Regulatory behaviour under threat of court reversal: theory and evidence from the Swedish electricity market

Magnus Söderberg[1, a], *Flavio M. Menezes*[2, b] *and Miguel Santolino* [c]

[a] Corresponding author: MINES ParisTech, PSL Research University, CERNA – Centre d'Economie Industrielle, 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

This paper investigates how government bureaucrats influence outcomes in regulated markets when their decisions are subject to the threat of court review. We develop a theoretical model that provides a number of behavioural implications when (*i*) all regulators' dislike having their decisions overturned by courts, (*ii*) inexperienced regulators care more about not having their decisions overturned than experienced regulators, and (*iii*) experienced regulators also care about consumer surplus. The theoretical implications are tested using a database of Swedish regulatory decisions. We provide empirical evidence that inexperienced regulators are more likely to set higher regulated prices than experienced regulators, and as the complexity of the case increases, there are on average more overturned decisions and higher prices for inexperienced regulators. The links between experience, complexity and regulatory outcomes are both statistically and economically significant. Simulations show that if those decisions that were not appealed had been appealed, then the court would have lowered the prices by 10% on average.

Key words: regulation, effort, complexity, experience

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[1] Present address: IFEL B5; Gothenburg School of Business, Economics and Law; PO Box 610; 40530 Gothenburg; SWEDEN; E-mail: magnus.soderberg@gu.se.

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1. INTRODUCTION

This paper investigates the impact of regulators' behaviour and their characteristics on outcomes in regulated markets.[3] Two recent and general developments warrant the interest in this field. First, many industries that provide essential services (such as electricity, gas, telecommunications and water/sewerage) have been subject to unbundling of the competitive and natural monopoly segments of the industry and the privatisation and corporatisation of publicly owned enterprises. In the pre-reform period, prices were often set in an opaque process controlled by the government and sometimes by the government-owned institutions providing the service. In the post-reform period, firm prices have been regulated by bureaucrats, making outcomes in these industries increasingly reliant on bureaucratic decisions (e.g. Jordana et al., 2011).

Second, this development has coincided with a more general trend towards replacing judge-made law with regulation administered by public bureaucrats (Shleifer, 2012). A major reason for this change is the unpredictability of judges' decisions. Gennaioli and Shleifer (2008) argue that such unpredictability arises partly from judges' concerns related to the potential damage to their careers from having their decisions overturned by appellate courts. Bureaucrats' decisions, on the other hand, have been claimed to be more predictable and efficient given their relatively high level of expertise (Glaeser and Shleifer, 2003). While greater predictability can provide a rationale for the rise of regulation, it does to some extent ignore the fact that bureaucrats are also subject to their own motivations. For example, while bureaucrats may desire to maximise society's welfare, they also have other aspirations such as to be promoted within the government or to work for the industry in the future.[4]

The ubiquity of regulation in modern economies raises a number of concerns. These include the lack of consistency in regulatory decisions (across time, industries or jurisdictions), political influence on the regulatory process via the appointment process for regulators and the career concerns of regulators who might favour consumers (with a view to being reappointed) or industry (with a view to securing future jobs). An increasing body of evidence examines regulatory decisions to identify the effects of

[3] The terms 'bureaucrat' and 'regulator' are used interchangeably in this paper.

[4] These motivational concerns can be traced back to Niskanen's (1971) notion of bureaucrats being inclined to maximise their budgets and Stigler's (1971) proposition that bureaucrats may become captured by the industry. More recently, Leaver (2009) provides evidence of a causal link between regulators' levels of career concern and the extent to which their decisions are biased. In her sample of electricity rate reviews in the U.S. she finds that the length of office terms for regulators (with longer office terms being associated with less career concern) is negatively related to both the probability of initiating regulatory reviews and regulated prices.

these various factors. Examples of studies based on U.S. data include Davis and Muehlegger (2010), Leaver (2009), DeFigueiredo and Edwards (2007) and Knittel (2003). With the increasing availability of data elsewhere, there is also a new body of literature evaluating regulatory decisions outside the U.S., including Australia (Breunig and Menezes, 2012; Breunig, Hornby, Menezes and Stacey, 2006), Brazil (Silva, 2011) and Sweden (Smyth and Söderberg, 2010).

The aim of this paper is to investigate the behaviour of bureaucrats when their decisions are subject to an external review by a court. Whereas regulatory decisions can always be challenged on legal grounds by the courts, the external review of regulatory decisions is a lively policy issue.[5] Importantly, there has been no discussion on the impact of making regulatory decisions subject to external review on the behaviour of regulators. This paper aims to fill this gap.

A key premise of this paper is that regulators do not like to see their decisions changed. This is because having one's decisions overturned or changed can make it more difficult to be reappointed as a regulator or to secure career progression. Alternatively, this dislike may simply arise from a private wish to avoid mistakes or to avoid being seen as having made a mistake.[6] In particular, in our benchmark model, we assume that regulators only care about not having their decisions changed. These regulators make decisions with the exclusive aim of minimising the likelihood that any mistakes will be exposed by the court. The possibility of regulatory mistakes being explicitly subjected to judicial review is a novel feature of our analysis and follows from the institutional setting we study, where both customers and regulated firms can appeal the regulator's decisions.

