, 2013; Fairfield and Charman, 2017). Our evidence base includes operational and financial data from three DFs, 45 semi-structured interviews with Discom officials, DF managers, local administrators, and industrial consumers, and government documents, including third-party audits and DF–Discom contracts.

Our study pursues two interrelated objectives. The first is descriptive: to document the divergent loss-reduction outcomes across the three cities and to characterize the strategies each DF employed. The second is explanatory: to identify the local political economy conditions that determined why identical managerial and contractual arrangements produced unequal results. Critically, the DF model privatizes management rather than ownership - a distinction with important implications for the private operator's flexibility and accountability, and one that has received comparatively little systematic research attention (Chitnis, 2024). We find that all three DFs implemented comparable organizational improvements and infrastructure investments. Differences in their external environments explain the divergence in outcomes: the degree of local political stability and the composition of the consumer revenue base. Drawing on Resource Dependence (RD) theory (Oliver, 1991; Hillman et al., 2009), we show that DFs in more favorable external environments were better positioned to deploy defiance and co-optation strategies, whereas Kota's DF was constrained to compromise, limiting its enforcement capacity. These findings have direct implications for the design of private participation in electricity distribution. Our within-firm, within-state research design controls for many confounders that plague cross-firm studies of privatization, isolating the role of local political-economy factors. This study contributes to the literature on privatization outcomes (Okten and Arin, 2006; Bacon, 2018), institutional determinants of energy sector performance (Jamasb et al., 2021), and the political economy of utility reform in India (Dubash et al., 2018; Gupta et al., 2025).

The remainder of the paper is organized as follows. Section 2 provides background on India's electricity distribution sector and the DF model. Section 3 describes the research design, case selection, and methodology - including a fuller exposition of process tracing and Resource Dependence theory. Section 4 presents the results across three mechanisms. Section 5 synthesizes findings through the Resource Dependence theory. Section 6 outlines future research directions. Section 7 concludes with policy implications, scope conditions, and limitations.

2. Electricity distribution in India: context and private sector participation

State ownership, directly or indirectly, dominates the management of India's electricity distribution sector, with only ~10% of consumers served by the private sector (Patyal et al., 2023). However, state-owned distribution companies (Discoms) often suffer from poor service quality, opaque billing processes, inaccurate metering, and high electricity losses (Verma et al., 2020). Electricity losses, a hybrid measure of technical

and financial losses, are measured in India as Aggregate Technical and Commercial (AT&C) losses, which arise from two primary factors.[2]:

A. Distribution losses (billing losses):

The difference between the electricity input and the billed electricity, which is caused by:

- Technical losses: Physical energy losses during the distribution process;
- Inefficiencies: Billing errors and electricity theft.

B. Collection efficiency losses:

The gap between the revenue billed and the revenue collected by distribution utilities. This spans both consumers not paying and the government not paying promised subsidies.

2.1. Private sector participation in electricity distribution

The Government of India has increasingly positioned privatization as a central reform strategy to reduce electricity losses and improve overall sector efficiency(Business Standard, 2025; Rossow and Singh, 2024), with private participation taking multiple forms (see Table 1). However, the outcomes of full privatization in India have been uneven. The early experience in Odisha, initiated in 1996, did not deliver the expected efficiency improvements as the private licensee was unable to contain the distribution losses and eventually exited operations (Rossow and Singh, 2024; Tasdoven et al., 2012). In contrast, the privatization of Delhi's distribution network in 2001 led to measurable reductions in technical and commercial losses. However, its broader impact on consumer welfare remains unclear, primarily due to limitations in regulatory oversight and enforcement (Singh et al., 2006). As a result, full privatization in electricity distribution remains a politically contentious issue in India.

Table 1
Forms of public-private partnership (PPP) in the Indian electricity distribution sector.

Licensee	● Private organization works independently and takes ownership of the Area/Discom. ● Majority (<50%) or entire (100%) equity is owned by the private organization. ● Responsibilities include all activities originally performed by the erstwhile government-owned Discom, including tariff petitioning and power procurement.
Input-based Distribution Franchisee (DF)	● Private organization works to manage the distribution network on behalf of the government-owned Discom. ● DF purchases electricity from state-owned Discom at a fixed price per kWh (input rate). It resells electricity to consumers, with any surplus left after payment to the Discom providing its commercial profit. ● 100% ownership of the equity remains with the State Government. DF responsibilities include all activities performed by the government-owned Discom except regulatory filings and power procurement.
Other Outsourcing Models	● A private organization is given the responsibility to undertake selected activities on behalf of the Discom. ● 100% ownership of the equity remains with the State Government. Only specific activities required by the government-owned Discom are performed by the private organization such as 'Metering, Billing, and Collection', 'Only Billing and Collection', or 'Only Collection'.

Distribution Franchisees (DFs) offer an alternative to the politically difficult model of complete privatization of electricity distribution services. (Chitnis, 2024; Mukherjee, 2014; Thakur et al., 2017). Under input-based DF contracts, private companies manage the distribution network and pay the public utility a fixed amount based on local electricity consumption. These long-term contracts (typically 20+ years) *temporarily* transfer local assets to the DF. Thus, electricity loss reduction is incentivized because the DF's profits directly depend on consumer payments retained after paying the public utility and operating the distribution network.

However, more than half of the 28 cities transferred to privately managed DFs in India failed, with private companies exiting before their contracts ended (Chitnis, 2024; Rossow and Singh, 2024). Among the few research studies on the DF model in India (Das, 2020, 2021, 2022), find that DFs have the potential to enhance rural electrification and improve revenue and operational efficiency, but require strong coordination with Discoms and effective monitoring to succeed.(Thakur et al., 2017) highlight the systemic and economic challenges in the DF model's operations, suggesting that its success is far from guaranteed. Some reports suggest that while most DFs outperform parent Discoms in reducing AT&C losses (Rossow and Singh, 2024),they require state-level political backing for success (Chitnis, 2024) and a careful selection process (Mukherjee, 2014). However, the DF model is also criticized for lacking sufficient incentives for capital investments required for long-term innovation and grid modernization, such as the adoption of smart grids (Regy et al., 2021). Given the mixed outcomes of DF operations, further research is essential to identify the key determinants of DF success. The role of city-level political economy, distinct from state-level politics, has also not been systematically examined. This paper addresses such research gaps.

2.2. Electricity sector in Rajasthan

We chose to focus on the state of Rajasthan for three reasons: first, it is a representative case of challenges facing Indian electricity distribution - high AT&C losses, financial distress, and ongoing reform efforts (Dubash et al., 2018). Second, the state's privatization roadmap created a natural experiment that enabled rigorous comparative analysis (see Section 3). Third, prior engagement with the state facilitated access to data and fieldwork.

Electricity distribution in Rajasthan is managed by three state-owned Discoms (JVVNL, AVVNL, and JdVVNL), formed after unbundling of the State Electricity Board under the Rajasthan Power Sector Reforms Act (1999). Despite this restructuring, Rajasthan's Discoms continue to face high AT&C losses, significant debt burdens, and payment delays to generating and transmission companies (Power Finance Corporation, 2024).

3. Research framework

3.1. Case selection and comparative design

Case studies help understand complex real-life situations and phenomena, making them valuable for investigating the 'how' and 'why' of a subject (Kim and Kwa, 2020; Yin, 2009). To investigate the factors influencing the success of privatization in reducing electricity losses, our analysis uses a comparative case study of three cities (Kota, Bikaner, and Bharatpur) in Rajasthan, where electricity distribution was privatized under the DF model at approximately the same time (Table 2). CESC Ltd., a private electricity company based in Kolkata and operating for almost 150 years in India, secured a 20-year power distribution franchisee license from the Rajasthan government for Kota and Bharatpur in 2016 (part of JVVNL Discom) and for Bikaner in 2017 (part of JdVVNL Discom). To facilitate this initiative, CESC established wholly owned

[2] Mathematically, AT&C losses = (1-billing efficiency*collection efficiency) * 100.

subsidiaries dedicated to electricity distribution for each city.

The design is deliberately within-firm and within-state. Because the same private partner managed all three franchisees under the same regulatory and tariff framework, firm-level capabilities, state-level political conditions, and regulatory environments are effectively held constant. Observed variation in loss reduction can therefore be attributed to city-level factors. This design addresses a key limitation of cross-firm privatization studies, which cannot cleanly separate firm effects from local contextual factors.

3.2. Starting conditions and baseline comparability

Before privatization, the Rajasthan government conducted third-party audits to assess AT&C electricity losses in DF areas, with the findings shown in Table 3. Several features of the baseline conditions are worth noting for the comparability argument. First, all three cities are mid-sized urban centres without significant agricultural consumer bases. Second, collection efficiency was uniformly high (~100%) before privatization meaning subsequent variation in AT&C losses would be driven primarily by distribution losses. Third, while Kota had the highest baseline losses - and therefore the greatest reduction potential - it attracted the most competitive bidding (four bids versus two for Bharatpur and Bikaner each), suggesting investors did not perceive Kota as structurally disadvantaged.

