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Faisal Jamil
Eatzaz Ahmad

PAKISTAN INSTITUTE OF DEVELOPMENT ECONOMICS

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Faisal Jamil
National University of Science and Technology, Islamabad

and

Eatzaz Ahmad
Quaid-i-Azam University, Islamabad

PAKISTAN INSTITUTE OF DEVELOPMENT ECONOMICS
ISLAMABAD

Pakistan Institute of Development Economics
Islamabad, Pakistan

E-mail: publications@pide.org.pk
Website: http://www.pide.org.pk
Fax: +92-51-9248065

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C O N T E N T S

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ABSTRACT

Theft and corruption are common in electricity distribution systems worldwide. We have analysed electricity theft in the framework of an individual's choice under uncertainty and through a three-layered principal-agent-client model of corruption. The study finds that an individual steals electricity only if the subjective benefits are higher than the associated costs e.g., fine imposed in case of detection or job dismissal. The fair tariffs and efficiency wages along with higher deterrence and active consumer involvement in reporting electricity theft can help in combating corruption and pilferage in electricity sector. Moreover, deterrence through increased probability of detection and conviction are important policy measures.

JEL Classification: Q4, H8, R2, K1

Keywords: Individual's Choice, Principal-Agent Model, Electricity Theft

1. INTRODUCTION

Theft and petty corruption are quite common in electricity distribution systems of many countries, especially the developing ones. It occurs when a distribution company fails to recover its receivables either due to illegal abstraction or non-payment by consumers; and improper recording or reporting by electricity meter readers. As a result the utility fails to receive the full price of the power it sold. For example, dishonest consumers either steal electricity directly from distribution lines or collude with utility employees by bribing them to save themselves from detection and conviction. Electricity theft harms the financial health of distribution companies and affect future investments in the power sector. Electrical energy worth billions of dollars is stolen every year and the costs are routinely passed on to the paying customers directly in the form of high tariff rates and indirectly through poor quality of service [Smith (2004)].

This study attempts to model electricity theft in an electricity distribution system in the framework of individual choice under risk and principal-agent model of corruption. The electricity sector of developing countries generally faces extensive public controls that sometimes use electricity as a tool to pursue social, economic and political objectives. Public dominance and non-commercial approach in utilities' management result in widespread corruption, and inefficiencies at the generation and distribution levels [Lovei and McKechnie (2000)]. There may be temptation likewise for consumers to take advantage of poor governance and deficiencies in regulatory regimes.

The economics of electricity theft is concerned primarily with the cost and benefits of limiting this non-violent crime. The benefits of curtailing theft are associated with increase in revenues of utilities and improved quality of service for the consumers. The potential costs involved are increase in surveillance expenditures of utilities as well as payment of rewards and price incentives to monitors and consumers respectively. Although theft itself is a form of corruption, yet corruption in this study is considered as any kind of fraudulent use of electricity wherein consumer (client) and utility employee (agent) collude for their respective gains causing loss to the utility/government (principal). By corruption, we refer to the following phenomena. The agent and client may collude for illegal private gains by the agent not reporting fully the actual electricity consumption of a client, or agent may extort money from honest clients by reporting high meter readings or false detection of theft. The individual behaviour towards electricity theft is studied in the framework of expected utility maximisation. In addition, we construct a three-layered principal-agent-client model of corruption in the context of electricity theft. The agent delivers electricity to clients and does not turn over the actual revenues to the principal. On the basis of our models, we explicitly identify the major policy tools for the principal to combat corruption and electricity theft.

The paper is organised as follows. We begin in Section 2, by looking at the literature covering the wide range of issues including economics of crimes, corruption and law enforcement. Section 3 illustrates the anatomy of electricity theft, its extent and consequences. We proceed by constructing the simple theoretical model of individual behaviour towards electricity theft in different settings in Section 4. The potential policy variables are discussed in Section 5. Section 6 summarises the findings and concludes the study.

2. LITERATURE REVIEW

Becker (1968) motivates theoretical research on the economics of crimes. It suggests that the criminal is a utility maximiser who weighs the subjective costs and benefits from a crime and that imposition of penalties may help to reduce the crime rate. Polinsky and Shavell (1979) study the impact of fines on risk-neutral and risk-averse individuals and their results favour the imposition of maximal fines on convicts. Shavell (2003) suggests that if the expected private gain and cost in terms of harm caused by crime are nominal, morality can deter but if the cost and private gain are substantial, law enforcement will be required along with morality to provide optimal deterrence. Polinsky and Shavell (2001) illustrate that corruption dilutes deterrence imposed by penalties; hence it has to be reduced in order to make tools of deterrence effective.