We then consider a regulator who cares both about not having her decisions changed by the court and about consumer surplus.[7] We argue that more experienced regulators will have such characteristics. For inexperienced regulators, there is a risk that court reversals will be attributed to limited knowledge

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[5] For example, in Australia, regulatory decisions in electricity can be appealed on merit to the Australian Competition Tribunal. This has raised concerns that regulated companies can cherry pick particular aspects of a decision. For a defence of merit review in the Australian context see, for example, http://www.scer.gov.au/files/2012/03/Fels-ENA-Final-report-on-energy-merits-review.pdf.

[6] Individuals' tendency to dislike making errors (or to avoid regrets more generally) is a common assumption both in neuroscience (Coricelli et al., 2005) and in decision science (Reb and Connolly, 2009).

[7] The regulator's focus on consumer surplus (rather than, for example, total welfare) is motivated by Prendergast's (2007) model of bureaucratic bias. He shows that it is welfare improving for bureaucrats to adopt pro-consumer preferences when customers have relatively higher stakes than firms. Moreover, there has been much debate about consumers' disadvantageous position and the need for the regulator to act as advocate for consumers in the empirical setting that we consider in this paper.

or ability, and may have a disproportional impact on their reputation. Reversals of decisions by experienced regulators, on the other hand, can be interpreted as the regulator and court having different views of the law.[8] It is plausible, therefore, that inexperienced regulators have stronger incentives to avoid making 'mistakes' and that experienced regulators have greater opportunity to consider additional decision making objectives, such as consumer surplus,[9] with less concern for appeals and the threat of court reversal.

In our model decisions involve different degrees of case complexity. As a result, the regulator has to make a decision about how much effort to put into the investigation of a consumer's complaint about the price set by the regulated firm to connect her to the electricity grid. The regulator's decision of how much effort to exert is influenced by a number of parameters such as the cost of effort and the likelihood that the decision might be changed by an appellate court.

The possibility of a regulator making a mistake arises in our model 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 discover the firm's true cost by exerting costly effort. Once the regulator has chosen her level of effort, she decides what price to set. At this stage, both the customer and the firm may 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, but both *may* appeal otherwise. In our model, the focus is on how the regulators' decisions and their choice of effort are influenced by the possibility of appeal under different regulatory objectives. Finally, we assume that the court uncovers the firm's true cost. This is of course an oversimplification, but our results will remain true in a qualitative sense as long as the court has a sufficiently high probability of uncovering the firm's true cost.

We emphasise that while the model is stylised and a few strong assumptions are made, our primary objective is to identify a number of economic factors from first principles that can guide the specification of a reduced form empirical model. While the nature of the data we collected does not allow us to estimate a structural model, it has informed the development of the theoretical model.

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[8] Garside's et al. (2013) provides strong empirical evidence, in the context of competition cases in the U.K, that more experienced bureaucrats attract more external criticism. This is consistent with the notion that more experienced bureaucrats may care less about having their decisions changed by the courts and, therefore, may make decisions that are different from those made by less experienced bureaucrats.

[9] In Section 3.1 we provide empirical support for a link between experience and the type of objective.

Importantly, this theoretical framework allows us to make a number of testable predictions for different types of regulatory objective. Specifically, when the regulator is only concerned about not having her decision overturned, we show that, under certain conditions, a larger number of decisions will be overturned by the court when cases are more complex (i.e., cases requiring more effort for the regulator to make the 'right' decision) than in situations where the cases are less complex.

We also show that when the regulator cares about both not having her decision overturned 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.

Moreover, regulators who care about both not having their decisions overturned and consumer surplus will exert less effort when cases become more complex. This emerges as, in equilibrium, parties recognise the link between complexity, choice of effort and outcomes.

We empirically investigate customer complaints about the price set by firms for connecting a residential dwelling to the electricity network. Five regulators, employed as life-long civil servants at the Swedish Energy Markets Inspectorate, have reviewed 293 complaints during the 2003-2009 period and 141 of those were appealed to the Special Administrative Court.

Most of our theoretical predictions are confirmed in the empirical investigation. The key conclusion is that regulators' dislike of seeing their decisions overturned has an impact on regulatory decisions that is both statistically and economically significant. Simulations show that if those decisions that were not appealed had been appealed, the court would have lowered the prices by 10% on average. This value can be interpreted as a measure of the deviation from true costs for decisions that are not appealed and which could be reduced in various ways including by the appointment of experienced regulators.

The paper proceeds as follows. Section 2 presents a simple model that highlights the role of regulatory preferences in identifying the interrelations between regulator objectives, the effort chosen by the regulator, the cost of effort and regulatory outcomes. Section 3 describes the regulatory setting in the Swedish electricity sector. Section 4 contains our empirical investigation and Section 5 concludes.

