Regulatory behaviour under threat of court reversal

Magnus Söderberg [a], Flavio Menezes [b] and Miguel Santolino [c]

[a] CERNA, Mines ParisTech, 60 Boulevard St Michel, 75006 Paris, FRANCE.
Tel: +33 (0)1 4051 9091; Fax: +33 (0)1 4051 9145; E-mail: magnus.soderberg@mines-paristech.fr

[b] School of Economics, University of Queensland, St Lucia, Qld 4072, AUSTRALIA.
Email: f.menezes@uq.edu.au

[c] Riskcenter-IREA, Department of Econometrics, University of Barcelona, Avda. Diagonal, 690, 08034 Barcelona, SPAIN. E-mail: msantolino@ub.edu

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ABSTRACT

In this paper, we theoretically and empirically investigate reviews by regulatory bureaucrats and an appellate court when customers have complained about conditions proposed by a monopolistic service provider. First, we develop a theoretical model and consider two possible types of regulators; a self-interested regulated and a somewhat altruistic regulator. When the regulator is only concerned about her career we predict that, under certain conditions, a larger number of decisions will be overturned by the court in more complex cases than in less complex cases. We also predict that when the regulator cares about both her career and consumer surplus, less complex cases will be associated with more appeals by regulated firms but fewer decisions will be overturned and prices will be lower. As the complexity of the case increases, we predict a switch to more appeals by consumers, more decisions being overturned and higher prices on average. These theoretical predictions are, in general, confirmed by Swedish electricity sector data.

Key words: regulation, effort, complexity

JEL Classifications: K41, C34

1. INTRODUCTION

Global reform of network industries, such as electricity, gas, telecommunications and rail, in the last few decades of the twentieth century was characterised by an unbundling of the competitive and natural monopoly components of these industries. While new markets emerged in competitive segments such as gas production and electricity generation, the natural monopoly segments of these industries were reregulated. This process was followed by large privatization efforts and corporatization of public-owned enterprises. Importantly, price setting in the newly reregulated sectors by an independent regulator replaced an opaque system where prices were set by the government and sometimes by the government-owned institutions providing the service. This means outcomes in network industries have become increasingly reliant on regulatory and bureaucratic decisions.[1] The two primary tasks now performed by regulators are rate reviews and the resolution of customer complaints.[2,3]

Previous studies on regulatory outcomes have almost exclusively focused on rate reviews, often by state regulators in the U.S., where the regulated firms (but not the customers) can appeal the regulators' decisions. This focus on the U.S. is not surprising given the long experience that the U.S. has had with the regulation of mostly privately owned utilities and the additional advantage, at least from the perspective of empirical work, that state regulators were responsible for rate setting and reviews in some network industries. This diversity of regulators was a source for a number of studies evaluating economic regulatory outcomes.[4]

[1] Privatisation has led to a rapid increase in the number of regulatory agencies. See Jordana et al. (2011) for details.
[2] Brown et al (2006) discusses the wider range of tasks faced by regulators but broadly speaking these tasks can be classified as either pertaining to the "rate review" category or related to reporting or accountability requirements.
[3] Note that the 'regulator' is defined broadly here. Sometimes rate reviews and customer complaints are handled by different agencies. E.g. in Australia, Germany, Spain and the U.K., the electricity regulator deals with rate reviews and Ombudsmen with complaints. In the Scandinavian countries and in the U.S. the electricity regulator deals with both tasks. However, this difference is irrelevant for the analyses in this paper as long as regulatory dispute resolutions can be appealed.
[4] For example, see Dal Bo (2006), Cleaver (2007), DeFigueiredo and Edwards (2007), Davis and Muehlegger (2010), Knittel (2003), Klein and Sweeney (1999), Ross (1985), and Primeaux Jr and Mann (1986).

While the focus on U.S. regulatory outcomes and, in particular, on rate reviews, is understandable from both the viewpoint of relevance and a practical perspective due to data availability,[5] it ignores an important aspect of how regulators influence market behaviour through complaint management. This may be a serious omission since rate reviews and customer complaints have fundamentally different implications. In contrast to rate reviews, both the consumer and the firm can often appeal the outcome of a dispute. Moreover, the relative stakes involved for firms and customers are different for rate reviews and complaints. A small adjustment of the rates will have a substantial impact on the firm's financial status whereas it will affect the average customer's budget only marginally. The opposite situation applies for many customer complaints. Both of these differences may affect the regulator's decision incentives and preferences. Prendergast (2007) shows that when a bureaucratic mistake is causing relative harm to the consumers (such as when the consumer's stake is higher), bureaucrats will adopt pro-consumer preferences. In a situation in which a mistake results in relative benefit to the consumer, the bureaucrat will instead adopt more pro-firm preferences. One may interpret consumers' restricted ability to appeal rate reviews and full rights to appeal complaints as supportive of Prendergast's prediction in the context of regulatory oversight. From this, one can hypothesise that regulators responsible for reviews (complaints) have preferences that are relatively pro-firm (pro-consumer).[6]

To build a model and form expectations regarding regulatory outcomes for customer complaints we need to establish some of the characteristics associated with the problem. The first characteristic we emphasis is that regulatory effort is endogenous. One of the fundamental premises of the principal-agent literature is that there is a complex relationship between the choice of effort, the cost of effort and outcomes.[7] While this is well-established in the theoretical literature, previous empirical investigations of regulatory behaviour have assumed that the choice of effort is exogenous. In this paper, we take advantage of a unique dataset containing customer disputes from the Swedish electricity market to incorporate an innovative measure of regulatory effort in explaining regulatory decisions. More specifically, we use a stochastic frontier methodology where we interpret the strictly

[5] With the increasingly availability of data elsewhere, there is an increasing body of literature evaluating regulatory decisions outside the U.S. See, for example, Breunig and Menezes (2011) and Breunig, Hornby, Menezes and Stacey (2006) for Australia, Silva (2011) for Brazil, and Smyth and Söderberg (2010) for Sweden.
[6] Smyth and Söderberg (2010) found that the Swedish electricity regulator generally had pro-consumer preferences when it resolved customer complaints.
[7] See, for example, the seminal work of Laffont and Martimort (2002) for a broad exploration of the principal-agent literature and Laffont and Tirole (1983) for its application in the context of rate setting.

positive disturbance term as effort. This effort may be influenced by exogenous factors such as workload, case complexity and customer and utility types.

The second characteristic that we elaborate on is the regulator's objective(s). In addition to the pigovioun notion that bureaucrats work in the best interest of the public, economic theory has suggested alternative motivations for the regulator such as to maximise the size of the agency (Niskanen, 1971) or the possibility that she is captured by an interest group (Stigler, 1971).[8] More contemporary literature, which often include the possibility of appeals, suggests that both legal and bureaucratic decisions can be explained by decision-makers' willingness to avoid errors (Daugherty and Reinganum, 1999; Heiner, 1986; Leaver, 2009; Shavell, 2006) and that bureaucrats are influenced by their own or some higher level individual's/institution's ideological preferences (e.g. an appointing or legislate institution) (see Hauge et al., 2010; Guerriero, 2006; Innes and Mitra, 2011, Menezes and Roessler, 2010).[9] These views have been justified by the desire of individuals to keep their jobs, advance in their career or, more generally, care about their reputation (Hilton, 1972; Berry, 1984; Leaver, 2009; Levy, 2005; Eckert, 1981).

We build on these principles by constructing a model in which both customers and utilities can appeal regulatory decisions. In our benchmark model, we assume that the regulator only cares about her career. This implies that she will make decisions in order to minimise the likelihood that any mistakes will be exposed. The possibility of regulatory mistakes being explicitly exposed to review is a novel feature of our analysis and follows from the setting we invoke where both the customers and the regulated firms can appeal the regulator's decisions. A regulator who makes mistakes will find it more difficult to be reappointed or to secure career progressions. In an extension, we allow the regulator to care about both error minimisation and consumer surplus. In this setting, we return, at least partly, to the pigouvian notion that at some basic level regulators want to improve social well-being.