The irregularities in electricity sector of a region mainly stem from the socio-political structure of the region and institutional governance of the operating utilities. In economics literature, corruption is mostly analysed in the framework of principal-agent model where the interests of the principal and agent diverge and there is informational asymmetry to the advantage of the agent. In the context of crime, corruption and electricity theft, individuals' perceptions determine their behaviours. In the framework of the principal-agent-client model, the role of agent is found critical in the literature as he/she manages the relationship between clients and the principal [Klitgaard (1988)]. In different regions of a country, perception of individuals about corruption may vary and hence their chances of being corruptible may also vary [Sah (2005)]. Many past studies attempt to identify other deterring factors, such as morality and psychological and reputation costs [see, for instance, Gordon (1989); Myles and Naylor (1996) and Tirole (1996)]. Several past studies surveyed in detail the literature on corruption [see, for instance, Shleifer and Vishny (1993); Mookherjee and Png (1995); Groenendijk (1997); Bardhan (1997); Gupta, *et al*.

(2002); Aidt (2003) and Silva, *et al*. (2007)]. These studies cover multidimensional aspects of corruption and its determinants and identify corruption as a socially and economically undesirable phenomenon.

Smith (2004) explicitly focuses on electricity theft and compares its various forms and measures to reduce it. The study finds that lower losses (less than 6 percent) are most common in countries with low corruption perception and while higher losses (over 30 percent) are most common in countries with high corruption perception. The study links electricity theft with mal-governance. Few other studies explore the relationship between efficiency and corruption in the electricity sector. Bò and Rossi (2007) find that corruption increases the factor requirement of firms due to diversion of the managerial efforts away from factor coordination.

The issue of electricity theft with regard to modelling of individual behaviour towards crime and corruption is over looked in the literature. We develop a model of crime in the framework of choice under risk and an agency model of corruption in the electricity sector. The special features of the study are its novelty and sector specificity. Our model of electricity theft and corruption enables us to identify the key relationships among economic, social and governance variables based on the expected behaviour of the individual and suggest policy implications.

3. GENERAL ANATOMY OF ELECTRICITY THEFT

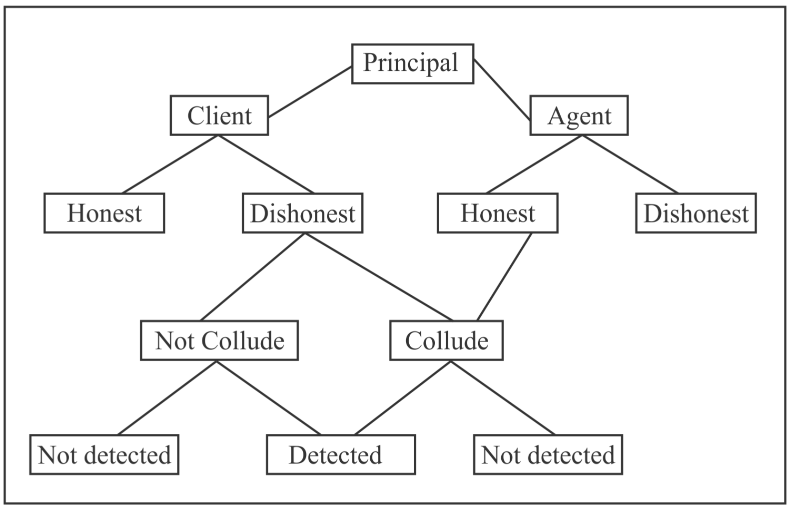
Electricity is generated at various power stations, which are generally located at distances from the load centres or end-users. It is then transported to end-users through wires, transformers and conductors. During transmission and distribution, a part of energy is lost. This is generally called transmission and distribution (T&D) losses in electricity system. The T&D losses break up into technical and non-technical losses. Apart from technical reasons, some energy is lost from utilities' standpoint due to illegal abstraction or electricity theft. It is generally called non-technical losses or more specifically electricity theft. Electric utilities charge for electricity on the basis of readings displayed on the meters at the consumers' interface. Electricity theft is a crime worldwide.