2. A THEORY OF REGULATORY BEHAVIOUR UNDER COURT REVIEW

We assume there are two types of firms that differ based on unitised costs: high cost (c_H) and low cost (c_L), $c_H > c_L$. 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 firm sets the price to charge the consumer either at c_L or at c_H. If the price is set at c_H, we assume that the consumer complains to the regulator,[10] otherwise there are no further developments. Consumer demand is equal to 1 at a price less than or equal to c_H, and 0 otherwise. The firm is assumed to set $p = c_H$ regardless of its cost. Clearly, it would set $p = c_H$ when it is a high cost firm and, given that the firm is not penalised for any ambit claims, it will also choose $p = c_H$ when it is low cost.

When the regulator receives a complaint, it has to determine a regulated price, p^R. We assume that the regulator does not know the firm's true cost, but they can find out the true cost by exerting some effort. Denote effort by $E = \{0, \varepsilon\}$. Let the cost of effort be given by $C(E) = E$. If the regulator exerts effort $\varepsilon > 0$, they fully learn the true cost of the firm. By exerting 0 effort, the regulator assumes that any low cost firm will pretend to be a high cost. More precisely, if the regulator exerts 0 effort, then all they know is that the firm's true cost is c_H with probability q. These are obviously simplifications that are meant to capture some of the key characteristics of the regulatory process. An alternative formulation where higher effort would mean more accurate, but not perfect, information about the true costs of the regulated firm would lead to similar qualitative conclusions.

Once the regulator has chosen their level of effort, they then decide what price to set. We assume that when they set $p^R = c_H$, the consumer appeals to the court with probability γ, and when the regulator sets $p^R = c_L$, a high cost firm appeals to the court with probability δ, where $\delta < \gamma$. The assumption $\delta < \gamma$ captures the notion that while the interaction of the consumer with the court is a one-off, the regulated firm's relationship with the court and the regulator is more complex, because it takes the form of a repeated game.[11] It should be noted that while there are no explicit appeal costs imposed on

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

[11] 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 that 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 about the probability of appeal given a particular regulatory decision, whereas the summary data described in Table 1 is unconditional on the decisions.

either consumers or the firm in the model, the fact that both δ and γ can take values less than 1 could conceivably capture such costs. As indicated earlier, we assume that the court will uncover the true cost of the firm.

Finally, the model considers each interaction between agents (e.g., between the consumer and the regulator or between the regulator and the courts) as a one-off. That is, although it is implicitly captured in the relationship between parties' probabilities of appeal, we do not explicitly consider the role of reputation in this setting.[12] While this is done again for simplicity and tractability, we conjecture that reputation building will be more important for inexperienced regulators and it might accentuate the difference in effort choices between them and experienced regulators, who are less concerned about having their decisions overturned by courts.

2.1 Benchmark model

Initially, we consider a regulator whose only concern is that the court does not overturn her decision. 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, the utility is equal to $-\Gamma < 0$. Proposition 1 summarises the regulator's decision in this setting.

Proposition 1. *Suppose*

$$\frac{q}{1-q} > \frac{\gamma}{\delta}.\text{[13]} \tag{1}$$

That is, the 'hazard rate' is greater than the ratio of the probability of appeal by the consumer to that of the firm. Then for sufficiently high cost of effort, or more specifically, if $\varepsilon > \gamma(1-q)\left[\overline{U} + \Gamma\right]$*, the regulator always chooses 0 level of effort and sets* $p^R = c_H$*. If* $\varepsilon < \gamma(1-q)\left[\overline{U} + \Gamma\right]$*, then the regulator always chooses* $E = \varepsilon$ *and sets* $p^R = c_L$ *when she uncovers the firm is low-cost, and will set* $p^R = c_H$ *otherwise.*

[12] For example, there is an economics literature that examines the role of reputation in dynamic games of incomplete information with a focus on sequential equilibrium. See Wilson (1985) for a survey and Camerer and Weigelt (1988) for experimental evidence suggesting that the notion of sequential equilibrium in dynamic incomplete information games describes actual behaviour well.

[13] Total cost in industries that rely on a physical network is strongly related to population density, with high density leading to lower cost. During the sample period we consider (2002-2009) only 3% of the 290 Swedish municipalities had a population density above 1000 inhabitants per square km and 16% had a density above 100 inhabitants per square km. Thus, condition (1) is plausible in our empirical setting.

Proof. See Appendix 1.

The following corollary follows in a straightforward manner from Proposition 1 and provides some novel propositions that can be tested empirically.

Corollary 2. *When a regulator is only concerned about not having her decisions overturned 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. In particular, in the less complex case, effort will always be exerted, and the regulator always has an incentive to set* p^R *equal to the true cost of the firm, thus no decisions will be overturned by the court.*

2.2 An alternative objective for the regulator

We now consider an alternative type of regulator who cares about both not having her decisions overturned and consumer surplus.[14] 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 not having her decisions overturned.

Proposition 3. *Suppose that*

$$\bar{U} > -\Gamma + \frac{(1-q)(1-\gamma) + q(1-\delta)(c_H - c_L)}{-(1-q)\gamma + \delta q} \qquad (2)$$

.

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

Proof. See Appendix 1.