The factor that determines the regulator's type is the amount of experience the regulator has resolving disputes. When the regulator starts resolving disputes, we assume she only cares about her career. This assumption seems reasonable given that continued responsibility for resolving disputes normally

[8] In this tradition, Ross (1984) develops a model where the regulator maximises a weighted combination of producer and consumer surplus. Valentini (2006) extends this model by relaxing the assumption of a perfectly informed regulator when utilities are subject to price-caps. Macher and Mayo (2012) have recently extended the capture theory by linking the degree of firm influence to wider firm, industry and country specific determinants.
[9] However, Candeub and Brown (2008) find that regulators' idiosyncratic preferences are more determinative than ideological preferences.

hinges on the regulator being able to avoid court reversals.[10] As the regulator learns the preferences of the litigants and the court she will not be monitored as intensively and she will be less concerned about the judgement made by her peers. Following the relatively higher stakes for consumers and the findings by Prendergast (2007) outlined earlier, we propose that this may lead to the regulator pursuing a mixture of objectives, including both error minimisation and consumer surplus.

The possibility of a mistake arises from the existence of asymmetric information; the regulated firm knows its true cost but the regulator only knows the distribution from which the cost is generated. The regulator can find out the firm's true cost by exerting costly effort. Once the regulator has chosen her level of effort, she then decides what price to set. At this stage, both the customer and the firm will appeal to an administrative court under different scenarios. For example, a regulated firm will not appeal when a high price is set and similarly a consumer will not appeal when a low price is set. Finally, we assume that the court uncovers the firm's true cost.

This theoretical framework allows us to make a number of testable predictions which will depend, in a predictable manner, on the regulator's preferences. In particular, when the regulator is only concerned about her career, we show that, under certain conditions, a larger number of decisions will be overturned by the court when cases are more complex than in situations in which the case is less complex. We also show that when the regulator cares about both her career and about consumer surplus, less complex cases will be associated with more appeals by regulated firms but fewer decisions will be overturned and prices will be lower. As the complexity of the case increases, we predict a switch to more appeals by consumers, more decisions being overturned and higher prices on average. These theoretical predictions are generally confirmed in our empirical analysis on Swedish electricity sector data. One additional theoretical prediction of importance, which is also confirmed empirically, is that regulators who care about both their careers and consumer surplus will exert less effort when cases become more complex.

The conceptual framework of regulatory behaviour outlined above is related to that of Leaver (2009). Leaver argues that regulators genuinely try to make good decisions but that they also care about their reputation and want to avoid being caught making mistakes. However, a pro-consumer regulator is unlikely in her model since a regulatory mistake can only be detected by the firm and a rate increase

[10] We provide support for this claim using descriptive statistics in section 3.1. As we explain in section 3. We consider a situation where there is a pool of civil servants who may serve as regulators at any given time.

has a much higher impact on the firm's budget than on the average customer's budget. Leaver (2009) finds that these conditions imply that regulated firms receive undue favours. The assumption that the regulator cares about its reputation is similar to our model, but the conditions under which the regulator operates are distinct. Moreover, our theoretical predictions are distinct from Leaver (2009) as we elaborate in Section 2.

Our model can additionally be related to judicial decision models or, more specifically, to models based on first-stage trial/district court judges subject to the threat of review by an appellate court. Shavell (2004, 1995) emphasises that first-stage judges want to avoid having their decisions reversed and that they can increase the accuracy of their decisions by exerting more effort. In our model, the focus is on how the regulator's decision and her choice of effort is influenced by the possibility of appeal when there exist different regulatory objectives.

The paper proceeds as follows. Section 2 presents a simple model that highlights the role of regulatory preferences in identifying the interrelations between effort, the cost of effort and the decision outcome. Section 3 contains a description of the regulatory setting in the Swedish electricity sector. Section 4 contains our empirical investigation and section 5 concludes.

2. A SIMPLE THEORY OF REGULATORY BEHAVIOUR UNDER COURT ENFORCEMENT

We assume there are two types of utilities that differ based on unitized costs: high cost (c_H) and low cost (c_L). The fraction of c_H firms in the population is equal to q whereas the fraction of c_L firms is equal to $1-q$. We assume the following sequence of events. A utility sets the price to charge the consumer either at c_L or at c_H. If the price is set to c_H we assume that the consumer complains to the regulator,[11] otherwise there are no further developments. Consumer's demand is equal to 1 at a price less than or equal to c_H and zero otherwise.

When the regulator receives a complaint, it has to determine a regulated price, p^R. We assume that the regulator does not know the utility's true cost but she can find out the true cost by exerting some

[11] Note that we could assume the decision is probabilistic but it will simply complicate matters without providing any additional insight.

effort. Denote effort by $E = \{0, \varepsilon\}$. If the regulator exerts effort $\varepsilon > 0$, she fully learns the true cost of the firm. Let the cost of effort be given by $C(E) = E$. By exerting zero effort, the regulator assumes that any low cost utility will pretend to be high cost. More precisely, if the regulator exerts zero effort, then all she knows is that the utility's true cost is c_H with probability q.

Once the regulator has chosen her level of effort, she then decides what price to set. We assume that when she sets $p^R = c_H$, the consumer appeals to the court with probability γ and when she sets $p^R = c_L$, a high cost utility appeals to the court with probability δ, where $\delta < \gamma$.[12] It should be noted that, while there are no explicit appeal costs imposed on either consumers or the utility in the model, the fact that both δ and γ can take values less than one could conceivably capture such costs. Finally, we assume that the court will uncover the true cost of the utility.

2.1 Benchmark model

Initially, we consider a regulator who is self-interested; that is, her only concern is that the court does not overturn her decision. We argue that this self-interest arises from her career concerns (later we will introduce a regulator who also cares about consumer surplus). Here, we assume that the utility of the regulator when a decision is not overturned by the court is $\overline{U} > 0$ and when her decision is overturned her utility is equal to $-\Gamma < 0$. Proposition 1 summarises the regulator's decision in this setting.

Proposition 1. *Suppose*

$$\frac{q}{1-q} > \frac{\gamma}{\delta}. \tag{1}$$

That is, the 'hazard rate' is greater than the ratio of the probability of appeal by the consumer to that of the utility. Then for sufficiently high cost of effort, or more specifically, if $\varepsilon > \gamma(1-q)\left[\overline{U} + \Gamma\right]$, the regulator always chooses zero level of effort and sets $p^R = c_H$. If $\varepsilon < \gamma(1-q)\left[\overline{U} + \Gamma\right]$, then the regulator always chooses $p^R = c_H$ and $E = \varepsilon$.

[12] This assumption captures the notion that while the interaction of the consumer with the court is a one-off, the regulated company's relationship with the court and the regulator is more complex as it takes the form of a repeated game. Frequent appeals might tarnish a regulated company's reputation -- especially if the outcome of the appeal is unfavourable. This naturally results in regulated firms being more cautious when deciding to appeal. There are also costs associated with appealing and in reality there is some uncertainty about the court's decision which is not considered in this model. This relationship is also expected based on Priest and Klein (1984) since consumers have higher stakes than utilities. This assumption is borne out by the data as described in Table 5 in Section 4.4 (at least for medium and high levels of effort).

Proof. See Appendix 1.

The following corollary follows in a straightforward manner from Proposition 1 and provides some novel propositions that will later be tested using our data on regulatory and court decisions from the Swedish electricity market.