We acknowledge that pre-existing structural differences beyond loss levels - including differences in building density, network topology, and historical billing practices - may have influenced outcomes independently of the political factors we identify. A key limitation of the available data is that Table 3 includes only one year of pre-privatization loss data for each city, which limits our ability to construct counterfactual trends, since Discom did not maintain a segregated record of the privatized area before privatization. That said, mechanism-level evidence from interviews and operational data indicates that political fragmentation and the consumer mix are binding constraints on Kota's DF, providing support for the interpretation beyond trend data alone.

3.3. Observed variation in loss reduction

Because all three cities had excellent collection efficiency before privatization, we focus on distribution losses as the primary driver of AT&C losses. Following privatization, all three Distribution Franchisees recorded declines in distribution losses (Fig. 1, Panel A). By 2021–22, Bharatpur achieved a 53% reduction (from 27% to 13%), Bikaner a 43% reduction (from 24% to 14%), and Kota a 35% reduction (from 30% to 19%). Notably, the trend in Kota closely mirrored that of its parent Discom, JVVNL (Panel B). At the same time, Bharatpur and Bikaner performed considerably better than their respective parent Discoms (Panels C and D). Kota's performance in these five years, therefore, fails to support the core rationale for management privatization. This variation motivates our central research question.

3.4. Methodology

To understand the reasons behind variation in electricity loss reduction across the three DFs, we employed a process-tracing methodology, which is well-suited to detailed causal mechanism analysis (Waldner, 2015). This method involves hypothesizing alternative explanations, testing these against data, and rejecting unsupported hypotheses. (Bennett and Checkel, 2012; Fairfield and Charman, 2017) (Fig. 2). Data collected includes:

- Operational details of three DFs, including organizational structure and infrastructure investments.
- 45 interviews with officials from parent Discoms, DFs, CESC, local administration, and industrial/commercial consumers conducted in 2023 (Table A1, Appendix A).
- Documents such as state government evaluations, third-party audits, and DF-Discom contracts.

Beach and Pedersen (2013) differentiate process tracing into three distinct variants: theory-testing, theory-building, and explaining-outcome. This study employs the explaining-outcome variant, which aims to craft a minimally sufficient explanation of a puzzling outcome in a specific case where the focus is more case-centric than theory-oriented (Beach and Pedersen, 2013, p. 13). Our central puzzle is why three cities operating under identical contractual conditions with the same private firm achieved divergent loss reduction outcomes. Beach and Pedersen (2013, p. 2) establish that studying causal mechanisms with process-tracing methods enables the researcher to make strong within-case inferences about the causal process whereby outcomes are produced, enabling us to update the degree of confidence

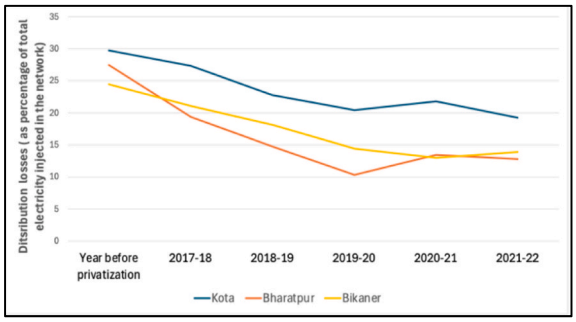
Table 3
Baseline comparability across the three DF areas (pre-privatization)[3] (Source: Government of Rajasthan records; Distribution Franchisee records; State Assembly election records. C&I = commercial and industrial consumers).

Attribute	Kota	Bikaner	Bharatpur
Distribution losses (pre-privatization)	30%	24%	27%
Collection efficiency	~100%	~99%	~100%
AT&C losses	30%	25%	27%
Consumers	176,381	142,569	50,267
Annual energy (million kWh)	1088	676	317
C&I share of revenue	~45%	~53%	~62%
Residential share of revenue	~45%	~40%	~30%
Mandated capex (million INR)	~1520	~1150	~480
Bids received	4	2	2
Commercial takeover	Sep 2016	May 2017	Dec 2016
Administrative Capacity	Divisional and District Headquarters, with the presence of senior administrative officials	Divisional and District Headquarters, with the presence of senior administrative officials	Divisional and District Headquarters, with the presence of senior administrative officials

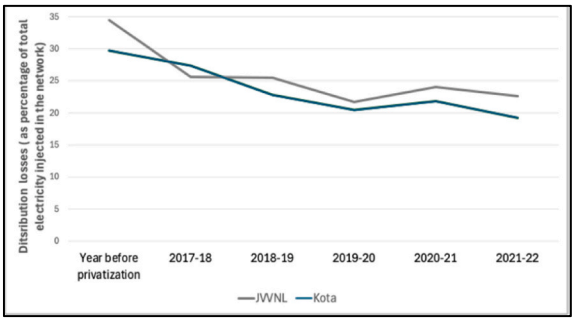
[3] The baseline report of Kota reported 103% collection efficiency before privatization, due to arrears recovery and accounting artefacts.

Table 2
Description of case study cities at the time of privatization of management through Distribution Franchisees. (Source: Government of Rajasthan official records).

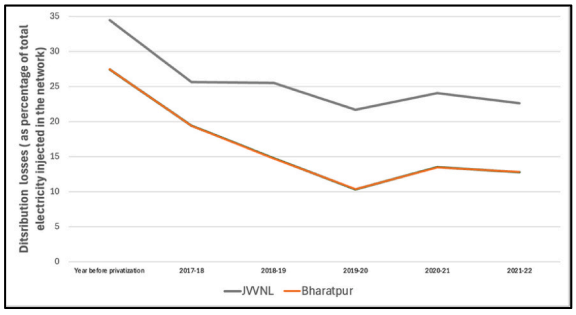
State-owned Distribution Companies (Discoms)	Discom Franchisee (DF) area	Number of bids received	Number of consumers	Annual City Energy Consumption (in million kWh) before privatization	Commercial takeover date by the Private sector
JVVNL	Kota city	4	176,381	1088	1 September 2016
JVVNL	Bharatpur City	2	50,267	317	1 December 2016
JdVVNL	Bikaner City	2	142,569	676	16 May 2017



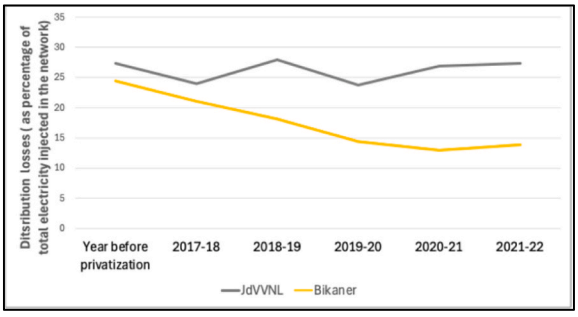
Panel A: Loss reduction trends in three DFs



Panel B: Loss reduction trends of Kota DF and its parent Discom (JVVNL)



Panel C: Loss reduction trends of Bharatpur DF and its parent Discom (JVVNL)



Panel D: Loss reduction trends of Bikaner DF and its parent Discom (JdVVNL)

Fig. 1. Comparison of the distribution losses of the three DFs with each other and with their parent Discoms in the period following privatization. Kota and Bharatpur DFs were formed mid-Financial Year (FY) 2016-17, while Bikaner DF was established at the start of FY 2017-18. Since India's financial year runs from April to March, FY 2017-18 provides a consistent baseline for comparison. (Source: Government of Rajasthan records).

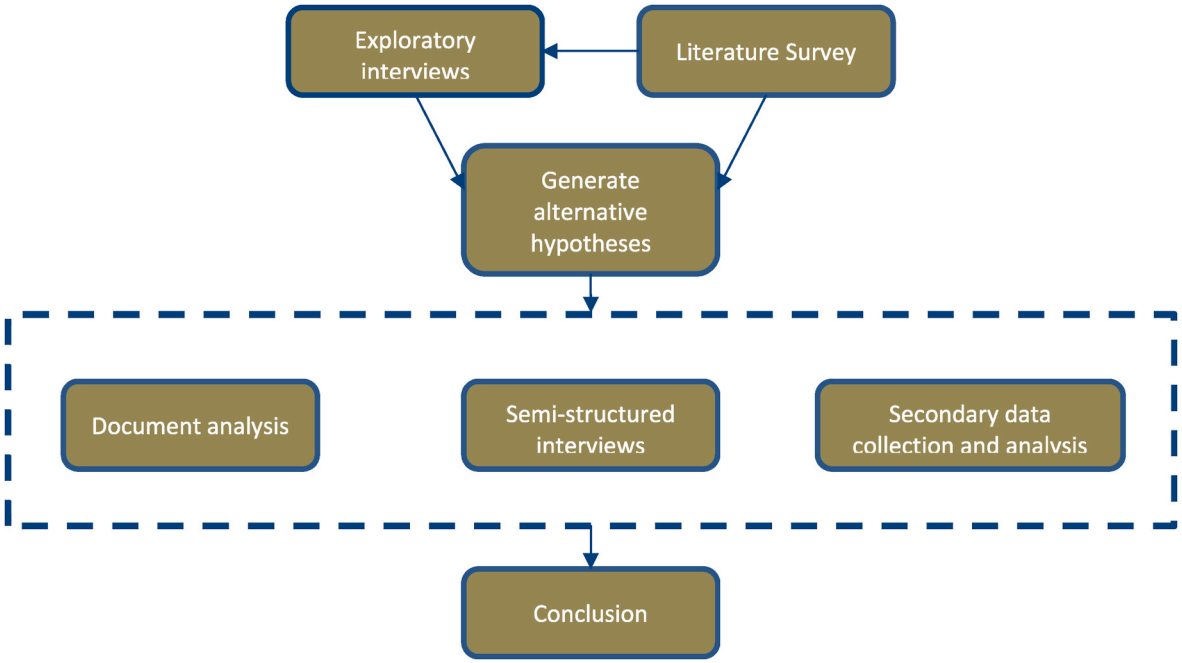


Fig. 2. Research methodology included an initial evaluation of the theoretical literature, combined with exploratory interviews, to identify potential mechanisms that could explain variation in individual DFs' reductions in electricity losses. This was followed by extensive analysis of government documents, semi-structured interviews, and DFs' operational data.

we hold in the validity of a theorized causal mechanism. This approach enables strong within-case inferences but cannot support cross-case generalization to a broader population of cases; the scope conditions of our findings are discussed in Section 7.3.