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[14] In our empirical approach we postulate that less experienced regulators will care more about not having their decisions overturned than experienced regulators. It follows that we will characterise less experienced regulators as those who care only about not having their decisions overturned and more experienced regulators as those who care about both not having their decisions overturned and consumer surplus.

Condition (2) is likely to hold when the disutility cost for the regulator is low and when the probability that utilities appeal is high. Proposition 3 suggests that as the cost of effort increases (for example, in more complicated cases), the regulator switches to 0 effort and sets $p^R = c_H$. Thus, we predict that less complex cases will be associated with more appeals by regulated firms but fewer 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 analysis.

Corollary 4. Suppose $\overline{U} < \frac{1-\delta}{\delta}(c_H - c_L) - \Gamma$ and condition (2) are both satisfied. Then, whenever 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.

The theoretical model developed above provides a number of testable implications: (i) regulators set lower prices when cases are uncomplicated; (ii) when regulators care about both not having their decisions overturned and consumer surplus they generally set lower prices than when they only care about not having their decisions overturned; (iii) regulators who care about both not having their decisions overturned and consumer surplus are more likely to respond to complexity by lowering effort, implying higher prices on average; (iv) when regulators only care about not having their decisions overturned and when cases are complex, the court reduces the regulator's chosen price; (v) when regulators care about both not having their decisions overturned and consumer surplus and when cases are less complex, the court sets the same price as the regulator; and (vi) when regulators care about both not having their decisions overturned and consumer surplus and when cases are complex, more decisions are overturned by the courts. Understanding the implications of the regulators' decisions to exert low or high levels of effort and the regulators' and court's price setting decisions is particularly relevant from a policy perspective.

3. CUSTOMER COMPLAINTS IN THE SWEDISH ELECTRICITY SECTOR

In the Swedish electricity distribution sector, customers can file complaints to the national energy regulator, the Swedish Energy Markets Inspectorate (EMI), regarding the contract conditions (e.g., the price for connecting to the network) set by the local monopolistic firms that own the networks. Based on its review of the monopolist's charges, the regulator either confirms the conditions in full or mandates that the distribution company reduce the price it has charged the consumer.

The 'regulator' is the individual who chairs the review and is responsible for making the final decision on the consumer's complaint. This regulator is a civil servant employed by the EMI and appointed by the Director General (DG) to resolve disputes. The DG is appointed by the national parliament and has no official party affiliation. At each point in time there is a pool of individuals available as regulators that the DG can choose from. There are no clear guidelines on how individuals are appointed as regulators but data reveals that up until 2005 the DG applied a rotating policy where regulators served in spells of 3 reviews on average whereas the average spell increased to almost 23 reviews in the 2006-2009 period. This increase in the number of consecutive reviews undertaken by regulators coincided with an organisational change in which a customer complaint unit was established. Although, in principle, the DG can still decide who will serve as regulator, it has been customary that reviews are chaired by the head of this new unit. When a civil servant's role as regulator ends, she is assigned to other duties within the organisation, such as to set distribution charges, provide customer advice, conduct market research or engage in international regulatory collaborations. Customer complaint data is suitable as a basis for studying the impact of economic incentives since it is only as the chair of complaint reviews that civil servants act in their own names; complaint decisions are signed by the chair whereas other regulatory decisions such as distribution charge decisions are made in the name of the regulatory organisation.

A regulator's decision is subject to appeal; either the customer or the firm can appeal the regulator's decision to the Special Administrative Court (the 'court'). The court then decides whether to confirm the price determined by the regulator, or to change it in favour of the appellant. There is only one court reviewing appealed regulatory decisions.

In practice, customers complain about a range of different aspects of their electricity supply and about different contract conditions.[15] Here, we focus solely on disputes that arise when customers complain about the price quoted by firms for connecting an electricity consuming 'unit' to the existing network. This focus on connections to understand regulators' behaviour is justifiable as connection cost drivers

[15] See Smyth and Soderberg (2010) for a comprehensive list of different complaints filed by Swedish electricity customers.

are well understood and measureable, and the regulator has used a transparent method to determine the maximum allowed price throughout the sample period we consider. This method is explained below.

Connection to the electricity network can be classified based on the type and ownership of the unit being connected: residential dwellings, industrial and other buildings, and connections of mobile towers. This distinction arises naturally as households and corporations have different locational preferences: residential customers tend to choose locations in close proximity to other households and social services whereas industrial customers are typically located within industrial areas with easy access to infrastructure. Mobile towers are associated with very distinct locational choices as they are exclusively placed on the top of large buildings and on hills or mountains. These preference differences affect connection characteristics and they may also have an impact on unobserved characteristics that influence regulators' decisions. Hence, we restrict our investigation to complaints by residential customers.