Corollary 2. *When a regulator is only concerned about her career and (1) holds, for a sufficiently high cost of effort (i.e. in more complex cases), Proposition 1 implies that more decisions will be overturned by the court than in the case of less complex cases.*

2.2 An alternative objective for the regulator

We now consider an alternative type of regulator who cares about both her career and the level of consumer surplus. In this setting, consumer surplus is simply equal to the difference between the consumer's valuation and the cost of service provision. Proposition 3 establishes that, with this type of regulator, we should observe more appeals by the regulated firm and a larger number of overturned decisions. In addition, such a regulator will choose a lower regulated price than a regulator who cares only about her career.

Proposition 3. *Suppose that*

$$\overline{U} > \Gamma + \frac{(1-q)(1-\gamma)(c_H - c_L)}{(1-q)\gamma + \delta q} \quad . \tag{2}$$

Then under the assumptions of the model a low cost of effort will be associated with more appeals by the regulated firms but less decisions being overturned and lower prices. Conversely, as the cost of effort increases, we predict a switch to more appeals by consumers, more decisions being overturned and higher prices on average.

Proof. See Appendix 1.

Proposition 3 suggests that as the cost of effort increases (for example, in more complicated cases), the regulator switches to zero effort and sets $p^R = c_H$. Thus, we predict that less complex cases will be associated with more appeals by regulated firms but less decisions being overturned and lower prices.

Conversely, as the complexity of the case increases, we predict a switch to more appeals by consumers, more decisions being overturned and higher prices on average. The following corollary follows in a straightforward manner from this anaylsis.

Corollary 4. Suppose $\overline{U} < \frac{1-\delta}{\delta}(c_H - c_L) - \Gamma$. Then whenever condition (2) is satisfied and positive effort is exerted, the regulator sets $p^R = c_L$ independently of the realisation of costs. This will lead to the court overturning the regulator's decision upon an appeal by the regulated firm but no appeals will be made by consumers. This is more likely to happen when the difference between high and low cost is low, or when the disutility cost for the regulator is high, or when the benchmark utility $\overline{U}$ is low.

3. CUSTOMER COMPLAINTS IN THE SWEDISH ELECTRICITY SECTOR

In the Swedish electricity distribution sector, customers can file complaints to the regulator regarding the contract conditions determined by local monopolistic utilities. Based on its investigations, the regulator either confirms the conditions in full or withholds a proportion of the utility's 'benefits' – e.g., the price when the contract concerns a monetary transfer. Either the customer or the utility can appeal the regulator's decision to the County Administrative Court (the 'court'). The court then decides whether to confirm the amount determined by the regulator, or to change it in favour of the appealing agent. Here, we focus solely on connection disputes that arise when customers complain about the price quoted by utilities for establishing a new connection to the existing network. Focusing on one type of dispute eliminates the need to consider case type heterogeneity.[13]

In this setting, the regulator is the individual who is responsible for making the final decision about the amount the utility is allowed to charge the customer. This individual is a civil servant employed by the Swedish Energy Markets Inspectorate who is appointed by the Director General to resolve disputes. There are several individuals that can serve as regulators at any given point in time and Smyth and Söderberg (2010) found that regulators that decide against consumers face a higher probability of being replaced.[14] This is consistent with the arguments presented in Section 2 where we argued that regulators are inclined to develop a pro-consumer attitude when resolving disputes. It should also be

[13] In this study we distinguish between two different connection types: 1) connection of mobile antennas and 2) connection of residential/industry properties.

[14] Smyth and Söderberg (2010) studied what factors influence the Director General's (DG) decisions to replace regulators when resolving disputes.

pointed out that while the DG is appointed by the national parliament, s/he has no official party or ideological affiliation and, likewise, there are no clear ideological influences in appointing/replacing the regulators. This suggests that an ideological dimension in the regulator's decision-making may not be central in the cases we consider. Hauge et al. (2010), Guerriero (2006) and Innes and Mitra (2011) examine in detail the impact of the regulator's ideological preferences on decisions.

3.1 Data

We use information on decisions related to connection disputes made by the regulator from 2002 to 2009, providing a total of 409 observations. The majority of the decisions were made during 2007-2009 with only 29 decisions being made between 2002 and 2006.[15] The regulator withheld a proportion of the utilities' claim in as many as 81% of the complaints raised by customers. The average ratio between the amount awarded by the regulator (P^R) and the utility's claim (P^U) is 0.708, indicating a noticeable impact being made by the regulator. With $A=1$ denoting an appeal and *n* being the sample size, Table 1 shows that customers (utilities) have appealed 23% (38%) of the regulator's decisions, resulting in well over half of the regulator's decisions being appealed to the court.[16] Not only do utilities appeal more, they also appear to be more successful in court with 26% of their decisions being reversed in their favour. The corresponding number for customers is 16%. When customers appeal the court sets its average amount to $P^C = 0.96P^R$, and when the utilities have appealed it sets its average price to $P^C = 1.09P^R$.

Table 1. Descriptive statistics for appeals and court responses.

	$n^{-1}\sum_{i=1}^{n} A$	$\Pr(P^C \neq P^R \mid A=1)$	$P^C / P^R \mid A=1$
Customers appeal ($A^{Cu}=1$)	0.227	0.161	0.959
Utilities appeal ($A^{Ut}=1$)	0.384	0.261	1.093
All appeals	0.611	0.224	1.043

Sample: 409 complaints filed by customers.

[15] Excluding those 29 decisions does not change any of the qualitative conclusions presented in this paper.
[16] It should be clear that this data does not contradict our assumption that the probability of appeal by high cost utilities is lower than the probability of appeal by consumers. The data simply reflects that the probability of appeal by all firms (of different types) is greater than the probability of appeal by consumers.

A key claim in this paper is that regulators who are relatively inexperienced only care about error minimisation, whereas more experienced regulators care about both error minimisation and consumer surplus. One of the predictions found in Section 2 is that when regulators become more experienced and start caring about both errors and consumer surplus, the court will reverse a larger share of their decisions. To scrutinise this claim empirically, it is necessary to have some prior knowledge of when a regulator can be considered experienced. The simplest approach would be to assume a linear relationship between experience and the number of decisions made (or a similar variable like time since first decisions). However, the assumption that experience increases at a constant rate is strong and, in addition, our theoretical model is based on comparing two states; "little" and "much" experience. Graphical representations of the relationship between the share of court reversal and the number of decisions made by the regulator can provide an indication as to whether the relationship is in fact positive, as we claim in our theoretical model, and help guide the empirical classification of regulators by type.

Figure 1a shows the share of regulatory decisions reversed by the court as a function of the total number of decisions made by each of the nine regulators during the sample period. The relationship does indeed appear to be positive and non-linear. One regulator has conducted substantially more decisions than all the other regulators (over 300 decisions, which can be compared to approximately 75 decisions for the regulator that has made the second most). However, excluding that regulator indicates that the relationship is still positive (displayed in Figure 1b). In Figure 2 we plot the same relationship but now we look at the share of regulatory decisions being reversed when the regulators have made 1-25 decisions, 26-50 decisions, and so on, up until 200 where we use 50-classes (201-250 and 251-300). Keeping in mind that all observations above 75 decisions have been generated by one individual, Figure 2 shows that there appears to be a structural break around 175 decisions where the reversal rate starts increasing at what appear to be a linear rate.

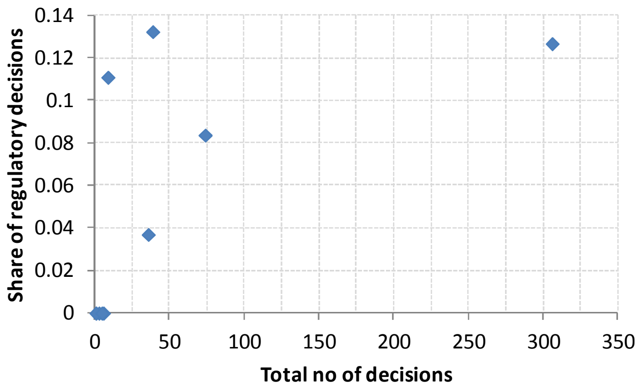

Figure 1a. Share of regulatory decisions reversed by the court.