3.5. Theoretical framework

3.5.1. Resource dependence theory

To explain the variation in outcomes, we draw on Resource Dependence (RD) theory, which explains how organizations strategically manage dependencies and respond to pressures from their external environment (Hillman et al., 2009; Drees and Heugens, 2013; Ozturk, 2021). Oliver (1991) identifies five strategic responses organizations employ when facing institutional pressures: acquiesce (comply with external demands), compromise (balance competing expectations), avoid (buffer or circumvent pressures), defy (challenge or ignore pressures), and manipulate (co-opt or influence external actors). The choice of strategy depends on the organization's dependence on external actors and the degree of environmental uncertainty: organizations with greater dependence on powerful actors tend to be more accommodative or use compromise-based approaches; those in lower-dependence or more predictable environments can defy or manipulate more effectively.

We apply this framework directly to the DF case. Each DF depended on three broad sets of external actors: consumers (for revenue), local government (for legitimacy and enforcement support), and local political leaders (for political support during contentious reforms). The degree of this dependence - and the uncertainty of the political environment - varied across cities, shaping which strategic responses were available. RD theory, hence, serves as the analytical link between the local political economy conditions we observe and the loss reduction outcomes we seek to explain.

3.5.2. Causal mechanisms

Drawing on exploratory interviews, document analysis, and existing theoretical literature, we identify three mechanisms through which private management may reduce electricity losses. We distinguish between a direct mechanism, which has an immediate physical effect on loss reduction, and enabling conditions, which shape the organizational and institutional context within which direct interventions can be implemented effectively (Fig. 3).

- **Mechanism 1 –** Organizational capacity improvements function as an **enabling condition.** It includes improvements in HR specialization, internal accountability, and employee management practices. While these changes lay the organizational foundation for technical interventions, they do not, by themselves, reduce losses without corresponding physical changes.
- **Mechanism 2 –** Technical infrastructure improvements represent the **direct cause.** It involves physical upgrades to metering, distribution equipment, cabling, and energy tracking that directly reduce technical losses and improve billing accuracy.
- **Mechanism 3 –** Management of the external environment, which is an **enabling condition,** includes strategies to deal with consumers, local politicians, and local government administrators. It determines whether enforcement of anti-theft measures and upgrades to metering are feasible within local political economies. This mechanism operates indirectly by shaping the space within which Mechanism 2 can be sustained and scaled.

4. Results

This section analyses the three mechanisms identified in Section 3.5.2 to explain why loss reduction varied across the three DFs. We examine each mechanism in turn, assessing whether it can account for Kota's underperformance relative to Bharatpur and Bikaner.

4.1. Mechanism 1 (enabling condition): organizational capacity

Poor organizational capacity in state-owned Discoms is widely identified as a driver of high AT&C losses in India (Berg et al., 2005; Ruet, 2005; G. Srivastava and Kathuria, 2020). We therefore carefully analysed the organizational capacity of the three DFs. We found that all three DFs encountered similar challenges (such as managing the previous cadre of Discom employees) and implemented comparable strategies (such as job specialization) across all three cities. Kota DF did not exhibit any distinctive differences from the other two DFs.

Specifically, after five years of privatization, each distribution franchisee had a similar organizational structure, with employee-to-consumer ratios and workforce levels reflecting the size of each DF's network infrastructure and consumer base (Table 4). They also maintained uniform recruitment qualifications.

Distribution Franchisees' human resource management included various improvements over the Discoms, but no major differences among them were noted:

- **HR Specialization:** The DFs prioritized human resources specialization, contrasting with the generalist work culture typically found in Discoms. They created special wings: surveillance (to monitor distribution infrastructure) and Quick Response Teams (to address electricity theft). Many Discom officials viewed this emphasis as a significant strength of DFs, as it streamlined employee tasks and enhanced overall productivity. For example, a senior official of the Discom said, "One of the major reasons behind their better performance is their division of work." *They have specific people for particular tasks, and these persons are only focused on that task and nothing else.*" Another interviewee, who earlier was a Discom employee but later took up a job in one of the DFs, mentioned[4], "*If anything comes up, I know that I can delegate it to the concerned person and not have to stress about everything. However, in Discom, for example, a Junior Engineer is responsible for everything and anything that happens in an area … …. Since one person is burdened with everything, there is a delay in the process, and the system sometimes lacks accountability as well.*"
- **Organizational support to employees:** DF management provided robust support to employees when faced with public or political backlash during efforts to reduce electricity losses, such as power theft, meter tampering or meter replacements. In some instances, DF officials even faced threats of legal action, but the management effectively handled these issues. Discom officials highlighted this support as a significant factor contributing to DFs' success. For example, a Discom employee said[5] *'DFs can be more ruthless and yet more protective than Discoms. They fire inefficient people, but DFs also support their employees if things go wrong.'*
- **Strategic handling of Discom employees:** Contracts required DFs to retain Discom employees for four years. However, DFs refrained from assigning ex-Discom employees to anti-theft tasks. They also reassigned meter readers to other duties and outsourced meter readings to a third party for better security. Over time, DFs reduced their reliance on third-party meter readers by tagging the GPS coordinates of all consumer meters, enabling supervisory staff to monitor meter readings more efficiently.

4.2. Mechanism 2 (direct cause): technical infrastructure investment

India's mediocre electricity distribution infrastructure is cited as a cause of high AT&C losses, particularly technical losses (Jamasb et al., 2021; Sarangi et al., 2021; Thakur et al., 2017). Improving infrastructure is also a key motivation for involving the private sector in electricity

[4] Interview on 16th September 2023.

[5] Interview with a Discom official in Bharatpur on 19th June 2023. Local Discom officials in Kota and Bikaner also echoed similar sentiments.