In order to supply electricity to its consumers, utility delegates its employees various activities, such as maintenance, electricity retailing and theft detection. A utility employee acting as an agent directly interacts with the consumers and hence may collude with some of them as is the case in the agency model of corruption. The agent may help consumers in hiding the actual electricity consumption by accepting bribes from them. Both of the corruptible employees and consumers benefit through this illicit relationship. The electricity theft can be summed up as an issue related to three Rs i.e. improper *Recording* (illegal abstraction of electricity), less than actual *Reporting* (collusion of employees with consumers to hide actual consumption for illegal private income), and low *Recovery* (non-payment from consumers). Less than optimal level of any of the three Rs may result in one of the following outcomes.

(a) Electricity theft committed by consumers themselves.
(b) Consumers stealing electricity with the connivance of utility employees.
(c) Consumers not paying for their electricity charges.

The drain of resources through theft or non-payment reduces the utility's profitability resulting in poor quality of electricity supply. The relationship among key players in the three-layered agency model is illustrated in Figure 1. Corruption has been high on research agenda of many international agencies like World Bank, Asian Development Bank, Transparency International and USAID in the past two decades.[1] On the whole, these agencies focus on sectoral aspects of corruption and ways to combating it [see, for example, Eskeland and Thiele (1999); Lovei and McKechnie (2000); Ruth (2002)].

Fig. 1: Principal-Agent-Client Linkages in Electricity Theft



4. MODEL OF ELECTRICITY THEFT

The theft model is developed on the basis of theoretical literature on crimes and in the framework of the three-layered principal-agent-client model of corruption [see, for instance, Becker (1968); Allingham and Samdo (1972); Becker and Stigler (1974); Clotfelter (1983); Gordon (1989); Besley and Mclaren (1993); Clarke and Xu (2004); Bò and Rossi (2007)]. The individual's

[1]World Bank president James Wolfenson emphasised at the joint annual meeting of IMF and World Bank in 1996 that corruption would be on the Bank's top priority [Jain (2001), p. 102]. The World Bank (2009) publication of sourcebook titled, "Deterring corruption and improving governance in the electricity sector" is clearly a sign of commitment and deliberation of corruption in electricity sector.

choice under uncertainty is considered as the starting point for model building at Sections 4.1 and 4.2. Our choice of studying individual behaviour is methodological and it does not deny the importance of social and economic institutions, of which the individual is a part.

4.1. Individual's Behaviour Towards Electricity Theft

The standard approach to model the behaviour of electricity stealing consumer is based on the economics of decision-making under risk with the presumption that the individual involved is an expected-utility-maximiser. We assume that the electricity consumer is risk averse and is connected to electricity grid. However, he/she can extract electric power from grid illegally either through meter-tampering or by-passing the electricity meter of the utility if he/she chooses. The decision of the individual is based on comparing the associated expected benefits with the risk involved and expected costs. In particular, paying fully for electricity consumption can be viewed as purchasing a safe asset, while electricity theft is analogous to purchasing a risky asset. Therefore, electricity theft decision facing an individual essentially becomes a portfolio selection that conforms to the Von Neumann-Morgenstern axioms for behaviour under uncertainty.

A consumer faces the choice of whether or not to commit electricity theft. What he/she will gain from engaging in electricity theft depends on a number of random factors, some of which are assumed to be known to him/her before he/she makes the decision. Let the average electricity price be λ and individual consumes C units of electricity that has the value $R = \lambda.C$, measured at a particular point in time when he is assumed to pay. The electricity stealing consumer conceals an amount $T(= C - X)$ units and pays only for X units whereas T units become a part of distribution losses of utility. Hence, utility charges an amount $r = \lambda.X$, and his/her pecuniary gain equals $G = \lambda.T$ which is only a fraction of the total due payment. Since the amount of electricity stolen T is endogenous it is difficult to interpret the actual gain for the electricity stealing consumer. Therefore, to make the relationship interpretable, we use a constant amount of theft i.e. $\check{T}$ such that $\check{T}$ is the maximum amount of electricity that could be stolen by a client. Let us assume the electricity tariff rate λ to be fixed for simplicity and ignore the implications on electricity theft of prevailing multiple block pricing where tariff rate rises for each higher block consumed.