We now describe the review process itself. When reviewing complaints, the regulator first determines whether the connecting customer is located in an urban or a rural area. In urban, built-up areas, the regulator applies a homogenous price regardless of the particular circumstances of the connection. In rural areas, however, the regulator allows the monopolist to charge a higher connection price so that the firm can recover the higher fixed costs associated with new lines, transformers and other extraordinary costs.[16]

The fixed cost for rural connections includes 60 metres of low voltage line, which implies that customers who are located within 60 metres of the existing network pay the same price. When more than 60 metres of line is needed, the firm can also charge a fixed price per metre of extra line. The metre cost is determined by the regulator and is based on the average of historical costs reported by firms to the regulator. For lines exceeding 560 metres, the regulator assumes that high voltage lines are needed and it therefore grants a higher metre cost for that part of the connection. In certain situations the firms may also add the cost of transformers. Specifically, when connections require less than 560 meters of new line, the regulator determines the need to use a transformer based on engineering principles and for line extensions exceeding 560 metres the firm is always granted the cost

[16] Examples of extraordinary costs are restoration of road surface and drainage of underground waterways.

of a transformer.[17] Our empirical approach, expounded in Section 4, is based on this regulatory framework.

Connecting a new residential dwelling to the existing network always involves extending the existing network. This extension, however, will often (partly) benefit other units already connected. The principle used by the regulator to allocate these common costs is that a connecting unit should only pay for the part of the infrastructure that is specific to its need. If, for example, a new connection requires 100 metres of line extension and one transformer and half of the line length is used by another unit, then the new customer should pay the full cost of the 50 meters that is specific to her, the full cost of the transformer but only half of the cost of the remaining 50 meters of line.

While the model for determining the maximum allowed price is in principle a simple one, determining the number of customers sharing particular line sections, transformers etc., is a complex task. The more units being affected by a new connection, the more complex and time consuming the review is. In our econometric investigation, we use number of connected units affected by the new connection as a measure of how complex the review is. We argue that this is a more suitable measure than what has been used previously in the empirical literature on judicial decisions. For example, Kaheny et al. (2008) used the number of document pages of the decision to represent complexity. The problems with this 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 review time can be affected by several factors unrelated to complexity (e.g. regulatory experience/ability, available budget, and room for legal discretion). Since the number of affected customers is based on engineering principles and can be challenged by both firms and customers in court, it will be less prone to subjective influences that may cause endogeneity concerns.

3.1 Data

There are 293 observations covering the decisions made by regulators from the 1st of January 2002 to the 31st of December 2009.[18] Information about each case is drawn from the case files provided by the

[17] It is unusual that the regulator allows the firm to charge customers for extraordinary costs, but we evaluated all models with the extraordinary costs also included. This did not affect the results.

[18] Prior to 2002 case files did not include all relevant information, e.g. line length required to connect the dwelling, and in February 2010 the regulatory model was fundamentally changed. The new model is still under review by the court, which precludes the use of more recent cases.

Swedish Energy Regulator (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 A2.1 in Appendix 2.

The regulator withheld a proportion of the firms' claims in as many as 80 per cent of the 293 reviews. The average ratio of the amount awarded by the regulator (P^R) to the firms' claim (P^F) is 0.767. Table 1 shows that customers have appealed 18 per cent of the regulator's decisions, while firms have appealed 30 per cent, resulting in almost half of the regulator's decisions being appealed.[19] The court reversed 19 percent of decisions appealed by firms and 25 percent of decisions appealed by customers. It is evident that court decisions exhibit substantial case level heterogeneity, but the average adjustments are small, amounting to a 2% reduction when customers appeal and a 1% increase when firms appeal.

Table 1. Descriptive statistics for appeals and court responses.

	Share of regulatory decisions appealed	Share of appeals reversed by court	P^C/P^R
Appeals made by customers	0.177	0.245	0.979 (0.608-0.979)
Appeals made by firms	0.304	0.193	1.008 (1.008-1.1534)
All appeals	0.478	0.220	0.993 (0.608-1.1534)

Sample: 293 customer complaints about prices set by firms for connecting residential dwellings. Ranges for P^C/P^R are given in brackets.

Nine regulators reviewed connections of residential dwellings during the 2002-2009 period. Three of the regulators chaired only three or fewer reviews and one chaired 8 reviews. We denote these as 'incidental regulators' and exclude them from the empirical investigation. The remaining five are included in the sample and the characteristics for each one are summarised in Table 2.

[19] This data does not contradict our assumption that the probability of appeal by high cost firms is lower than the probability of appeal by consumers who respond to a high price. The data simply reflects that the real-world probability of appeal by *all* firms is greater than the probability of appeal by *all* consumers.

Table 2. Descriptive statistics for each regulator.

	Regulator 1	Regulator 2	Regulator 3	Regulator 4	Regulator 5
No of observations in sample	33	88	37	47	88
Years decisions were made	2008-2009	2007	2007	2003-2007	2009
Average level of experience (SD)	18.7 (10.6)	47.6 (27.4)	19.3 (11.3)	44.7 (20.4)	44.5 (25.5)
Average P^R/P^F (SD)	0.89 (0.14)	0.74 (0.20)	0.77 (0.18)	0.73 (0.24)	0.76 (0.19)
Average line length (SD)	346 (375)	350 (440)	343 (403)	414 (402)	223 (402)

Regulators' experience is measured by the number of chaired reviews. No regulator has experience characteristics that are clearly different from the others and line length statistics indicate that regulators have been exposed to similar cases. On average, regulators have also made similar pricing decisions but it should be noted that experience and the reduction of firms' prices are positively correlated. This gives support to our assumption that experience and focus on consumer surplus are positively related. Each regulator chaired reviews over 1-5 years and the overlap is limited. To reduce this heterogeneity we add both regulator and year fixed effects in all estimations. The regulator fixed effects serve the purpose of controlling for all time-invariant private and institutional preferences/abilities and the year fixed effects control for energy tax adjustments and other institutional changes such as the change in tariff regulation that occurred in 2008.