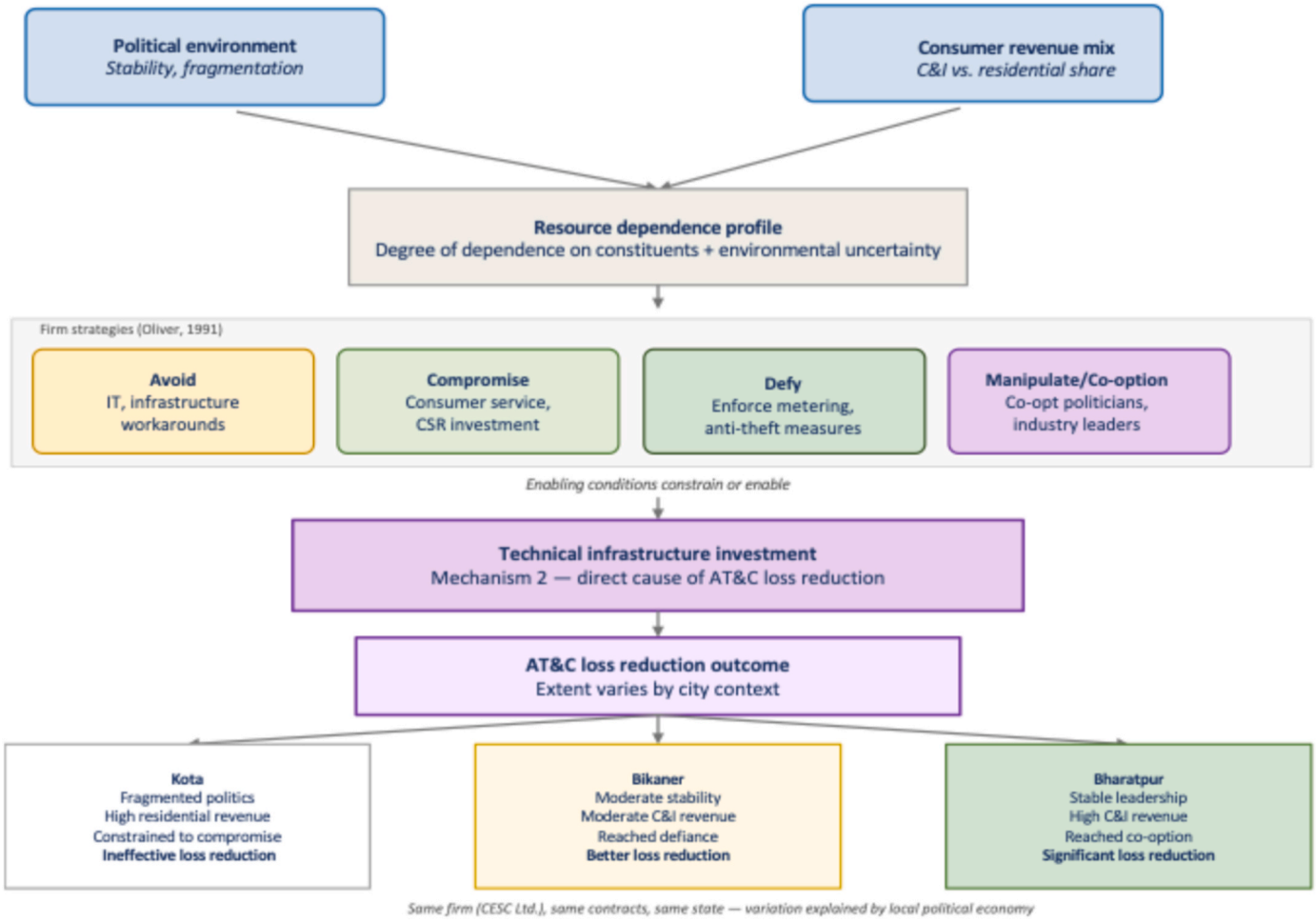


Fig. 3. Conceptual framework (Oliver, 1991; Hillman et al., 2009): how local political economy shapes AT&C loss reduction outcomes through resource dependence and firm strategies. Layer 1: local political economy context (political environment, consumer mix – C&I (commercial and industrial) vs residential). Layer 2: resource dependence profile. Layer 3: firm strategies (avoid, compromise, defy, manipulate). Layer 4: AT&C loss reduction outcome, with case evidence for Kota, Bikaner, and Bharatpur.

Table 4
Distribution Franchisee employee numbers following approximately five years of privatization (as of 31 March 2022). (Source: Distribution Franchisee records).

Distribution Franchisees	Permanently employed[a]	Outsourced[b]	Contractual Employment[c]	Total consumers	Ratio of employees to consumers
Kota	146	121	614	249,772	0.0035
Bikaner	90	91	421	174,781	0.0033
Bharatpur	50	41	150	65,266	0.0036
Total	286	253	1185	489,819	0.0035

[a] Employees on permanent payroll of DFs.
[b] Junior management staff performing regular work of office assistant (e.g. cashiers, junior supervisors, assistant revenue officers in sub-division offices) and hired through placement agencies.
[c] Staff working for the contractors engaged by DFs for myriad works such as preventive maintenance of Distribution Transformers and other distribution infrastructure, meter reading, etc.

distribution (Rossow and Singh, 2024). Moreover, the capital investment decisions made by Distribution Franchises (DFs) can yield critical insights into the shortcomings of the existing system, as these decisions are typically informed by a cost-benefit analysis that weighs the cost of system improvements against the anticipated reduction in losses.

Our findings indicate that all three DFs significantly upgraded the electricity distribution infrastructure, with Kota DF investing at levels comparable to those of the others per consumer and per kWh consumption (Table 5). Each DF exceeded the capital expenditure requirements outlined in its contract, with most spending concentrated in the initial years after privatization (Fig. 4). This pattern of excess mandated investments across cities suggests that Discoms either underestimated the cost of necessary technological upgrades or set minimal requirements to give Distribution Franchisees the flexibility to determine how much to invest further, if required. Since DFs are incentivized to incur capital expenditures when they lead to loss reduction and improved profitability, this discretion aligns with their business interests. Overall, Kota DF spent the most per consumer and per kWh of energy injected into the grid among the three DFs.

(Ruet, 2005) advocates granting field offices in Discoms greater budgetary autonomy to enhance efficiency. We found that compared to Discoms, DFs had more independence in making investment decisions tailored to local needs. Table 6 shows the per-consumer expenditure incurred by DFs in various operational improvements. Kota DF spent

Table 5
Capital expenditure requirements per Distribution Franchisee contract vs total actually spent; capital spending per consumer and per kWh entering the grid. (Source: Distribution Franchisee and Government of Rajasthan records).

Distribution Franchisee	Capital expenditure mandated for the first years of the DF contract (in million INR)	Total Capital expenditure incurred by DFs through FY 2021-22 (in million INR)	Percentage expenditure incurred vs mandated	Number of consumers as of March 2022	Capital expenditure incurred per consumer (INR)	Electricity entering the grid in FY 2021-22 (million kWh)	Capital expenditure incurred per kWh of electricity entering the grid (INR)
Kota	1520	2650	174%	249,772	10,610	1188	2.23
Bharatpur	480	600	125%	65,266	9193	292	2.05
Bikaner	1150	1640	147%	174,781	9383	780	2.10

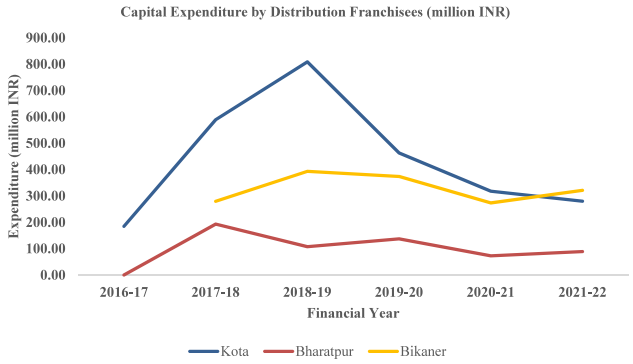


Fig. 4. DFs' annual capital expenditure from 2016 to 2022. (Source: Government of Rajasthan records).

nearly twice as much on metering activities to improve energy accounting, while Bikaner spent more on upgrading distribution transformers to enhance the distribution network's capacity. All three DFs made substantial investments in reinforcing the energy systems, including installing new poles and towers and upgrading distribution wires, underscoring the inadequacy of the existing infrastructure.

Unlike state-run Discoms, Distribution Franchisees (DFs) are not restricted by government procurement procedures, enabling them to acquire necessary materials more quickly. This operational flexibility enables DFs to implement infrastructure improvements efficiently, enhancing service delivery and minimizing delays on critical projects. A senior CESC official emphasized this advantage, stating,[6]"*Compared to Discoms, it is easier to procure material at our end. This reduces the time gap between persuasion (of consumers) and execution (of work like armour cabling of wires).*" Notable steps taken by DFs to reduce distribution losses through infrastructure improvements included:

- Replacing defective meters and transformers, installing armoured cables, and establishing centralized command and control centres.
- Conducting exhaustive consumer indexing, asset mapping and distribution transformer metering to minimize manual intervention, reduce non-actual billing and identify high-loss areas.

In summary, all three DFs made comparable infrastructure investments when adjusted for consumer base and power injected into the grid. Kota DF's underperformance cannot be attributed to insufficient infrastructure investment.

Table 6
Per-consumer expenditure (INR) incurred by DFs on various infrastructure improvements. (Source: Distribution Franchisee records).

DF Operation Improvements (INR)	Kota	Bharatpur	Bikaner
Energy accounting: Installation of advanced metering infrastructure/smart meters, energy audits, feeder metering, Distribution Transformer metering, and consumer metering	4227	2006	2271
Capacity improvements of the network: Installation/augmentation of distribution transformers	1397	1444	2119
Energy system enhancements: Installation of new poles and towers and upgradation of electric wires, installation/augmentation of power transformers, maintenance of 33/11 kV substations	4565	4131	4894
Total (INR)	10,189	7581	9284

4.3. Mechanism 3 (enabling condition): management of the external environment

Distribution losses in India stem not only from techno-economic factors but also from complex socio-political dynamics surrounding electricity provision. In addition to the political salience of electricity services, prevailing social norms, such as the widespread theft of electricity and non-payment of electricity dues, have also been found to contribute to high loss levels (Wong et al., 2021). Therefore, the external environment of electricity companies plays an important role in shaping loss-reduction efforts. All three DFs sought to reduce electricity theft while managing an unfavorable external institutional environment, i.e., one in which high electricity losses were a socially acceptable reality. The external environment for DFs comprised three main stakeholders: consumers, the government (local administration), and local politicians or other leaders. As shown below, the DFs were unevenly constrained in their ability to manage pressures from these stakeholders, due to differences in their respective resource environments.

4.3.1. Consumer environment

Consumer mix: In all three cities, electricity consumers were primarily in the residential, commercial and industrial sectors. This remained largely unchanged for five years post-privatization. privatization Unlike many Discoms, they did not deal with a large agricultural consumer base, which is often blamed for Discoms' high electricity losses. However, variations in sales composition influenced DF strategies and outcomes. In Kota, residential consumers accounted for a larger share of sales (Table 7), requiring significant resources for monitoring (e.g., metering, reducing electricity theft, etc.). In contrast, Bharatpur and Bikaner had more than half of their revenue from the Commercial and Industrial sectors, which are considered stable sources with very little electricity theft.

This matters for resource dependence: DFs more reliant on residential consumers face higher monitoring costs, greater exposure to theft, and a more politically sensitive enforcement environment. After taking over, DFs avoided large-scale efforts to minimize opposition in the initial

[6] Interview with CESC senior management on 18th March 2023.

Table 7
Sector sales and revenue of each DF (Source: Distribution Franchisee records).