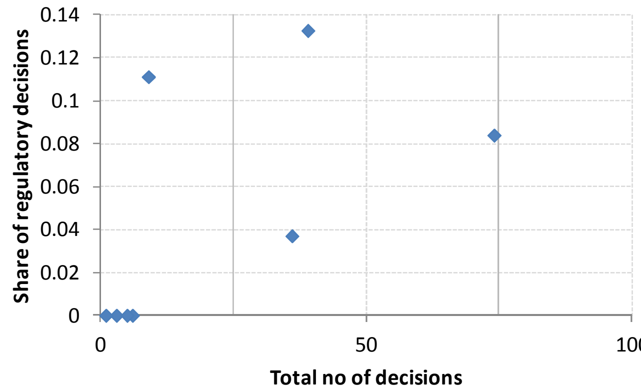

Figure 1b. Share of regulatory decisions reversed by the court (restricted to regulators that have made less than 100 decisions in total).

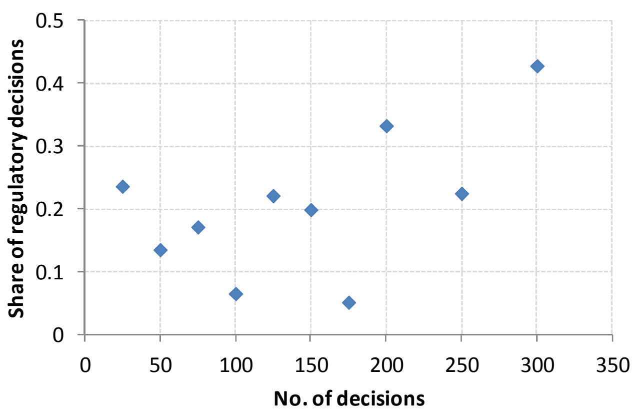

Figure 2. Share of regulatory decisions reversed by the court.

Since we are reluctant to form an opinion based on the behaviour of one regulator we set the threshold between 'inexperience' and 'experience' at 50 decisions. Hence, we define a regulator who only cares about error minimisation as someone who has been responsible for less than 50 decisions. This means that two regulators will be included in the sub-sample where the regulator cares about both errors and consumer surplus. In the empirical section we indicate whether the regulator is inexperienced with the dummy variable *Car*. We include a sensitivity analysis with respect to the definition of *Car* in Table A2 in the Appendix. It can be observed that the signs of the relevant coefficients are identical when an experienced regulator is defined to have made from 50 to 150 decisions. Hence, our results are not particularly sensitive to how *Car* is defined.

Another core variable in this study is case complexity. Similar to effort, complexity is unobserved. Kaheny el al., (2008) used number of document pages to represent complexity. The obvious issues with using this as a proxy are that different writers use different writing styles and background information included in judicial decisions is sometimes merely copied from earlier cases. Clermont and Eisenberg (2002) use review time as a proxy for complexity but as we show in this study, there are several factors unrelated to complexity that have a significant impact on review time. Hence, both these measures appear to be questionable proxies and raise endogeneity concerns. Instead, we propose using the number of precedents to represent case complexity. As the number of precedents is clearly exogenous in relation to the present case, and since all precedents must be considered by the regulator and the court, it provides a more straightforward econometric solution and it is a more objective measure of case complexity than both the number of pages and review time. Following Fon and Parisi (2006), we expect a rich availability of precedents to increase complexity. This is plausible in our case where there is a large degree of diversity of outcomes in the precedent cases.

To be precise, we define complexity as the total number of precedents that have to be considered for each decision (*Cplex*). A precedent is defined as a case decided by the Court in the past that is of the same type as the present case. That means that when the Court has made a decision regarding a dispute about the connection of a residential/industry property, the regulator has to consider one more precedent in all its subsequent decisions of that type.

Information about each case is drawn from the case files that have been provided by the Swedish Energy Markets Inspectorate (EMI). Additional information was collected from annual regulatory statistics (also collected from the EMI) and firms' annual reports. Descriptive statistics for all variables are given in Table A1 in Appendix 2.

4. EVIDENCE

In Section 4.1 we estimate regulatory effort and determine its functional properties. Section 4.2 investigates the decisions of both customers and utilities to appeal the regulator's decisions. Section 4.3 provides the court's response functions conditioned on appeals. Finally, Section 4.4 summarises the empirical findings and investigates how consistent these are with the theoretical predictions of section 2.

4.1 Regulatory effort

Effort E_i exerted by the regulator in case *i* is naturally unobserved. However, as a starting point, we suggest that more E_i requires longer review time (*RevT*$_i$).[17] Other factors that may affect review time include workload, case complexity, customer and utility types, regulatory experience, and regulator and year fixed effects. The regulator fixed effects capture, for example, individuals' variation in ability. Lax and Cameron (2007) have suggested that workload might also have a direct effect on effort since decision-makers might respond to higher workload by conducting quicker, less thorough investigations. Thus, to circumvent this endogeneity problem, we replace workload with a variable representing the number of days since the Swedish electricity market was deregulated (*Days*) and a dummy for cases representing connection of mobile antennas (*Ant*).[18] Workload has increased steadily during the period of deregulation, while the connection of mobile antennas is more readily reviewed due to a relatively high degree of standardisation.[19] An indicator variable (*CustC*) is included that takes the value 1 when the customer is a corporation. The generally held opinion among regulators is that corporations provide higher quality input to a case than that of a private individual. Finally, the variable *NoDec*, which represents total number of decisions made by the responsible regulator, is included to control for more experienced regulators conducting faster reviews. We place these additional (non-core) variables in the vector **X** and formulate the function as $RevT_i = f(\mathbf{X}_i, \boldsymbol{\alpha}) E_i \exp(v_i)$, where $f(\cdot)$ is a multiplicative function and v_i is the random noise. Taking the natural logarithm yields

$$RevT_i^T = \alpha_0 + \mathbf{X}_i^T \boldsymbol{\alpha} + E_i^T + v_i, \tag{3}$$

where superscript *T* denotes a natural logarithmic transformation. Ordinary least squares (OLS) is not an appropriate method to estimate the unknown parameters because the random term mixes E_i^T and v_i. However, when a distributional assumptions are imposed on both E_i^T and v_i, they can be econometrically disentangled from each other. Here we assume that E_i^T and v_i are independent where v_i is normally distributed with mean equal to zero and variance σ_v^2 and E_i^T is exponentially

[17] Prendergast (2003) claims that effort and review time are positively correlated.

[18] The Swedish electricity market was deregulated on the 1st of January 1996.

[19] We also evaluated the model with workload included as a regressor (calculated as the number of decisions made during the previous 12 months), and found the same qualitative results.

distributed with variance $\sigma^2_{E_i^T}$.[20] The implication of this distributional assumption is that the regulator always exerts a positive effort, and that low values of effort are more likely than high values. Since the mean and standard deviation are identical for the exponential distribution one can interpret an increase in $\sigma^2_{E_i^T}$ as an increase in E_i^T. We define $\sigma^2_{E_i^T}$ to be a function of the regulator's objective (*Car*), case complexity (*Cplex*) and other exogenous shocks (**W**):

$$\sigma^2_{E^T,i} = \exp(\beta_0 + \beta_1 Car_i + \beta_2 Cplex_i + \beta_3 Car_i Cplex_i + \mathbf{W}_i \boldsymbol{\lambda}) . \quad (4)$$

The inclusion of *Cplex* follows from our theoretical prediction. The interaction between *Car* and *Cplex* allow us to investigate whether regulators with different objectives respond differently to complexity. Because *Cplex* is included in both (3) and (4) there is a risk that the estimated parameters will appear implausible; e.g. by being incorrectly signed.[21] However, multicollinearity problems were not detected. When we exclude *Cplex* in either (3) or (4), we only observe marginal adjustments to the mean and standard error of the *Cplex*-parameter in the other model.