4. EVIDENCE

In Section 4.1, we explain the main empirical problem, i.e. that regulator experience is endogenous and how it is tackled. Section 4.2 investigates the prices set by regulators and Section 4.3 contains the analyses of the court's price decisions. Finally, Section 4.4 simulates regulatory and court outcomes for different levels of experience and complexity and closely investigates the consistency between the theoretical predictions from Section 2 and the empirical findings.

4.1 Overcoming Endogeneity

One of the main empirical challenges is that a regulator's experience can be endogenous. This can occur because regulators who set lower prices are more likely to stay longer as chairs, and/or that experienced regulators might be assigned to more complex cases.

This potential endogeneity has to be addressed since the price established by the regulator is included in the dependent variable in all models we estimate. More specifically, policy-makers have expressed concerns that consumers are in an unfavourable position in the electricity distribution sector and that their position needs to be strengthened (see Smyth and Söderberg, 2010, for details). This can lead the DG to select regulators with a high share of decisions favouring consumers. Indeed, Smyth and Söderberg (2010), who investigated all customer complaints (i.e., not just complaints about the connection of residential dwellings), found that the share of past decisions in favour of customers tends to be positively correlated with experience. There have also been concerns about the disproportionally high share of legal resources used to resolve regulatory disputes. Regulators who avoid appeals may therefore be preferred by the DG.

To circumvent this endogeneity problem we follow Garside et al. (2013) and construct an instrument based on the principle that incoming complaints are mechanically assigned to the regulator with the lowest workload. Although we have no specific information about how cases are actually assigned among available regulators, we assume that workload is a determining factor. This construction eliminates all factors influencing the assignment of new cases, except workload, and thus, it will be completely exogenous in relation to the outcome of the reviews. It should be noted that the construction of the instrument does not consider *actual* workload since it is designed in a purely mechanical fashion. When calculating `the workload for each available regulator we control for the proportion of work that remains for each of the (mechanically assigned) cases currently under review. This is done by dividing the number of remaining days by the total number of review days for each case. At each point in time we observe the pool of available regulators and can therefore assign a new case to the regulator with the lowest workload. To calculate the share of remaining time we use the actual duration of each review.

4.2 Regulator's price setting

According to theoretical predictions (i)-(iii) at the end of Section 2, the regulator's price decision will be influenced by her level of experience (*NoRev*), case complexity (*Complex*) and the interaction between them. The dependent variable is formulated as $\frac{P^R}{P^F}$. Taking the ratio of these two prices has the advantage of eliminating the influence of basic cost factors that are accepted by all agents. Examples of such factors are the use of (different types of) transformers and the amount of power.

Furthermore, we control for the regulatory framework described in Section 3 by adding the following variables: (i) an indicator for whether the connection is in an urban area (*Urban*), (ii) indicators for whether the connection requires less than 60 metres or more than 560 metres of line length, respectively ($LengLess60$ and $LengLong560$), and (iii) total line length ($LengTot$). We also add variables indicating whether the firm is one of the three largest in the market (*ThreeLar*),[20] and the number of relevant court precedents (*NoPrec*). *ThreeLar* controls for the possibility that the larger firms have a greater ability to influence regulatory outcomes and *NoPrec* controls for the amount of information the regulator has to collect and the degree of discretion that she has given the binding legal positions determined in previous cases. Variable definitions and descriptive statistics are provided in Table A2.1 in Appendix 2.

Hence, the model we use to explain regulators' price decisions is formulated as:

$$\frac{P_{it}^R}{P_{it}^F} = \beta_1 NoRev_{it} + \beta_2 Complex_{it} + \beta_3 NoRev_{it} \times Complex_{it} + \beta_3 LengLess60_{it} + \beta_4 LengLong560_{it} + \beta_5 LengTot_{it} + \beta_6 Urban_{it} + \beta_7 ThreeLar_{it} + \beta_7 NoPrec_{it} + \mathbf{T}_t \boldsymbol{\gamma}_t + \theta_i + \varepsilon_{it}, \quad (3)$$

where *i* is regulator and *t* is a case number representing the chronological order in which decisions are made.[21] $\mathbf{T}_t$ is a vector of time fixed effects; θ_i is the regulator fixed effect and ε_i is the random error term.[22] We estimate (3) using homoscedastic-consistent SEs. These SEs are preferred over SEs clustered over regulators since we only have five regulators and clustered SEs are known to be biased downward when there are few clusters (Nichols and Schaffer, 2007). White's robust SEs were evaluated and were generally similar to the SEs that are reported. To test for a specific form of within-correlation we estimate a dynamic panel data model using the approach developed by Arellano and Bond (1991). Correlation between adjacent reviews can occur if regulators bring insights or focus from a recently closed case to a new one. However, we find no evidence of such correlation.[23]

[20] The Swedish local electricity distribution market is dominated by three firms that in 2009 had a combined market share of 49%.