DF	Agriculture	Domestic	Commercial and Industrial	Others
Kota (sales, kWh)	1%	49%	39%	11%
Kota (revenue, INR)	1%	45%	45%	9%
Bharatpur (sales, kWh)	0%	33%	59%	8%
Bharatpur (revenue, INR)	0%	30%	62%	8%
Bikaner (sales, kWh)	5%	44%	47%	4%
Bikaner (revenue, INR)	3%	40%	53%	4%

period.[7] While this strategy made operations easier in the short term, it also complicated efforts to change social norms later. This was particularly notable in Kota, where residential consumers accounted for the largest share of sales.

Consumer services: Winning consumer trust and loyalty was a key priority for DFs, achieved through service quality improvements such as operating call centres and reducing service times. For example, transformer replacement time decreased from 12 to 2 h, and new connection times decreased from 7 to 2 days on average, as per an internal Rajasthan government evaluation.

For residential consumers, DFs focused on improving energy accounting (e.g., increasing legal connections and accurate metering) to ensure accurate billing and strengthen their financial solvency. Improved energy accounting also enables better tracking of power flows, thereby increasing energy efficiency. Key steps included:

- Conducting camps in slum areas to promote legal connections, leading to ~40% increase in domestic connections in Kota, ~30% in Bharatpur and ~20% in Bikaner.
- Relocating electricity meters outside homes for easy inspection, upgrading distribution wires to theft-proof armoured cables and performing detailed consumer indexing and transformer metering to track energy flow.
- Replacing old Discom meters with more accurate digital meters. Kota DF attempted to install smart meters to curb residential electricity theft, but faced strong consumer opposition (Hindustan Times, 2017). Lacking support from local elites and failing to gain public trust, the project was ultimately shelved, resulting in wasted expenditures and increased consumer mistrust. Bikaner and Bharatpur DFs also faced resistance to meter replacements but mitigated opposition by securing support from the local administration (Bikaner) and political and industry leaders (Bharatpur) (see Section 4.3.3 below).

For commercial and industrial consumers, DFs prioritized increasing sales and ensuring quality supply and service delivery, recognizing them as stable revenue sources. Gaining their trust helped counter opposition from other groups. This strategy was most effective in Bharatpur, where influential industrial consumers, such as mustard oil processing facilities, bolstered the DF's position. By targeting these influential consumers, the DF fostered positive reactions to reforms. An industry customer in Bharatpur stated,[8] *"Initially, DFs conducted regular meetings with industrialists to address their concerns and gain their trust. Now, that meeting happens every six months. Plus, they were able to get people on their side because of their quality of service. Their maintenance system is also extremely good."*

4.3.2. Local government

Local government, comprising civil administration and local police, plays an important role in supporting electricity companies' efforts to reduce losses by leveraging its influence over local politicians and broader civil society. Distribution Franchisees built relationships with local police and civil administration officials to gain legitimacy and counter political and consumer opposition to privatization in all three cities. As part of this strategy, DFs sometimes deployed their discretionary Corporate Social Responsibility (CSR) funds to implement developmental initiatives recommended by local administrative actors, thereby fostering institutional alignment and garnering administrative support (see Section 4.3.4).

Local administrations were better positioned to support Distribution Franchisees (DF) in Bikaner, where opposition to privatization lacked cohesive political backing and resistance to DF-initiated reform measures was relatively isolated, than in Kota or Bharatpur.[9] For instance, a local administrative initiative in Bikaner that publicly compared the accuracy of the new meters with that of Discom meters helped ease consumer resistance. In contrast, DF in Kota faced widespread public resistance, and support across political parties was minimal. This significantly weakened both the effectiveness and capacity of the local administration to assist the DF. In Bharatpur, stable political leadership aligned with the government's reform agenda reduced the need for local administrative support (see Section 4.3.3).

4.3.3. Local political environment

As new actors in the local political context, Distribution Franchisees (DFs) needed to establish trust with local leaders, despite having support at the state level. This need arose from the long-term nature of electricity projects, which require sustained cooperation and support from local stakeholders. Without strong local trust and collaboration, DFs could face challenges in implementing necessary infrastructure improvements, enforcing regulations, and ensuring compliance, all of which are essential for reducing losses.

Rajasthan's local political landscape is shaped primarily by the State Assembly elections. Although all Members of the Legislative Assembly (MLAs) in the three cities belonged to the ruling Bharatiya Janata Party (BJP), which led the privatization initiative at the state level, political dynamics differed significantly across cities in the lead-up to privatization in 2016–17. Bharatpur was characterised by strong political stability, with the same leader winning three consecutive State Assembly elections (2003-2013)[10]. In contrast, Kota experienced frequent political shifts, with changes in both the winning parties and elected representatives, resulting in a relatively volatile political environment. Bikaner occupied a middle ground, where the same BJP candidates consistently won both recent elections (2008 and 2013), although the INC had previously won. These variations in political stability influenced the implementation of privatization and the level of political support available to electricity reforms in each city.

Bharatpur: Stable political leadership played an important role in enabling cooperation among the Distribution Franchisee (DF), local leaders, and the public. This stability led to a structured approach in resolving concerns, mitigating opposition, and fostering long-term trust in the DF's operations.

As with other privatization efforts, the DF faced significant and spontaneous resistance during its initial takeover. Opposition stemmed from multiple factors, including public scepticism toward private companies, concerns over potential tariff hikes, and fear of dislocation among Discom workers.[11] Political leaders, who often leverage

[7] Based on interviews with various CESC officials at senior level as well as field offices.

[8] Interview with an industry consumer in Bharatpur on 12 September 2023.

[9] Interview with DF officials in Bikaner on 14th October 2023.

[10] The same candidate won in 2003 elections (as candidate of INLD, a regional party) and 2008 and 2013 (as candidate of BJP) in Bharatpur

[11] Interview with Bharatpur DF officials on 12th September 2023 and with senior CESC management in Jaipur on multiple dates.

electricity issues for electoral gain, were also initially resistant and wary of how privatization would affect their voter base. However, this opposition subsided as the DF improved service quality, reliability, and consumer engagement. An industrial consumer described this shift, stating,[12] *"There was strong opposition initially, but now everyone is happy. Trust issues with private companies have faded as they are performing extremely well."* By aligning with local political representatives, the DF ensured that key decision-makers viewed its presence as beneficial rather than disruptive. For example, unconstrained by government recruitment processes, DFs could hire personnel based on recommendations from key stakeholders. They could also absorb the costs of infrastructure adjustments, such as relocating power lines away from residential areas due to safety concerns, if it led to greater political support for loss-reduction activities.[13] A senior government official emphasized the importance of this approach, noting,[14] *"Over time, the private company managed the key political leaders as well as the local administration. Backing of the political leaders indirectly led them to have people's support as well."*

Bikaner: Bikaner's local political landscape was more fickle than Bharatpur's (due to the presence of stronger local leaders in the opposition party, i.e., INC) but more consistent than Kota's (due to less rivalry in the local leaders of the ruling political party, i.e., BJP), resulting in a moderately stable environment for the Distribution Franchisee (DF) from a political economy standpoint. In contrast to Bharatpur, where stable political leadership facilitated stronger institutional and political backing, the relatively less stable political environment in Bikaner meant the DF had to address challenges more independently, relying on its service performance and strategic engagement with other local stakeholders to gain acceptance.

Bikaner DF encountered resistance primarily from a small but politically influential local community and had to rely on the local administration to gain legitimacy and counter it.[15] These efforts included convincing many citizens of the accuracy of the new meters, then isolating the resisting minority and enforcing strict meter replacement policies by taking support from the local administration.[16] Efforts to limit electricity theft, particularly in the city's outskirts, were met with resistance from the residents. In response, the DF undertook developmental initiatives through Corporate Social Responsibility (CSR) programs in collaboration with local stakeholders, helping to ease tensions and gain broader acceptance (see Section 4.3.4). While initial resistance, driven by a few local leaders, was similar to that observed in other cities, it gradually declined as consumer satisfaction with DF services increased. A commercial consumer reflected a shift, stating,[17] *"The overall experience has been good, with no problems. They follow up on payment delays instead of cutting electricity, unlike Discoms."* This growing consumer approval played a crucial role in reducing opposition and reinforcing the DF's legitimacy in the region, even as political backing remained limited.

Kota: The political environment in Kota was more competitive and fragmented than in Bharatpur and Bikaner, making it more difficult for the Distribution Franchisee (DF) to secure the necessary political support from local leaders of either party. While the DF struggled to secure backing from senior political leaders, such as Members of the Legislative Assembly, it attempted to work with junior politicians and community leaders. However, this approach proved ineffective, as coordination among multiple, less influential stakeholders led to complex decision-making, making it difficult to maintain a cohesive reform strategy.

To reduce electricity theft, the Kota DF introduced stricter measures, including the installation of smart meters. However, this initiative faced strong consumer resistance due to apprehension about the new technology and the possibility of higher electricity bills. The lack of strong political backing for these changes intensified the issue, resulting in large-scale public unrest. The fragmented political landscape further limited local administrative officials' capacity to support the DF in its loss-reduction efforts. Local politics led to low public trust in the DF and rendered unreserved cooperation sensitive due to the risk of perceived partisanship.[18] As a result, the smart meter project was ultimately abandoned. Unlike in Bharatpur and Bikaner, where political opposition to privatization subsided over time, Kota continued to face resistance to private-sector involvement.[19] A senior CESC official reflected on this persistent challenge, stating[20], *"We faced opposition from political leaders since the start. At present, it is also very difficult to manage the political side of things in Kota because there is no one major leader, and there are multiple people to be managed, which becomes difficult."* This enduring political fragmentation, combined with ongoing opposition from local leaders and the public, hindered the DF's ability to establish long-term legitimacy and successfully implement reforms in Kota.