In **W** we include behavioural aspects of the regulatory process that may affect *E*, such as learning and negotiating power. First, we include *Days* and *Ant* that represents number of days since the electricity sector was deregulated and an indicator for connection of mobile antennas. *Days* captures broad learning effects and the interaction term between *Days* and *Ant* controls for specific learning in that sub-class of cases. Second, we include an indicator variable, *ThreeL*, which takes the value 1 when the utility is one of the three largest.[22] The largest utilities are also more inclined to appeal compared to smaller utilities which may have an effect on the regulator's level of effort. When customers are corporations (*CustC*), rather than private persons, they have more negotiating power relative to the utilities and as they have greater access to financial and legal resources, this could result in higher quality information to the regulator. Finally, regulator fixed effects are included. The joint estimation of (3) and (4) is displayed in Table 1. Panel (a) displays the results of the full specifications. Panel (b) shows a reduced specification that only includes parameters that were significant at the 10% level after stepwise elimination.

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[20] Alternative distributional assumptions, e.g. half-normal and truncated normal, did not converge.

[21] While not resulting in biased estimates, multicollinearity can generate parameters that are wrongly-signed (Farrar and Glauber, 1967).

[22] The Swedish electricity distribution sector consists of three dominating utilities that distributed X% of the total electricity on the low voltage networks in 2009.

Both Panels (a) and (b) in Table 1 show that the coefficient associated with *Cplex* is negative and significant at the 5% level in (4), implying that increased case complexity reduces effort when the regulator cares about both errors and consumer surplus.[23] Hence, although our theoretical prediction that increased complexity can reduce effort may seem unintuitive, we find strong empirical support for this. We use the predicted values of effort, $\hat{E}_i^T$ in our subsequent analyses of appeals and the court's response to appeals.[24]

Table 1. Estimation output for equations (3) and (4).

	(a)				(b)			
	Eq. (3)		Eq. (4)		Eq. (3)		Eq. (4)	
Variable	**Mean (S.E.)**		**Mean (S.E.)**		**Mean (S.E.)**		**Mean (S.E.)**	
Days	-0.5460 (2.2512)		21.189 (9.1193)	**			18.208 (6.0560)	***
Ant	4.2128 (15.709)		-9.8601 (2.0735)	***	2.7742 (0.0742)	***	-10.322 (4.2196)	***
*Ant*Days*	-0.1764 (1.8733)							
Car			2.8292 (3.3659)				1.6035 (0.8382)	**
Cplex	0.3472 (0.1176)	***	-1.2497 (0.5595)	**	0.3590 (0.0679)	***	-1.0536 (0.4644)	**
*Car*Cplex*			-0.2542 (1.0320)					
ThreeL			0.2323 (0.4219)					
CustC	0.0177 (0.1091)		1.1353 (0.7922)					
NoDec	0.0256 (0.0186)							
Constant	10.097 (17.399)		-171.53 (74.306)	**	5.8862 (0.1510)	***	-147.01 (48.921)	***
Regulator fixed effects	Yes		Yes		Yes		Yes	
Year fixed effects	Yes		No		Yes		No	
Sigma (v)	0.1393 (0.0077)	***			0.1400 (0.0074)	***		
Log likelihood	-36.287				-38.851			
No. obs.	409				409			

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

[23] The net effect of case complexity for regulators who only cares about error minimisation is also negative but it is not significant at any reasonable level.

[24] See Stata Manual v. 11, p. 503 for details on how $\hat{E}_i^T$ is estimated.

4.2 Appeals

We set the binary variable A^k to indicate whether the regulator's decision is appealed, where *k* is *Cu* (*Ut*) when an appeal is made by a customer (utility). In section 2 we claimed that when regulators only care about avoiding errors and when they exert high effort, it is more likely that customers appeal. We also established that when regulators care both about avoiding errors and consumer surplus, the probability of an appeal will be a function of effort. Thus, A^k will be a function of *E*, *Car* and the interaction between them:

$$A_i^k = \gamma_0^k + \gamma_1^k \hat{E}_i^T + \gamma_2^k Car_i + \gamma_3^k \hat{E}_i^T Car_i + \mathbf{Z}_i \boldsymbol{\pi}^k + u_i^k \quad (5)$$

In the **Z** vector we include variables representing the regulator's judgement and litigants' relative cost of litigation. To capture the deviation between the regulator's assessment and a utility's initial claim, we create a variable by taking the ratio between the amount awarded by the regulator P^R and the amount charged by the utility, P^U. Taking $\frac{P^R}{P^U}$ eliminates the influence of any basic cost drivers such as transformers and line lengths for which the regulator has long since established templates that, to a large extent, are accepted by the utilities. One would expect customers to be more inclined to appeal for high levels of $\frac{P^R}{P^U}$, whereas the opposite holds for the utilities. A dummy variable representing customers that are corporations (*CustC*) is added since it has been claimed that corporations have a lower opportunity cost of litigation than private persons (Söderberg, 2008). Similarly, the largest utilities have more legal resources than those that are smaller. Thus, we include a dummy variable that captures when the utility is one of the three largest (*ThreeL*). Year and regulatory fixed effects are not included since they cause the model to be over-specified. We estimate (3) using both linear probability (OLS and 2SLS) and probit (with and without instrumental variables) models.

There are a few challenges involved in estimating (5). First, standard errors are underestimated by OLS because $\hat{E}_i^T$ is an estimated variable. To circumvent this problem, we estimate standard errors using a bootstrap method with 500 replications. Second, A_i^k and $\frac{P^R}{P^U}$ may both be affected by unobserved case and regulator characteristics. Thus, we use the number of customers affected by the connection (*NCon*) and low voltage line length required for the connection (*LowL*) as instruments for

$\frac{P^R}{P^U}$. *NCon* is a characteristic of a network connection that the regulator has relatively good information about and because the regulator has extensive access to engineering expertise, it often takes a different view to utilities. Moreover, these alternative views are rarely questioned by the utilities. The results from these estimations are presented in Table 2 for when customers appeal and in Table 3 for when utilities appeal.

Table 2. Estimation output of customers' decision to appeal.

Variable	OLS		OLS		2SLS		probit		IV-probit	
	Mean (S.E.)		**Mean (Boot. S.E.)**		**Mean (Boot. S.E.)**		**Mean (S.E.)**		**Mean (S.E.)**	
$\hat{E}^T$	-0.0064		-0.0064		-0.0090	*	-0.0168	**	-0.0169	***
	(0.0037)		(0.0049)		(0.0050)		(0.0066)		(0.0063)	
Car	-0.0250		-0.0250		-0.0314		-0.0375		-0.0381	
	(0.0330)		(0.0967)		(0.1109)		(0.0251)		(0.0257)	
$\hat{E}^T \times Car$	0.0100	***	0.0100		0.0117		0.0200	***	0.0198	***
	(0.0025)		(0.0072)		(0.0074)		(0.0067)		(0.0070)	
Pr/Pu	0.4866	***	0.4866	***	0.8032	*	0.4529	***	0.5202	*
	(0.0674)		(0.0887)		(0.4522)		(0.0552)		(0.2966)	
CustC	0.2464	***	0.2464	***	0.2451	***	0.2655	***	0.2615	***
	(0.0231)		(0.0529)		(0.0722)		(0.0411)		(0.0373)	
ThreeL	-0.1579	***	-0.1579	**	-0.1607	**	-0.1338	***	-0.1326	***
	(0.0387)		(0.0719)		(0.0774)		(0.0324)		(0.0337)	
Days	9.6E-6		9.6E-6		2.2E-5		3.8E-5		3.0E-5	
	(8.5E-5)		(7.9E-5)		(9.4E-5)		(1.3E-4)		(1.4E-4)	
Constant	-0.2035		-0.2035		-0.2854					
	(0.3541)		(0.3465)		(0.3293)					
Sargan P>χ^2					0.471					
R^2	0.226		0.226		0.196		0.240			
Log likelihood	-172.29		-172.29		-180.16		-166.67		-137.84	
No. obs.	409		409		409		409		409	

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. S.E. clustered over 7 regulators. Marginal effects reported for probit and IV-probit, with S.E estimated using the Delta method. Constants were included in main estimation but are not reported when marginal effects are estimated.