[21] We also experimented with various transformations of continuous variables, e.g. log-transformations, but those models did not improve the fit between the model and the data.

[22] In Section 3 we described that the DG might have changed the way she assigned regulators in 2006. To evaluate if this potential change affects the results we also estimate all models where observations prior to 2006 are excluded. All those results are very similar to those reported in Tables 3 and 4.

[23] Results are available from the authors upon request.

Moreover, we estimate (3) when *NoRev* is included also as a squared term. Considering that *NoRev* covers a wide range of different experience levels, ranging from 1 to 95[24], it is possible that its relationship with $\frac{P^R}{P^F}$ is non-linear. As a result, we also relax the linearity assumption.

Results for both linear and non-linear models are presented in columns (1) and (2) in Table 3. By and large, the results are consistent with the theoretical relationship between regulator's experience and case complexity and the regulatory decisions. It also suggests that larger firms are treated somewhat differently by the regulatory process. This could be because large firms operate their networks differently or because they are more experienced with the regulatory process. Table 3 also shows that including the squared $NoRev$-term does not improve the fit between the model and data.

It is also noteworthy that the impact of complexity changes across the different models. This shows that there is strong support for higher experience reducing the price set by regulators when cases are relatively simple. As case complexity increases, regulators reduce the price less, or even accept firms' prices in full. However, a more precise understanding of how experience and complexity affect the regulator's decision can be gained by simulating the outcome for different values of *NoRev* and *Complex*. We perform such simulations in Section 4.4 where we also scrutinise the consistency between the theoretical predictions and empirical results more closely.

[24] One should note that while the maximum number of decisions in our sample is 88, the maximum number of decisions by a single regulator is 95. This difference is due to the existence of a number of decisions for which we do not have all the information that were excluded from our estimation but were counted towards the regulators' experience.

Table 3. Results when using P^R/P^F as depentent variable.

Variable	OLS		OLS		2SLS		2SLS	
	(1)		(2)		(3)		(4)	
NoRev	-0.00431	***	-0.00259		-0.00391	***	0.00373	
	(0.00053)		(0.00207)		(0.00082)		(0.00504)	
NoRev^2			-0.00001				-0.00008	
			(0.00002)				(0.00005)	
Complex	0.01702	**	0.01376		0.02375	***	0.02844	**
	(0.00710)		(0.00849)		(0.00830)		(0.01226)	
NoRev × *Complex*	0.00105	***	0.00198	***	0.00078	***	0.00079	
	(0.00019)		(0.00074)		(0.00026)		(0.00109)	
NoRev^2 × *Complex*			-0.00002				-2.7e-6	
			(0.00001)				(0.00001)	
LengLess60	0.02389		0.01999		0.02351		0.00884	
	(0.02503)		(0.02519)		(0.02518)		(0.02690)	
LengLong560	0.03079		0.02981		0.03532		0.01854	
	(0.03551)		(0.03587)		(0.03563)		(0.03808)	
LengTot	0.00005		0.00005		0.00005		0.00006	
	(0.00004)		(0.00004)		(0.00004)		(0.00004)	
Urban	-0.01142		-0.01086		-0.01306		-0.00662	
	(0.02777)		(0.02776)		(0.02784)		(0.02839)	
ThreeLar	-0.04177	**	-0.03774	*	-0.04566	**	-0.03790	*
	(0.02095)		(0.02098)		(0.02109)		(0.02168)	
NoPrec	0.00138		-0.00083		0.00124		-0.00170	
	(0.00311)		(0.00321)		(0.00207)		(0.00255)	
Regulator FE	Yes		Yes		Yes		Yes	
Year FE	Yes		Yes		Yes		Yes	
Cragg-Donald Wald F stat					46.917		8.308	
Overidentification test (p-value)					0.176		0.602	
R^2	0.467		0.449		0.463		0.429	
No obs	293		293		293		293	

Notes. *p< 0.10, **p< 0.05, ***p< 0.01. Homoscedastic-consistent standard errors (SE) are in brackets.

The analysis above has assumed that *NoRev* is exogenous. Next we relax this assumption by making use of the instrument described in Section 3. The instrument for *NoRev*×*Complex* is created by multiplying the mechanically constructed instrument for *NoRev* by *Complex*. When using the specification in (3), i.e. without $NoRev^2$ and $NoRev^2 \times Complex$, we use the instrument both in level and squared and create interactions between both these variables and the instrument. When $NoRev^2$ and $NoRev^2 \times Complex$ are added to (3), we maintain the idea that the endogenous variable can be explained by higher-order polynomial expansions of the instruments and thus, we also include the cubic form of the instrument as a main effect and interacted with *Complex*. In addition to allowing for a more flexible correlation structure between the instrument and the endogenous variable (i.e. the possibility of a non-linear relationship), this approach also allows us to perform an over-identification test.