The choice for the consumer lies in two alternative options, either to pay in full for the electricity consumed or steal electricity. One of the two outcomes is expected if he/she chooses the latter option. The consumer may be able to conceal electricity theft or be detected with probability p. The probability of detection is assumed to depend on the surveillance expenditures. As a general rule, the fines or sanctions imposed on the offender depends on the harm to society due to the offence [Becker (1968)]. In case of detection the consumer has to pay a fine *f*, where fine is assumed to exceed the value of electricity theft that is, $f > \lambda \check{T} > 0$. If a consumer engaged in electricity theft succeeds in hiding his/her crime, the value of illegally consumed electricity is his/her pecuniary benefit. We ignore the cost of other risks and focus mainly on the risk of detection and lost reputation and money due to fine. The non-pecuniary reputation cost in case of detection depends on the society's behaviour towards the crime. Although the moral psychological cost is also involved, yet it may be insignificant. Since the individuals notice how others behave, the pilferage decision essentially becomes interdependent.[2]

If the consumer engaged in theft is detected and penalised, the fine will be pecuniary cost. For without the bribery case, we specify the expected utility function for the consumer as

$$E(U) = (1 - p).U(Y + G - \rho) + p.\ U(Y + G - f - d - \rho) \quad \ldots \quad \ldots \quad (1)$$

Where,

- U = Function giving utility of wealth including pecuniary benefit of electricity theft. This function is assumed to reflect risk aversion, that is $U' > 0$ and $U'' < 0$.
- Y = Wealth of the consumer.
- G = Pecuniary gain in the form of illicit saving through electricity theft that equals electricity price 'λ' multiplied by the amount of electricity stolen 'T'.
- p = The probability that an individual who steals electricity is convicted. We assume the probability of being caught to be independent of the amount of theft, although in practice, the utility surveillance expenditures may be based on the amount of electricity consumption or losses.
- F = The fine collected from an individual who is convicted for electricity theft. The fine or penalty can be of pecuniary or non-pecuniary nature but this variable measures the pecuniary cost in case of detection. It is assumed that the fine or penalty depends on the assessed illegal private benefit to the consumer. It may also include the cost of obtaining new connection in case of power cut as a penalty of theft.
- D = Money equivalent to non-pecuniary value of reputation cost.
- P = Money equivalent to non-pecuniary value of moral satisfaction loss.

Akerlof (1980) specified the reputation function in his theory of social customs and observed that the reputation function of an individual depends on

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[2]Gordon (1989) models individual morality and reputation in the tax evading decision of consumers and shows the interdependence of evasion decisions such that individuals are more likely to evade if they are aware of others evading. This is in contrast to the Allingham and Samdo's (1972) model where evasion reflects an independently made portfolio decision.

two things: his/her obedience to code of behaviour, D, and the portion of population who believes in that code, μ. Hence the larger the number of honest consumers in a society, the more will be the loss in reputation if an individual commits electricity theft. Hence, the reputation function can be written as,

$$d = d(D, \mu), \quad \frac{\partial d}{\partial D} > 0, \frac{\partial d}{\partial \mu} > 0 \qquad \ldots \quad \ldots \quad \ldots \quad \ldots \qquad (2)$$

In any case, an individual will engage in electricity theft if and only if,

$$(1 - p).U(Y + G - \rho) + p.U(Y + G - f - d - \rho) > U(Y) \quad \ldots \quad \ldots \qquad (3)$$

The policy variables obtained from this discussion are tariff rate, value of fine, probability of detection and reputation cost. It is a non-equilibrium model since electricity tariff is not adjusted simultaneously, and solving the model with revenue target assumption may either result in the agent's extorting money from honest consumers or public subsidy may bridge the revenue gap.

4.2. Electricity Theft in Case of Corruption among Consumers and Employees

The key players in our three-layered (principal-agent-client) model of electricity theft with corruption are; consumer (client), utility employee (agent) and the utility/government (principal). The utility employee is in direct contact with the consumer and hence, acts as an agent of the principal. Basically, we focus on the interaction between the agent and the client. The discretionary powers of the agent in electricity retailing give rise to corruption. In this study, corruption may be defined as an unauthorised transaction between the agent and the client or abuse of office or discretionary power for personal gain [same as, Klitgaard (1988); Groenendijk (1997)]. Electricity is a source of considerable rent-seeking for the officials. The behaviour of the agent is constrained by the principal's ability to set precise rules and to closely monitor the former. Generally, rules allow some discretion to employees since a thorough monitoring is very costly. The extent of imprecision in the implementation of rules and the cost of monitoring the employees in a utility may determine the level of corruption.