Table 3. Estimation output of utilities' decision to appeal.

Variable	OLS Mean (S.E.)	OLS Mean (Boot. S.E.)	2SLS Mean (Boot. S.E.)	probit Mean (S.E.)	IV-probit, Mean (S.E.)
$\hat{E}^T$	0.0025	0.0025	0.0020	0.0028	0.0023
	(0.0064)	(0.0079)	(0.0077)	(0.0060)	(0.0059)
Car	-0.0120	-0.0120	-0.0133	-0.0280	-0.0296
	(0.0401)	(0.0855)	(0.0918)	(0.0425)	(0.0386)
$\hat{E}^T \times Car$	-0.0061	-0.0061	-0.0033	-0.0039	-0.0036
	(0.0056)	(0.0046)	(0.0037)	(0.0053)	(0.0041)
Pr/Pu	-0.6593 ***	-0.6593 ***	-0.5962	-0.6195 ***	-0.5626
	(0.0541)	(0.0651)	(0.4194)	(0.0322)	(0.4188)
CustC	0.1804 **	0.1804 **	0.1802 **	0.1741 ***	0.1766 ***
	(0.0506)	(0.0745)	(0.0823)	(0.0413)	(0.0576)
ThreeL	0.0204	0.0204	0.0198	0.0124	0.0120
	(0.0349)	(0.0584)	(0.0702)	(0.0342)	(0.0333)
Days	-2.7E-4 ***	-2.7E-4 ***	-2.7E-4 ***	-2.9E-4 ***	-3.0E-4 ***
	(5.1E-5)	(6.8E-5)	(7.5E-5)	(6.0E-5)	(8.1E-5)
Constant	1.8835 ***	1.8835 ***	1.8672 ***		
	(0.2275)	(0.2894)	(0.3828)		
Sargan P>χ^2			0.563		
R^2	0.207	0.207	0.206	0.174	
Log likelihood	-238.09	-238.09	-238.33	-224.95	-196.13
No. obs.	409	409	409	409	409

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. S.E. clustered over 7 regulators. Marginal effects reported for probit and IV-probit, with S.E estimated using the Delta method. Constants were included in main estimation but are not reported when marginal effects are estimated.

One general conclusion from the output presented in Tables 2 and 3 is that both linear probability models (LPMs) give comparable results. However, the probit models are more efficient. A Wald-test of exogeneity following the estimation of the IV-probit rejects the hypothesis that $\frac{P^R}{P^U}$ is endogenous. Based on this we use the standard probit estimates in Section 4.4 where we compare our theoretical predictions to the empirical evidence.

4.3 Court's response to appeals

We use the ratio of the amount awarded by the court (P^C) and the regulator (P^R) as our dependent variable. In section 2 it is claimed that the court responds differently depending on whether it is the consumer or the utility that appeals. Thus, the court's decision is estimated separately for consumer appeals and utility appeals. Moreover, in our theoretical analysis it is postulated that $\frac{P^C}{P^R}$ is affected by the regulator's objective and effort. Hence, just as in (3) we use *E*, *Car* and the interaction between them as our primary variables of interest. A vector **K** is added with additional exogenous shocks:

$$\frac{P^C}{P^R} = \delta_0^k + \delta_1^k \hat{E}_i^T + \delta_2^k Car_i + \delta_3^k \hat{E}_i^T Car_i + \mathbf{K}_i \boldsymbol{\theta}^k + \varepsilon_i \quad (6)$$

where $k \in \{Cu, Ut\}$. The vector **K** includes a measure of days since the market was deregulated (*Days*). Regulator and year fixed effects are again excluded to avoid over-specification when estimation equation (6).

Since (5) and (6) represent sequential stages in the regulatory process it is possible that u_i and ε_i are correlated, causing the parameter estimates in (6) to be biased. To account for error correlation, we use the Heckman regression model (Heckman, 1976) where the selection stage (5) is modelled using a probit regression and the second stage (6) using a linear regression. Results are displayed in Table 4.

First, we note that the correlation ρ between the error terms in (5) and (6) is significantly different from 0 when utilities appeal, but not when customers appeal. Consequently, we use the OLS estimates when customers appeal and the Heckman outputs when utilities appeal in our comparative analysis.

Table 4. Estimation output of court's response.

	Customers appeal				Utilities appeal			
	OLS		Heckman		OLS		Heckman	
Variable	**Mean (S.E.)**		**Mean (S.E.)**		**Mean (S.E.)**		**Mean (S.E.)**	
$\hat{E}_i^T$	0.0057 (0.0035)		0.0048 (0.0078)		0.0267 (0.0027)	***	0.0287 (0.0036)	***
Car	-0.0103 (0.0205)		-0.0117 (0.0276)		-0.0260 (0.0696)		0.0027 (0.0873)	
$\hat{E}_i^T \times Car$	-0.0061 (0.0041)		-0.0052 (0.0081)		-0.0173 (0.0097)	*	-0.0189 (0.0103)	*
Days	-1.1E-4 (6.7E-5)		-1.1E-4 (6.7E-5)		-4.2E-5 (9.2E-5)		6.5E-5 (1.1E-4)	
Constant	1.4122 (0.2803)	***	1.4152 (0.2746)	***	1.2416 (0.3874)	**	0.9194 (0.4467)	**
ρ			0.0245 (0.2008)				-0.4436 (0.0471)	***
R^2	0.038				0.026			
No. obs.	93		93		157		157	

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. S.E. clustered over 7 regulators.

4.4 Consistency between theory and evidence

The appeal behaviour of customers and utilities, and the court's associated responses, are summarised in Table 5 for instances in which the regulator only cares about her career and in Table 6 for data in which the regulator cares about both her career and consumer surplus. Results in both tables are categorised for effort levels ranging from 1 to 125. The sample range for effort is 1 to 113 and the effort level of 125 is therefore an out-of-sample prediction. We begin by analysing the case in which regulators only care about her career. In Table 5 we observe that a customer's probability of making an appeal is 0.22 for the lowest level of effort. As the level of effort increases the point estimate of customers' probability to appeal increases to around 0.70, but the associated standard errors go up markedly, making the final effect statistically undeterminable. Utilities appeal with probability 0.36 for the lowest level of effort and the probability decreases to slightly below 0.24 for the highest level of effort. Thus, the estimates suggest that the probability of utilities to appeal is negatively related to the value of effort. This indicates that customers are more likely to appeal for high levels of effort than utilities which is consistent with our theoretical findings.

To investigate how the court responds to an appeal we tabulate the predictions of $\frac{P^C}{P^R}$ for both customer appeals and utility appeals. If $\frac{P^C}{P^R}$ is not statistically different from 1 we conclude that the court has not reversed the regulator's decision. To test this, we include the 90% lower and upper confidence interval. When customers appeal, the court only reverses the regulator's decision when the regulator exerts low and medium levels of effort. On the other hand, when utilities appeal it is very likely that the court reverses the regulator's decision. The only exception is for the very highest level of effort where we cannot reject that the hypothesis that $P^R = P^C$. However, it should be noted that a value of 125 for effort is out-of-sample. These findings are largely in agreement with our theoretical predictions given in Section 2.