4.3.4. Strategies employed and their effectiveness

To summarize, all DFs implemented a range of strategic approaches to navigate local political and economic challenges:

- **Improving consumer services:** All DFs concentrated on improving consumer services and securing the support of influential stakeholders, such as industrial and commercial consumers.
- **Using flexibility in operational expenditures to secure stakeholder support:** Unlike government-owned discoms, DFs have greater discretion over spending. They leveraged this advantage to absorb the costs of infrastructure adjustments, such as shifting poles or overhead lines, to gain support of local leaders. Additionally, they could sometimes hire personnel based on stakeholder recommendations without being constrained by government hiring processes.
- **Investing in Corporate Social Responsibility (CSR) to build local support:** DFs tailored their CSR initiatives to align with local political and economic priorities:
  - **Bharatpur:** Directed funds toward refurbishing public hospitals, schools, and sports facilities to build goodwill among the larger civic society.
  - **Bikaner:** Invested in tourism festivals, infrastructure projects, and government office upgrades, working closely with local officials.
  - **Kota**: Focused on educational and health projects in high-loss areas, with less involvement from local politicians.
- **Leveraging Information Technology (IT) for energy tracking:** All DFs used IT for consumer indexing, asset mapping, transformer metering, and GPS tagging of meters, alongside sophisticated command and control centres for precise energy flow monitoring and reduced dependence on meter-readers.
- **Proactively addressing resistance to loss reduction efforts:** While being reluctant to aggressively combat electricity theft in the initial period after taking over management of electricity services, all DFs later actively countered resistance when faced with such opposition. For example, when consumers protested meter replacements, door-to-door testing was conducted in collaboration with local authorities (in Bikaner), and mobile meter testing vans from accredited labs were hired for on-site verification (in Kota).

[12] Interview with an industry consumer in Bharatpur on 12th September 2023.
[13] Interview with senior CESC management in Jaipur on multiple dates.
[14] Interview with a Discom official in Bharatpur on 12th June 2023.
[15] Interview with Bikaner DF officials on 14th October 2023.
[16] Interview with Bikaner DF officials on 14th October 2023 and with senior CESC management in Jaipur on multiple dates.
[17] Interview with a Bikaner commercial consumer on 14th October 2023.
[18] Interview with Kota DF and Kota administrative officials on 16th September 2023.
[19] Interview with Kota DF officials on 16th September 2023.
[20] Interview with a senior CESC official on 8th September 2023.

These strategies gave DFs the time needed to establish themselves within the local political landscape and gradually reduce their dependence on political backing to carry out loss-reduction activities. A senior DF official emphasized the long-term nature of these efforts, stating, *"Sustaining loss reduction is very different from one-time improvements. It requires consistent efforts and surveillance."*

However, each DF operated in a distinct external environment, which affected the effectiveness of the above strategies. In particular, Kota DF encountered larger challenges due to the following attributes of its external environment:

- Unlike Bharatpur and Bikaner, Kota had a more competitive political environment, with multiple local leaders engaged in an ongoing power struggle; this made it harder for the DF to navigate political dynamics.
- Kota DF relied more heavily on residential consumers for revenue compared to its counterparts. This increased its reliance on managing a large and diverse residential sector while continuing to provide reliable service critical for industrial and commercial consumers.

These features of the local political economy made it difficult for Kota DF to enforce anti-theft measures and maintain financial stability, thereby hindering efforts to reduce electricity losses.

5. Discussion

5.1. Resource dependence theory: applying the framework

Having established in Section 3.5.1 that Resource Dependence theory links organizational strategy to external dependence and environmental uncertainty, we now apply this framework to explain why the three DFs achieved different outcomes. Oliver's (1991) typology identifies five strategic responses -namely, acquiesce, compromise, avoid, defy, and manipulate - with the choice determined by the degree of dependence on external constituents and the degree of environmental uncertainty. Applying Oliver's typology to our case study, Table B1 (Appendix B) shows the strategies adopted by city DF units to manage the external environment while effectively curtailing electricity losses.

The evidence suggests that these strategies were not applied simultaneously but evolved, starting with avoidance and progressing through compromise and environmental manipulation to defiance. This allowed them to use tactics to gain time strategically and gradually shift the prevailing social norm of high electricity losses toward a new norm of strict energy accounting and improved services, while balancing the interests of local politicians and other influential stakeholders. Through this process, they were able to build legitimacy and create conditions under which the enforcement of loss reduction became more acceptable.

Oliver's framework also indicates that the effectiveness of strategies depends on the external environment's characteristics (Table 8). In particular, two dimensions are relevant - constituents and context. The constituents dimension includes multiplicity, referring to the number and diversity of stakeholders and dependence, indicating the degree of reliance on these stakeholders. The context dimension includes uncertainty, capturing the unpredictability of the environment, and interconnectedness, which reflects how different actors and factors are linked. For instance, organizations are more likely to adopt accommodative strategies when they are highly dependent on a small set of powerful stakeholders. In contrast, they may have greater scope to resist or shape external pressures when dealing with a more dispersed set of actors. In this sense, strategic choice is closely tied to the distribution of power among external stakeholders and the level of uncertainty in the environment, with DFs adopting more compliant approaches under conditions of high dependence and uncertainty and exercising greater autonomy where such constraints are less binding.

This framework helps explain why Bharatpur and Bikaner outperformed Kota in reducing electricity losses. While all three Distribution Franchisees operated in settings with multiple stakeholders, including consumers, local government, and political actors, the degree of dependence on these stakeholders and the nature of the political environment varied across cities, significantly influencing their strategic choices and outcomes.

In Kota, the Distribution Franchisee faced high revenue dependence on diverse consumer categories, requiring it to balance a large residential base with the expectations of higher performance from the industrial and commercial sectors. Additionally, Kota's political environment was fragmented, uncertain, and competitive, making it difficult for the DF to advance loss-reduction measures without encountering significant resistance. The DF's limited ability to manipulate or defy opposition meant it had to navigate external pressures carefully, often compromising rather than implementing aggressive reforms. In contrast, Bharatpur and Bikaner were better able to align their strategies in their respective political environments and consumer mix to their advantage. In Bharatpur, the DF worked closely with key stakeholders, including local political leaders and industry consumers; this helped secure broader support for its initiatives and reduce uncertainty in its external environment. In Bikaner, the DF adopted a different approach by defying opposition and strategically leveraging its political context to advance reforms.

5.2. The causal pathway: from political economy to loss reduction

The core causal pathway identified in this study can be stated explicitly as follows: local political economy conditions shaped each DF's resource dependence profile; this, in turn, influenced the range of strategic responses available; these strategies determined whether Mechanism 2 (technical enforcement) could be sustained; and sustained implementation led to loss reduction (see Fig. 2).

Two specific attributes of the local political economy were causally consequential:

Political stability and cohesion. In settings characterized by stable and coherent political leadership, as seen most clearly in Bharatpur, DFs were able to develop and build durable relationships with key decision-makers, thereby reducing environmental uncertainty. This led to co-optation and defiance strategies that generated political support for contentious enforcement actions. In fragmented political environments -

Table 8
Lower levels of dependence on external stakeholders, along with a more predictable operating context, enable DFs to defy external pressures or engage with the external environment more effectively, thereby supporting the reduction of electricity losses. Table modified from (Oliver, 1991).

External Environmental Characteristics	Suitable Strategic Responses				
	Acquiesce	Compromise	Avoid	Defy	Manipulate
Constituents					
Multiplicity	Low	High	High	High	High
Dependent	High	High	Moderate	Low	Low
Context					
Uncertainty	High	High	High	Low	Low
Interconnectedness	High	High	Moderate	Low	Low

such as Kota - no single leader could provide reliable backing, and engaging multiple competing figures created coordination problems that undermined a coherent enforcement strategy. This finding is consistent with cross-country panel evidence on the role of democratic institutions and governance quality in shaping energy-sector outcomes (Villar-Roldán et al., 2025a), which suggests that lower political stability and poor electricity access are associated with lower renewable energy development in urban areas. The underlying mechanism, namely that strong institutional frameworks and governance quality enable energy sector actors to operate and invest effectively, is directly relevant to our study's distribution loss context. In our case, political fragmentation limited the DF's ability to enforce reforms and sustain technical investments over time.

Consumer revenue dependence. A higher share of revenue from commercial and industrial consumers reduced each DF's dependence on the residential consumer segment, which is difficult to monitor, more susceptible to theft, and more vulnerable to political mobilization against enforcement measures. This structural feature shaped the feasibility of aggressive anti-theft measures independently of the political environment. In Kota, the combination of political fragmentation and high residential dependence compounded these constraints.