The principal may be fully informed about its revenue loss and the amount of electricity stolen by consumers but it cannot distinguish honest consumers from the corruptible ones unless the agent delegated to monitor detects electricity theft. The corruptible agent may collude with the consumers and sometimes share the payoffs with its supervisors and colleagues to dilute the probability of conviction hence, the net payoff for him constitutes only a fraction of the total bribe received. Suppose a utility employee, say meter-reader is delegated to report the electricity used by consumers. A consumer faces the choice of whether or not to steal electricity by paying nominal bribe to the meter reader. Whether or not he/she will engage in corruption depends on the cost and benefit of doing so. Let the individual's pecuniary gain be G less bribe payment b. The bribe payment here serves to dilute the deterrence through reducing probability of detection. In case of detection the consumer has to pay a fine f, where $f > (G - b) > 0$.

The pecuniary benefit may lead the agent to accept bribe in exchange for favouring the client in reducing its electricity charges. As a result, the agent will report X units of electricity. Since electricity is charged on the basis of meter-reading and the meter reader reports electricity consumption to the principal hence petty corruption prevails in the sector and is of recurrent nature. As shown in Figure 1, a fraction of the consumers as well as employees are corruptible, on whom the model focuses. The principal can discover electricity pilferage with probability p. If an agent is charged and proved accepting bribe from the client, he may be dismissed and have to pay penalty $\eta > 0$. Similarly, the convicted client has to pay fine $f > 0$. For practicably implementable deterrence, the penalty for corrupt agent η and fines for convicted consumers, f must be less than their respective wealth.

The consumer's gain from electricity theft is equal to $(G - b)$, while that of agent equals b, the bribery receipt. The financial loss of the principal equals G, which consequently results in the social cost of theft to other consumers. The client faces the choice whether or not to steal electricity consumed at some given probability of being caught. Below, we model separately the behaviour of the client towards electricity theft with corruption as well as the agent towards accepting bribe.

(i) Given the wealth of the client, he/she will offer bribe if his/her expected gain is greater than the honest payment for the electricity consumed. i.e. if $G - pf$ is positive.

$$(1 - p)\, U(Y + G - b - \rho) + p.U(Y + G - b - f - d - \rho) > U(Y - \lambda.C) \quad \ldots(4)$$

Keeping all parameters the same as described in Equation (1) and,

$b =$ The bribery paid to get the favours of the agent.

Presumably, a higher fraction of total electricity stealing risk-averse clients opt bribe payment to conceal actual electricity consumption with reduced probability of detection. The incidence of theft in this case, essentially depends on policy variables including; tariff rate (r), amount of fine or penalty (f), probability of detection (p), and reputation cost associated with electricity theft.

(ii) The behaviour of the utility employee or agent towards corruption can be explained in the manner of Aidt (2003). We compare the expected benefit of the agent in the form of wage, bribery and cost, in case of conviction in the form of penalty and dismissal from the job. Let the wage rate in some other job be w^0 which is assumed to be lower than the wage rate *w* in the electric utility. In case of detection, let us assume that he/she has to pay the penalty ŋ > 0 and dismissal from job.

$$E(U) = 1 - p\,.U(w + b) + p.U(w^0 - ŋ) \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (5)$$

An agent will accept bribe for facilitating electricity theft only if expected payoff is higher than his/her legitimate income. Assuming that the agent is risk averse, he/she will accept bribe if and only if,

$$(1 - p).\ u(w + b) + p.u(\ w^0 - ŋ) > u(w) \quad \ldots \quad \ldots \quad \ldots \quad (6)$$

Since we assume that utility function of the agent is linear therefore, expected utility maximisation is equivalent to expected income maximisation. The following policy variables can be manipulated by the principal to lower the agent's corruption with electricity theft: wage rate in the utility (*w*), penalty rate (ŋ), probability of detection (*p*) and reputation (*d*). These policy variables comprise economic, social as well as aspects related to law and governance and can be handled prudently to achieve the desired outcomes for a sustainable electricity industry.

5. POTENTIAL CONTROL VARIABLES

We analyse the characteristics of consumers and utility employees so as to formulate an appropriate policy through the identification of control variables. The primary objective of the policy is to reduce the agent-client collusion since the policies that impair this collusion will also reduce electricity theft. The appropriate strategy may be a mixture of incentives and penalties for both the consumers and employees. Given the policy package (*w*, *f*, *d*, ŋ, λ), the principal will choose optimal level of corruption and electricity theft based on the combination of incentives and deterrence or punitive measures. We discuss the potential control variables in the following lines.