Table 5. Appeals and court responses when regulator only cares about her career.

Effort	Customer appeals				Utility appeals			
	Pred(A^{Cu}) (S.E.)	P^C / P^R	90% LCI P^C / P^R	90% UCI P^C / P^R	Pred(A^{Ut}) (S.E.)	P^C / P^R	90% LCI P^C / P^R	90% UCI P^C / P^R
1	0.2197 (0.0295)	0.9481	0.9138	0.9824	0.3589 (0.0298)	1.2096	1.0509	1.3682
25	0.3012 (0.0729)	0.9374	0.8981	0.9767	0.3345 (0.0588)	1.4453	1.2230	1.6676
50	0.3969 (0.1785)	0.9262	0.8727	0.9798	0.3099 (0.1041)	1.6909	1.1628	2.2189
75	0.4985 (0.2876)	0.9151	0.8433	0.9869	0.2860 (0.1480)	1.9364	1.0899	2.7829
100	0.6002 (0.3795)	0.9039	0.8123	0.9955	0.2631 (0.1883)	2.1820	1.0147	3.3493
125	0.6957 (0.4375)	0.8927	0.7805	1.0050	0.2412 (0.2243)	2.4276	0.9386	3.9165

Notes: The sample range for effort is from 1 to 113. P^C / P^R values when customers (utilities) appealed based on OLS (Heckman) estimates displayed in Table 4.

When the regulator cares about both her career and consumer surplus (displayed in Table 6), we observe that customers only appeal for very low levels of effort, whereas the utilities appeal with 39% probability when effort is at its lowest and around 70% for the highest levels of effort. The court will reverse appeals from customers when the regulator has exerted low levels of effort but we cannot reject the hypothesis that the court confirms a decision when high effort was exerted. When utilities appeal, the court will always reverse the regulator's decision and the magnitude of the adjustment increases for higher levels of effort. All these findings are consistent with our theoretical predictions presented in section 2.

Table 6. Appeal and court responses when regulator cares about both her career and consumer surplus.

Effort	Customer appeals				Utility appeals			
	Pred(A^{Cu}) (S.E.)	P^C / P^R	90% LCI P^C / P^R	90% UCI P^C / P^R	Pred(A^{Ut}) (S.E.)	P^C / P^R	90% LCI P^C / P^R	90% UCI P^C / P^R
1	0.2375 (0.0205)	0.9645	0.9616	0.9674	0.3906 (0.0119)	1.2257	1.1914	1.2601
25	0.0169 (0.0228)	1.1003	0.9572	1.2433	0.4607 (0.1375)	1.9150	1.7644	2.0656
50	0	1.2417	0.9527	1.5307	0.5351 (0.2936)	2.6329	2.3368	2.9291
75	0	1.3831	0.9482	1.8181	0.6082 (0.4349)	3.3509	2.9080	3.7938
100	0	1.5245	0.9436	2.1054	0.6778 (0.5474)	4.0689	3.4789	4.6589
125	0	1.6660	0.9391	2.3928	0.7418 (0.6214)	4.7869	4.0497	5.5241

Notes: The sample range for effort is from 1 to 113. P^C / P^R values when customers (utilities) appealed based on OLS (Heckman) estimates displayed in Table 4. Pred(A^{Cu}) and its S.E. are <1.0E-6 when effort is ≥ 50.

5. CONCLUSIONS

In this paper we extend the literature on how regulators influence agents' appeals behaviour by theoretically and empirically investigating regulatory decisions, customers'/utilities' decisions to appeal the regulators' decisions and court decisions when customers have filled complaints about charges imposed by monopolistic utilities. Investigations of customer complaints add to our understanding of regulatory behaviour since they are fundamentally different to rate reviews; an area that has received most attention in the literature.

Our purpose is to untangle some of the complex relationships between choice of effort, the cost of effort and regulatory outcomes that the (theoretical) principal-agent literature has claimed characterise the regulatory process. In our investigation, we emphasise two aspects of the regulatory decisions process that have not previous been considered in a study involving both theory and empirics: (*i*) regulatory effort is endogenous since more complex cases increases the cost of effort, and (*ii*) that a regulator always cares about her career (i.e. wants to minimise errors) but sometimes she also cares about consumer surplus. The unusual assumption that a regulator cares about consumer surplus follows from Prendergast's (2007) claim that when customers have relatively higher stakes bureaucrats will adopt pro-consumer preferences.

In our theoretical model we predict that when the regulator is only concerned about her career, a larger number of decisions will be overturned by the court when cases are more complex than in situations in which the case is less complex. We also show that when the regulator cares about both her career and about consumer surplus, less complex cases will be associated with more appeals by regulated firms but fewer decisions will be overturned and prices will be lower. As the case complexity increases, we predict a switch to more appeals by consumers, more decisions being overturned and higher prices on average. An unintuitive prediction for regulators with mixed objectives is that they will exert less effort when cases become more complex. These theoretical predictions are generally confirmed in our empirical analysis.

In the empirical section we adopt an innovative approach to estimate effort based on a stochastic frontier model that has two disturbance terms: one that is strictly positive and one 'standard' disturbance with zero mean and constant variance. The frontier in this model represents the length of a regulatory review with zero effort. The strictly positive disturbance term represents effort and we can determine which factors have an influence on the front and/or the level of effort. We find, for example, that higher case complexity reduces effort when the regulator cares about both her career and consumer surplus. We also offer an alternative definition of case complexity to that used in the previous literature. We use the number of precedents, rather than number of document pages and review time as used in the past, to proxy for complexity. Our proxy has the advantage of being strictly exogenous and less blurred by other influences.

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Appendix 1

Proof of Proposition 1

First we calculate the regulator's expected utility conditional on effort. Then we determine the optimal level of effort and the associated regulated price. For $E = \varepsilon$, the regulator fully uncovers the regulated firm's true cost. In this case, if the regulator uncovers c_H , and sets the regulated price p^R equal to c_H , then she obtains utility:

$$U\left[p^R = c_H \mid E = \varepsilon, c_H\right] = \overline{U} - \varepsilon .$$

In this case the consumer appeals to the court with probability γ . However, the court does not reverse the regulator's decision. If instead the regulator sets $p^R = c_L$, she obtains utility:

$$U\left[p^R = c_L \mid E = \varepsilon, c_H\right] = \delta(-\Gamma) + (1-\delta)\overline{U} - \varepsilon .$$

In this case, the regulated firm appeals to the court with probability δ and the court reverses the decision. Note that $U\left[p^R = c_H \mid E = \varepsilon, c_H\right] > U\left[p^R = c_L \mid E = \varepsilon, c_H\right]$. If instead, the regulator uncovers c_L, then her utility under the two possible prices is equal to:

$$U\left[p^R = c_H \mid E = \varepsilon, c_L\right] = \gamma(-\Gamma) + (1-\gamma)\overline{U} - \varepsilon$$

and

$$U\left[p^R = c_L \mid E = \varepsilon, c_L\right] = \overline{U} - \varepsilon .$$

Note that $U\left[p^R = c_L \mid E = \varepsilon, c_L\right] > U\left[p^R = c_H \mid E = \varepsilon, c_L\right]$.

We now look at the case where the regulator chooses $E = 0$ and as such she does not know the true realised costs and therefore computes her expected utility as follows:

$$U\left[p^R = c_H \mid E = 0\right] = q\overline{U} + (1-q)\left[\gamma(-\Gamma) + (1-\gamma)\overline{U}\right]$$

and

$$U\lfloor p^R = c_L \mid E = 0 \rfloor = (1-q)\overline{U} + q[\delta(-\Gamma) + (1-\delta)\overline{U}].$$

Note that $U\lfloor p^R = c_L \mid E = 0 \rfloor > U\lfloor p^R = c_H \mid E = 0 \rfloor$ if $\frac{q}{1-q} > \frac{\gamma}{\delta}$.