These two factors interact: political fragmentation raises the cost of managing a large residential consumer base. In contrast, high residential dependence raises the political stakes of enforcement, further discouraging local leaders from supporting the DF. In other words, within the DF model, local political economy conditions are a significant moderating variable in reducing electricity losses. This is also consistent with broader evidence on how governance conditions shape developmental outcomes across regions (Villar-Roldán et al., 2025b). In this study, authors demonstrate that political and institutional conditions shape developmental trajectories independently of macroeconomic factors - a pattern directly analogous to our finding that city-level political economy, rather than firm capabilities or investment levels, determined DF performance across three cities operating under identical contractual conditions.

5.3. *The political contingency of privatization*

A prominent argument for private participation in electricity distribution is that private firms are insulated from political interference (Rossow and Singh, 2024; Tongia, 2007) and have better corporate management, whereas public utilities are more susceptible to political pressures (Okten and Arin, 2006; Tasdoven et al., 2012). Our findings qualify this argument: private management does not insulate firms from local political pressures - it changes the nature of their relationship with those pressures. Successful DFs did not avoid engaging with politics; instead, they approached it strategically, using organizational flexibilities unavailable to Discoms to co-opt key stakeholders, build legitimacy, and enable effective enforcement. In cities, where the political environment was supportive, i.e. Bharatpur and Bikaner, this strategy delivered results. In contrast, in Kota, the same organizational advantages were insufficient to overcome structural political constraints.

Further, while the existing academic literature has focused on state-level politics as the primary factor shaping privatization trajectories in the Indian electricity distribution sector (Dubash et al., 2018; Sareen, 2018), our findings show that city-level political economy is independently consequential. Sub-state political dynamics, leadership stability, coalition cohesion, and opposition fragmentation determine whether state-level political backing translates into on-the-ground enforcement capacity. This dimension warrants systematic investigation across a wider set of contexts.

6. Directions for future research

As discussed in Section 2.1, Public-Private Partnerships (PPPs) in electricity distribution can take various forms. In this section, we integrate insights from our empirical research and Resource Dependence (RD) theory to outline potential directions for future research to understand better which PPP models are most likely to be effective in reducing electricity losses across diverse external environments.

It is important to clarify, however, that this study does not advocate privatization as an inherently preferable strategy for reducing losses. Since we did not compare private and public utilities, our study does not evaluate privatization's relative effectiveness compared with public distribution models. Moreover, any such normative recommendation would require a holistic assessment of privatization's broader implications for consumer welfare, beyond its influence on technical and financial performance, as well as alternative options for policy-makers. Furthermore, prior experiences with privatization in the Indian electricity sector have been subject to significant criticism, particularly regarding inadequate regulatory oversight and limited transparency in institutional reporting mechanisms. (Prayas Energy Group, 2020; Singh et al., 2006). Instead, our focus here is to raise questions that can inform the selection of suitable locations and private-participation models to reduce electricity losses, *if a decision is made to pursue privatization*.

Organizational flexibility and PPP model design. The ownership structure of distribution companies significantly affects their adaptability to external circumstances, with private entities more adaptable than state-owned companies and private licensees enjoying greater operational flexibility than other modes of privatization (Fig. 5). For example, Distribution Franchisees have greater flexibility in personnel hiring and discretionary operational expenditure than public-sector Discoms. However, a Distribution Franchisee cannot petition the regulator to set its own tariff structure (for different categories of consumers) or reduce power procurement costs to increase profitability (as opposed to just focusing on revenue maximization from the sale of electricity) – while both of these options are available to Private Licensees (Table 1). Our findings raise the question of whether greater organizational flexibility could partially offset the challenges posed by a difficult political environment. Could a private licensee arrangement have produced better outcomes in Kota by giving the operator more tools to manage its external environment? Could DF contracts be redesigned - for example, by granting greater autonomy in power procurement - to improve outcomes in politically challenging cities while remaining more politically acceptable than full privatization (Shrimali and Sen, 2020)?

Political environment and reform sequencing. Our findings suggest that political stability and cohesion are significant moderators of DF success. Future research could examine whether threshold conditions

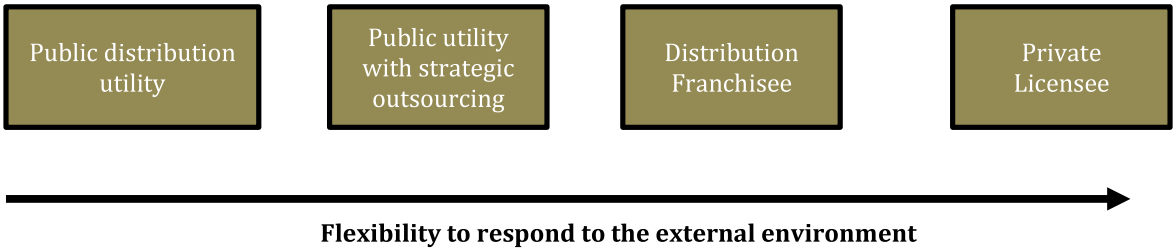


Fig. 5. Different public-privatization partnership (PPP) models in electricity distribution have varying abilities to respond to their external environment.

exist below which the DF model is unlikely to succeed regardless of firm quality, and whether pre-privatization political economy assessments could be incorporated into operator selection and contract design. For instance, could a more stable local political landscape reduce uncertainty and help private players better navigate challenges arising from revenue dependence across different consumer categories?

Substitutability of mechanisms. There may be conditions under which Mechanisms 1, 2, and 3 partially substitute for one another. Strong political support (Mechanism 3) may reduce the need for capital investment in theft-deterrent infrastructure (Mechanism 2) by making enforcement socially and politically feasible. Conversely, sufficiently robust technical infrastructure may reduce dependence on political support by making theft physically difficult. Exploring this substitutability has practical implications for how private operators prioritize investment in politically challenging environments.

7. Conclusions, limitations, and policy implications

7.1. Summary of findings

This study examined why the same private firm, operating under near-identical contractual (DF model) and regulatory conditions across three Rajasthan cities, achieved substantially different levels of electricity distribution loss reduction. Our analysis traced this variation across three mechanisms - organizational capacity (Mechanism 1), technical infrastructure investment (Mechanism 2), and management of the external environment (Mechanism 3) - finding that the first two mechanisms operated comparably across all three cities. Kota DF invested more per consumer than Bharatpur or Bikaner, and all three DFs implemented comparable organizational improvements. The divergence in outcomes is due to Mechanism 3, wherein the differences in the local political economy determined each DF's ability to enforce anti-theft measures, sustain metering upgrades, and build stakeholder legitimacy needed for sustained loss reduction. Two factors were decisive. First, political stability and leadership cohesion: in Bharatpur, a relatively stable political environment enabled alignment among key stakeholders and sustained enforcement; in Bikaner, a moderately stable environment allowed a narrow opposition to defy; in Kota, a fragmented, multi-leader landscape constrained the DF to compromise. Second, the composition of consumer revenue: DFs with a higher share of commercial and industrial revenue experienced lower monitoring costs and a relatively less politically sensitive enforcement environment. Both factors interact and compound: Kota faced both constraints simultaneously.

7.2. Theoretical contribution

This study makes three contributions to the literature. First, it builds on the existing work on privatization outcomes (Okten and Arin, 2006; Bacon, 2018) by showing that management privatization, even within the same firm and regulatory framework, can lead to heterogeneous results shaped by local political economy conditions, thereby shifting the analytical focus from firm-level characteristics to the influence of contextual factors.

Second, it applies Resource Dependence theory (Oliver, 1991; Hillman et al., 2009) to the electricity distribution context, demonstrating that the framework predicts not only which strategies private operators employ but which strategies are structurally available. The sequential progression from avoidance to compromise to manipulation to defiance, documented across all three DFs, provides a theoretically grounded account of how private utilities navigate hostile institutional environments.

Third, by highlighting city-level political economy as a determinant of DF performance, the study complements the existing focus on state-level politics in India's electricity reform literature (Dubash et al., 2018; Sareen, 2018;Gupta et al., 2025) by examining sub-state political dynamics that are independently consequential for reform outcomes.

7.3. Scope conditions and generalisability

Several scope conditions bear on the applicability of these findings. First, they apply most directly to the input-based Distribution Franchisee model. Private licensees - with additional flexibility in tariff design and power procurement - may be better positioned to navigate difficult political environments, a question identified for future research in Section 6.

Second, the findings are most likely to hold in politically competitive urban environments where local leaders have electoral incentives to engage with electricity provision. In settings with strong independent regulatory bodies that insulate utilities from local political pressures, the political fragmentation mechanism identified here may be less binding.

Third, our cases involve urban areas without significant agricultural consumer bases. The political economy of agricultural electricity supply introduces dynamics that our analysis does not capture. Future studies should extend this framework to: rural and peri-urban areas with significant agricultural consumer bases; regions with stronger independent regulators; and cross-country comparisons.