Tariff Rate**:** Utility maximisation for a risk averse offender implies that theft will tend to increase with tariff rate.[3] An increase in tariff rate may affect electricity demand and revenue of utilities in two ways. The honest consumers may cut their consumption of electricity, while the proportion of dishonest consumers may increase. The corruptible utility employees will raise the bribe rate and monitoring efforts to detect consumers who are stealing electricity without paying bribe resulting in higher payoffs for them. Therefore, a Laffer curve type relationship between tariff rate and utility revenues exists and that revenues would be lesser if the tariff rate increased from certain high levels perhaps not due to shrinking demand but due to rising electricity theft. The

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[3]Clotfelter (1983) analysed the impact of tax rate on tax evasion and found positive relationship between the two.

result may be higher electricity consumption, higher bribe earnings for corrupt employees, higher electricity theft and lower revenue to the utility.

The principal-client relationship is also an important factor in determining the consequences of higher tariff rates. The deficit of trust on electricity billing may also lead to increased theft. Therefore the bill needs to be simplified representing electricity consumption. Tariff rate differentials among consumer-categories e.g., across sectors are another major factor that makes electricity theft potentially profitable for some sectors. Cross-subsidisation, that is electricity tariff rate differentials among sectors of the economy, is often used for various social, economic and political objectives.

Wages: Wage rate for a utility employee appears an important policy variable for combating petty corruption and consequently electricity pilferage. The idea of efficiency wages as a tool to control corruption goes back to Becker and Stigler (1974). The underlying intuition is that when wage is high enough, the expected cost of being caught and penalised in terms of job loss may undermine the agent's temptation for corruption. The higher cost will more than offset the net payoff from malfeasance. From Equation 6, the minimum wage rate that may keep all the employees of the utility honest is given as,

$$w = w^0 + \frac{(1-p)}{p}b - \eta \qquad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (7)$$

The efficiency wage equals private sector wage w^0 plus a mark-up equal to temptation of corruption among utility employees. It indicates that mark-up or premium is proportional to effectiveness of corruption detection system i.e., higher the probability of detection, in case of an employee accepting bribe, the lower will be the premium to make wages efficient. The higher wages in a utility portray higher cost of dismissal for an employee if detected. However, the efficiency wages may reduce monitoring efforts from the utility employees [Mookerjee and Png (1995)]. This can be dealt with through the payment of performance-based monetary rewards for reporting theft. Polinsky and Shavell (2001) postulated that the payment of rewards to enforcers can reduce or eliminate the problem of bribery but they cautioned that such payments can encourage extortion.

Due to lower wages, or as described by Besley and Mclaren (1993) as the capitulation wages, i.e., wages so low that no one will accept them unless these are augmented with corruption, agents may view bribe as morally justified addition to wages [Greenberg (1990)]. The low wages and contractual job policy in lower staff of the utility may also spur corruption among the employees. Evidence shows that wage does have significant impact on decreasing corruption for example, in Singapore a wage premium above private sector salaries has been found to be a useful tool in fighting corruption, which favours the efficient wage [Mookherjee and Png (1995)].

The relationship between corruption and compensation policy to utility employees is quite complex and efficiency wages may not necessarily reduce corruption to the desired levels unless it is supported with deterrence through monitoring and enforcement. It requires a thorough investigation whether capitulation wages result in lower total revenues for the utility net of wages paid to the employees as compared to efficiency wages with lesser corruption and electricity theft.

Probability of Detection and Enforcement Process: The probability of detection and the resulting punishment are essential parts of crime models. Enforcement is characterised by the probability of detection to be imposed on the corruptible employees and electricity consumers. It follows from Equations (3), (4) and (5) that an increase in both these variables can reduce the expected utility and resultantly can slash electricity theft down. The econometric analysis of criminal behaviour generally applies arrest rates and sanctions imposed as measures of probability of punishment. On similar analogy, the fine imposed on consumers convicted of electricity theft is punitive for electricity theft.

The level of deterrence and the probability of detection are dependent on, keeping all other things constant, the number of monitoring agents and the effort put to monitor electricity theft. It seems trivial for the utility to increase deterrence by employing more monitors and reduce theft. But the matter is not as simple since the monitoring utility employees may be corruptible and simply by increasing the number of employees may not increase deterrence. Most utilities have surveillance wings specifically for monitoring consumers and employees in addition to routine checks of meters and distribution lines to detect cases of theft and corruption. This way the chances of conviction of corrupt employees and consumers rise. In other words, the collusion and sharing of benefits through convincing utility officials for not detecting theft would become difficult in this over-lapping arrangement.