Finally, note that for $\frac{q}{1-q} > \frac{\gamma}{\delta}$, the regulator chooses effort $E = 0$ if

$$\overline{U}[q + (1-q)(1-\gamma)] - (1-q)\gamma\Gamma > \overline{U} - \varepsilon.$$

That is, the regulator chooses $E = 0$ and $p^R = c_H$ when $\frac{q}{1-q} > \frac{\gamma}{\delta}$ and

$$\varepsilon > (1-q)\gamma(\overline{U} + \Gamma).$$

■

Proof of Proposition 3.
For $E = \varepsilon$, we can calculate the regulator's expected utility when c_H is realised as follows:

$$U^{CS}\lfloor p^R = c_H \mid E = \varepsilon, c_H \rfloor = \overline{U} - \varepsilon$$

and

$$U^{CS}\lfloor p^R = c_L \mid E = \varepsilon, c_H \rfloor = \delta(-\Gamma) + (1-\delta)(\overline{U} + c_H - c_L) - \varepsilon.$$

Note that $U^{CS}\lfloor p^R = c_H \mid E = \varepsilon, c_H \rfloor > U^{CS}\lfloor p^R = c_L \mid E = \varepsilon, c_H \rfloor$ if

$$\overline{U} > \frac{1-\delta}{\delta}(c_H - c_L) - \Gamma.$$

This inequality holds for example whenever the probability that the regulated firm appeals following a regulatory decision where $p^R = c_L$ is sufficiently close to one. Conversely, the inequality is unlikely to hold if δ is small or if the consumer's surplus is large.

Similarly, if c_H is realised, then the regulator's expected utility is given by:

$$U^{CS}\left\lfloor p^R = c_H \mid E = \varepsilon, c_L \right\rfloor = \gamma(-\Gamma + (c_H - c_L)) + (1-\delta)(\overline{U}) - \varepsilon .$$

That is, in this case the consumer appeals to the court with probability γ and the court overturns the regulator's decision and the price reduces to c_L. Similarly,

$$U^{CS}\left\lfloor p^R = c_L \mid E = \varepsilon, c_L \right\rfloor = (c_H - c_L) + \overline{U} - \varepsilon .$$

Note that if the regulator chooses $E = \varepsilon$, then she will set $p^R = c_L$ when the utility is low cost.

We now consider the case where $E = 0$ and compute the regulator's expected utility as follows:

$$U^{CS}\left\lfloor p^R = c_H \mid E = 0 \right\rfloor = q\overline{U} + (1-q)\left\lfloor \gamma(-\Gamma + (c_H - c_L)) + (1-\gamma)\overline{U} \right\rfloor$$

and

$$U^{CS}\left\lfloor p^R = c_L \mid E = 0 \right\rfloor = q\left\lfloor \delta(-\Gamma) + (1-\delta)\overline{U} \right\rfloor + (1-q)\left\lfloor \overline{U} + (c_H - c_L) \right\rfloor .$$

When $E = 0$, the regulator sets $p^R = c_H$ whenever

$$\overline{U} > \Gamma + \frac{(1-q)(1-\gamma)(c_H - c_L)}{(1-q)\gamma + \delta q} \qquad (1)$$

and noting that the numerator is positive as long as $\frac{q}{1-q} > \frac{\gamma}{\delta}$. Finally, whenever (1) is satisfied, the regulator will choose effort ε (and $p^R = c_L$) over zero effort (and $p^R = c_H$) whenever

$$(c_H - c_L) + \overline{U} - \varepsilon > q\overline{U} + (1-q)\left[\gamma(-\Gamma + (c_H - c_L)) + (1-\gamma)\overline{U}\right]$$

or

$$\varepsilon < (c_H - c_L)((1-q)\gamma - 1) + q\gamma\overline{U} + (1-q)\gamma(-\Gamma)\,.$$

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Appendix 2.

Table A1. Descriptive statistics.

Variable	Description	Mean	S.D.	Min	Max
$RevT^T$	Number of days between the regulator receiving the complaint and the decision.	557.97	351.13	34	2196
Days	No. of days since the electricity market was deregulated.	4 279	323.6	2 346	4 929
Ant	Indicator for when case concerns connection of mobile antenna.	0.5721	0.4954	0	1
Cplex	Number of precedents	56.423	58.954	0	187
Three_l	Indicator for when utility is one of three largest (Vattenfall, E.On, Fortum).	0.5501	0.4981	0	1
CustC	Indicator for when customer is corporation	0.5892	0.4926	0	1
NoDec	No. of decisions made by regulator.	114.30	95.678	1	306
$\hat{E}^T$	Effort (estimated)	2.3711	6.5801	1.0057	113.38
Car	Indicator for when regulator has made less than 50 decisions.	0.3839	0.4869	0	1
P^U	Amount claimed by utility (SEK)	116 383	286 316	11 826	5 500 000
P^R	Amount awarded by regulator (SEK)	78 029	190 020	3 664	3 600 000
P^C	Amount awarded by court (SEK)	90 766	236 514	12 865	3 600 000

All variables have 409 observations, except P^C, which has 251. Descriptive statistics for A^{Cu} and A^{Ut} is provided in Table 1.

Table A2. Sensitivity analysis for the definition of 'experienced' regulator.

Definition of experienced regulator	Eq (2), using specification displayed in panel (b) in Table 1		Eq (3), customers appeal			Eq (3), utilities appeal		
	β_1 (S.E.)	β_2 (S.E.)	γ_1 (S.E.)	γ_2 (S.E.)	γ_3 (S.E.)	γ_1 (S.E.)	γ_2 (S.E.)	γ_3 (S.E.)
>25 decisions	0.4456 (0.5123)	-0.8571 (0.4644)	0.0017 (0.0039)	0.3885 (0.2408)	-0.3211 (0.2049)	-5.6E-4 (0.0029)	-0.0260 (0.0815)	0.0254 (0.0242)
>50 decisions	1.6035 (0.8382)	-1.0536 (0.4644)	-0.0168 (0.0066)	-0.0375 (0.0251)	0.0200 (0.0067)	0.0028 (0.0060)	-0.0280 (0.0425)	-0.0039 (0.0053)
>75 decisions	0.6713 (0.6503)	-0.7583 (0.4623)	-0.0131 (0.0054)	-0.0203 (0.0398)	0.0155 (0.0065)	0.0074 (0.0021)	-0.0306 (0.0235)	-0.0081 (0.0043)
>100 decisions	0.5775 (0.6052)	-0.7191 (0.4797)	-0.0133 (0.0054)	-0.0347 (0.0328)	0.0158 (0.0064)	3.9E-4 (0.0020)	-0.0392 (0.0227)	-4.1E-4 (0.0043)
>125 decisions	0.6798 (0.6021)	-0.6913 (0.4777)	-0.0140 (0.0055)	-0.0432 (0.0287)	0.0165 (0.0064)	0.0010 (0.0019)	-0.0241 (0.0217)	-0.0012 (0.0042)
>150 decisions	0.6494 (0.6021)	-0.6966 (0.4791)	-0.0160 (0.0063)	-0.0694 (0.0247)	0.0186 (0.0069)	0.0022 (0.0019)	-0.0012 (0.0212)	-0.0025 (0.0041)
>175 decisions	0.3738 (0.6012)	-0.7417 (0.5077)	-0.0171 (0.0062)	-0.0921 (0.0228)	0.0198 (0.0068)	0.0057 (0.0016)	0.0388 (0.0262)	-0.0064 (0.0036)
>200 decisions	0.1395 (0.6126)	-0.8304 (0.5285)	-0.0131 (0.0041)	-0.0381 (0.0285)	0.0156 (0.0052)	0.0025 (0.0013)	0.0157 (0.0255)	-0.0029 (0.0036)