7.4. Limitations

We acknowledge six key limitations. First, the issue of limited external validity: the analysis is based on three cities in one Indian state, and the findings may not extend to other regulatory settings or countries. Second, as noted by Beach and Pedersen (2013, p. 69), process-tracing methods enable strong within-case inferences but cannot be used to make cross-case inferences. The explanatory outcome approach adopted in this study is inherently case-centric; our conclusions apply only to the particular context. Third, baseline comparability remains a concern as pre-privatization data are limited to one year; this limits our ability to establish counterfactual trends, and pre-existing structural differences may have independently influenced outcomes. Fourth, regarding data access, operational and financial information were primarily drawn from DF records and triangulated with government documents and interviews; however, potential reporting biases in firm-provided data cannot be entirely ruled out. Fifth, in terms of theoretical scope, while Resource Dependence theory offers strategic responses to external pressures, it may not fully account for factors like regulatory capacity, electoral cycle effects (Min and Golden, 2014), or bureaucratic capacity within distribution companies. Finally, limiting AT&C losses alone is not enough to restore a Discom's financial health. A holistic approach that includes tariff reform, debt restructuring, regulatory strengthening, and broader governance improvements is important for long-term financial viability (Devaguptapu and Tongia, 2023; Tyagi and Tongia, 2023).

7.5. Policy implications

This study explores the key mechanisms in shaping the effectiveness of Distribution Franchisees (DFs) in reducing electricity distribution losses in India. Our findings suggest that technical interventions alone are unlikely to deliver sustained improvements; rather, sustained loss-reduction outcomes depend on multiple operational enhancements and political adaptability. While DFs can enhance internal organizational capacity and undertake technological upgrades, their performance is linked to the extent to which they can cultivate and maintain support from relevant local stakeholders. Our research offers three key insights to guide the design and expectations of privatization models such as Distribution Franchisees. First, assessing a region's political economy and consumer mix is crucial before introducing private sector participation. Following the assessment, privatization through DFs should only be pursued when the external environment is supportive.

Second, state governments must remain engaged even *after management privatization*, as local political and administrative backing is critical for success in India's electricity sector. Finally, private firms entering new regions should prioritize customer service improvements, diversify their external support base, and build trust with consumers early on to navigate the complex socio-political landscape of the Indian electricity sector effectively.

Given the vast scope and heterogeneity of utilities in India and other countries, the insights from this study offer policymakers guidance on assessing the conditions under which privatization can successfully reduce electricity losses and on designing effective private participation models for electricity distribution services.

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CRediT authorship contribution statement

Rohit Gupta: Conceptualization, Formal analysis, Investigation, Methodology, Project administration, Writing – original draft. **Adam Goldstein:** Conceptualization, Methodology, Project administration, Supervision, Writing – review & editing. **Rahul Tongia:** Supervision, Validation, Writing – review & editing. **Siddharth Upreti:** Data curation, Validation, Writing – review & editing. **Denise L. Mauzerall:** Conceptualization, Methodology, Project administration, Supervision, Writing – review & editing.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Rohit Gupta reports administrative support was provided by CESC. Rohit Gupta reports a relationship with Jaipur Electricity Distribution Company that includes: non-financial support. The first author (RG) was a PhD candidate at Princeton University while being a civil servant in the Government of Rajasthan, but no competing interests exist between this research study and his professional obligations. Neither he nor other authors have any financial or personal relationship that could cause a conflict of interest regarding this article. If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Details of Interviews

IRB Approval for our study was obtained from Princeton University vide IRB Protocol Number 13530. The interviews were designed to assess whether privatization helped reduce Aggregate Technical and Commercial losses and improve service delivery, and were carried out in 2023. The study engaged an array of stakeholders, including government officials, DF officials, sector experts and electricity consumers from industries and commercial organizations (Table A1).

Table A1
Details of semi-structured interviews undertaken for the study

Category	Number of interviewees
Senior management of Jaipur and Jodhpur Discom	4
Mid-level Discom officials involved in the DF project	3
Officials working in the Rajasthan Regulatory Commission	1
CESC senior management	5
CESC team members in Kota, Bharatpur and Bikaner	14
Local administration officials in Kota, Bharatpur and Bikaner	5
Local Discom officials in three cities	7
Commercial and Industrial consumers	6 Kota (coaching institutes + industrial consumers), Bharatpur (mustard oil processing facilities) and Bikaner (food products)

The study employed semi-structured interviews, which facilitated both guided discussions and open-ended responses, and each lasted approximately 20-25 min. Before the interviews, informed consent was obtained, and participants were briefed about the study. Notably, DF officials were specifically asked about their strategies for minimizing losses, the challenges they encountered, and their interactions with various stakeholders, including regulatory bodies, civil society, and government officials or politicians. Confidentiality was ensured by removing all personally identifiable information during transcription. The insights from these interviews were intended to guide policymakers and industry leaders on the effectiveness of privatization in electricity distribution and its potential applicability in other regions.

Interview questions used to guide semi-structured interviews:

- Why do you think Kota, Bharatpur and Bikaner cities were selected for privatization of electricity distribution in Rajasthan?
  - Do you think these cities were the right choice for privatization? Please elaborate.
- Why do you think these cities suffer from high ATC losses?
  - What efforts were made in the past to address these losses, and were they successful?
- How do you perceive the performance of these different DFs in reducing Aggregate Technical and Commercial (ATC) losses?
  - Have they been as successful as was expected?
  - Do you think DFs accord sufficient priority to the reduction of ATC losses?
  - Is there any difference in their performance? If yes, what could be the reasons behind it?

- Which tactics were used by DF to reduce ATC losses after taking over the electricity distribution?
  - Did these tactics change over time?
  - Why could public discoms not take similar action?
- Did you support or oppose DF in their actions and policies for reducing ATC losses?) Please elaborate. (For Government officials/politicians/influential consumers/media persons)
  - If opposed to DF, why?
  - Did your opposition make any difference?
  - Do you continue to oppose them?
- Are there any actions which DFs can take which can lessen your opposition?
  - If supported DF, why?
  - Did DF reach out to you for support? If yes, please elaborate.
- Did you perceive any change in the quality of electricity services post privatization?
- Why did your company choose to participate in the bidding process? (For companies that made a bid in the privatization process)
  - Did you face any problems in the bidding process?
- Do you think electricity services in more cities and areas should be brought under privatization to reduce ATC losses or improve services?
- If the government decides to bring more areas under privatization, what steps and policies can make it more successful to reduce ATC losses?

Questions only for private distribution franchisee officials

- Are you satisfied with the company's (CESC) progress so far with respect to overall performance?
  - How important is the reduction of ATC losses for the successful operation of DFs?
- Are you satisfied with the DF's progress in reducing ATC losses in the three cities?
  - If you were to rate the success in reducing ATC losses among three cities, which city would you rank first, and which city would be the last?
- What were the main steps you took after taking over to reduce ATC losses?
  - Did you receive adequate support from other stakeholders, particularly government, political leadership, and civic society?
  - How did you garner support from other stakeholders towards this end?
  - Why did the predecessor public utility fail to take similar actions?
- Looking back, do you think CESC or DFs made any mistakes or missed taking any action? Please elaborate.
  - What could have been done to avoid these mistakes?
- Are there any differences between the three cities which impacted DF's performance in reducing ATC losses? Please elaborate.
- Do you think electricity services in more cities and areas should be brought under privatization to reduce ATC losses or improve services?
- If the government decides to bring more areas under privatization, what steps and policies can make it more successful to reduce ATC losses?
- If you were advising a peer official in another city that was about to implement a similar program, what advice would you give them based on the lessons you learned?

Appendix B. Classification of DF Strategies Using Oliver's (1991) Typology

Table B1
Classification of strategies deployed by DFs to manage their external environment, using the typology developed by Oliver (1991).

Strategies	Tactics	Examples	Tactics used in the Study Area	Effectiveness for Reducing Electricity Losses
Acquiesce	Imitate, Comply	Obey rules and accept norms; Mimic institutional models	None	Existing social norms and political interests regarding electricity were responsible for high electricity losses; therefore, compliance with these external pressures is not beneficial.
Avoid Pressures	Conceal, Buffer, Circumvent	Disguise nonconformity; Change goals, activities, or domains	Used IT to improve energy accounting, along with breaking the hegemony of ex-Discom employees and meter readers Installed theft-proof infrastructure (such as armoured cables) while making infrastructure improvements	Limited possibilities
Compromise	Balance, Pacify, Bargain	Balance expectations of multiple constituents; Placate and accommodate competing demands; Negotiate with institutional stakeholders	Focused on better consumer care and service delivery, rather than directly combating electricity theft during the initial period of operations Complied with the local administration's directions to gain legitimacy and secure support. Occasionally absorbed the cost of infrastructural adjustments to get the support of local stakeholders.	It may be effective in the short run in some places, but it can continue indefinitely – delay makes it difficult to change norms later.
Manipulate Environment	Co-opt, Influence, Control	Dominate institutional constituents and processes; Co-opt influential constituents (e.g. board members)	Used CSR funds Provided jobs Collaborated with district administration in Bikaner, industrial consumers in Bharatpur and community leaders in Kota	Most effective, but takes more time and money

(*continued on next page*)

Table B1 (*continued*)

Strategies	Tactics	Examples	Tactics used in the Study Area	Effectiveness for Reducing Electricity Losses
Defy Pressures	Dismiss, Challenge, Attack	Shape values and criteria (e.g. public campaign) Ignore explicit norms and values; Challenge/contest rules and requirements; Delegitimize the sources of institutional pressure	Installed smart meters and asked protesting consumers to get their meters tested from mobile labs in Kota. Organized door-to-door meter testing in Bikaner and an isolated resisting community. Actively combating electricity theft in later operational periods	High risk of backfiring without strong external support. Good pay-off otherwise

Data availability

The authors do not have permission to share data.

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