Punishment and Deterrence**:** The proposition that crime rate responds to corresponding benefits and risks, is usually called deterrence hypothesis. It asserts that people respond to the deterring incentives created by the justice and governance system. On detection of electricity theft, the consumer has to pay the penalty. Higher fines will help in reducing the theft in case of risk averse individuals. Bar-Ilan and Sacerdote (2004) find that individuals exhibit a large response to the level of fine and higher fines increase deterrence for all groups of individuals. An individual engaged in electricity theft is made to pay a fine with some probability of detection. Polinsky and Shavell (2001) argues that when fines are not optimal for some reasons then raising the fine rates for the offence can at least partially offset the deterrence-diluting effects of corruption. The penalty for electricity theft may comprise of pecuniary as well as non-pecuniary components such as heavy fines for theft detection and supply disconnection. Progressive fine rates will deter the large consumers and disconnection may be more effective for small consumers.

Reputation, Morality and Fairness Cost of Pilferage: The standard risk-aversion does not fully explain the individual consumer's behaviour as decision of an individual regarding electricity theft seems interdependent as reflected in increased likelihood of indulging in theft when others are believed to be similarly engaged [Gordon (1989) and Myles and Naylor (1996)]. The economic concept of utility is taken as an indicator of a person's well-being, i.e., the word 'utility' encompasses everything that raises a person's well-being. The sources of this well-being include all the material and hedonistic pleasures and pains that may affect utility, so also does the satisfaction, fair treatment for him/herself and for others etc. Thus one can expect that electricity theft decreases with perceived fairness if and only if the consumer's risk aversion is an increasing function of fairness [Falkinger (1995)].

The role of civil society as a force for improvement of services needs to be emphasised in reforming public services. The consumers are the primary stakeholders as they are the ultimate losers when electricity supply is in disarray due to electricity theft. The honest consumers, therefore, can be motivated to report electricity theft, since they are to face outages and high tariff rates. The consumer's theft reporting is also cost effective.

6. SUMMARY AND CONCLUSION

Electricity theft and corruption are crimes and combating these crimes is challenging since the enforcers and monitors are frequently themselves engaged in the activity. It is a source of substantial losses to public electric utilities and is therefore, a major concern for many governments. This study makes a first step towards better understanding the phenomenon of electricity theft and ways to combating it through institutional, legal and policy measures. The literature focuses on institutional factors, law enforcement and individual characteristics with a view to obtaining optimal deterrence through law and morality. The criterion is maximising individual gain along with social welfare.

We model the electricity theft as a model of crime in the framework of choice and risk as well as an agency model of corruption in electricity distribution systems. The frameworks developed enable us to pinpoint a number of variables that can be operationally measured and used in empirical analysis of electricity theft. Thus, our theoretical models link up theory and empirical modelling. First, we examine the behaviour of electricity stealing consumers from the socio-economic perspective and the suggestions are made based on economic theory under uncertainty. It suggests that the individual weighs the expected benefits and cost in terms of associated risk of being fined, and steal electricity only if the net expected benefit is positive. Second, we study the agency model of corruption in the context of electric utilities.

The study identified a battery of policy variables based on analytical framework, including tariff rate, wage rate, rate of conviction and being fined and involvement of civil society that may help in reducing electricity theft. These policy variables may greatly help in reducing electricity theft that jeopardises the utilities. Fighting corruption and electricity theft entails a commitment from the utility officials and public decision makers, which is inevitable due to overwhelming financial losses and unfavourable conditions for investment. Reliable electricity supply is inevitable for sustainable economic development. Electricity shortfall due to mismatch of electricity demand and supply is costly in terms of loss in production and welfare. Shortfalls can be avoided either by using pricing policy or through adequate investments in electricity supply infrastructure. The effectiveness of pricing policy to hold back excessive demand in the presence of extensive theft is uncertain. The other option to avoid shortfalls requires investments in capacity additions especially in the private sector. Electricity theft is a major hurdle in attracting investment in the sector. The findings of the study may be applicable in further empirical studies and may be of interest to most of the developing countries where hefty amounts of utilities' revenues are lost due to electricity theft every year.

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