Columns (3) and (4) in Table 3 display the results where *NoRev* is assumed to be endogenous and where we replicate the four assumptions regarding specification and data sample that we used in the exogenous case. First-stage results are provided in Appendix 3, Table A3.1. When we apply this instrumentation strategy the first stage F-statistic for the endogenous variables is clearly above 10 (a common rule-of-thumb) in column (3), and slightly below 10 in column (4). The overidentification test is strongly supported in both cases. The results suggest that relaxing the exogeneity assumption has no qualitative impact on the estimates. However, as expected, the IV-estimations reduce efficiency. To minimise the risk of bias we consider the results in column (3) to be our preferred results.

4.3 Court's price setting

As in section 4.2, we eliminate basic cost drivers by defining the dependent variable as the ratio of the amount awarded by the court (P^C) and the regulator (P^R). We then estimate the following model:

$$\frac{P^C}{P^R} = \beta_1 NoRev_{it} + \beta_2 Complex_{it} + \beta_3 NoRev_{it} \times Complex_{it} + \beta_3 LengLess60_{it} + \beta_4 LengLong560_{it} + \beta_5 LengTot_{it} + \beta_6 Urban_{it} + \beta_7 ThreeLar_{it} + \beta_7 NoPrec_{it} + \mathbf{T}_t \boldsymbol{\gamma}_t + \theta_i + \varepsilon_{it}, \quad (4)$$

where notations are as in (3). It should be noted that there is only one court reviewing decisions made by the EMI regulators and we do not have access to information about which judges participated in the reviews/decisions. Thus, no court fixed effects are included.

We perform the same tests of robustness regarding specification, sample and estimation as in Section 4.2[25]

[25] One potential problem with the appealed cases is that they might not be a random sample, thus violating one of the fundamental regression assumptions. Non-randomness can occur if, for example, firms with more financial and legal resources are more likely to appeal, if firms or customers have time-varying expectations about the court (such as who is serving as judge) or if firms and customers are more likely to appeal cases that involve larger charges. We attempted to control for this potential non-randomness by using Heckman's 2-step and maximum likelihood estimators. However, results were uninformative due to low level of statistical efficiency.

Table 4. Results when using P^C/P^R as dependent variable.

Variable	OLS (1)		OLS (2)		2SLS (3)		2SLS (4)	
NoRev	-0.00017		-0.00456	**	-0.00151	**	-0.01912	***
	(0.00042)		(0.00199)		(0.00063)		(0.00626)	
NoRev^2			0.00007	**			0.00029	***
			(0.00003)				(0.00009)	
Complex	-0.05704	***	-0.08614	***	-0.09393	***	-0.15727	***
	(0.01360)		(0.01829)		(0.01719)		(0.03346)	
NoRev × Complex	0.00011		0.00391	**	0.00108	***	0.01520	***
	(0.00032)		(0.00167)		(0.00042)		(0.00436)	
NoRev^2 × Complex			-0.00006	**			-0.00025	***
			(0.00003)				(0.00007)	
LengLess60	-0.00555		-0.00254		-0.00612		0.01426	
	(0.01311)		(0.01296)		(0.01355)		(0.01816)	
LengLong560	0.01123		0.00796		-0.00029		0.01165	
	(0.01466)		(0.01460)		(0.01542)		(0.02055)	
LengTot	-5.7e-6		-2.6e-6		0.00001		-5.1e-6	
	(0.00001)		(0.00001)		(0.00002)		(0.00002)	
Urban	-0.00677		-0.00425		-0.00701		-0.00111	
	(0.01470)		(0.01446)		(0.01487)		(0.01775)	
ThreeLar	-0.00963		-0.00905		-0.00543		-0.01262	
	(0.00882)		(0.00872)		(0.00918)		(0.01174)	
NoPrec	0.00062		0.00128		0.00180		0.00213	
	(0.00357)		(0.00362)		(0.00113)		(0.00174)	
Regulator FE	Yes		Yes		Yes		Yes	
Year FE	Yes		Yes		Yes		Yes	
Cragg-Donald Wald F stat					28.702		1.532	
Overidentification test (p-value)					Exactly ident.		0.124	
R2	0.418		0.400		0.329		0.106	
No obs	141		141		141		141	

Notes. *p< 0.10, **p< 0.05, ***p< 0.01. Homoscedastic-consistent standard errors (SE) are in brackets.

It should be noted that the first-stage F-statistic indicates that instruments are weak in column (4) so we treat those results as suggestive. The empirical results by and large suggest that the impact of *NoRev* and *Complex* on court decisions are negative and that the impact of $NoRev \times Complex$ is positive. These findings are consistent with predictions (iv)-(vi) but formal tests require that the main and interaction effects are evaluated simultaneously (see Section 4.4).

Nevertheless, the results in Table 4 suggest a number of relevant conclusions. First, both *NoRev* and *Complex* appear to be non-linearly related to the outcome. Second, there is a larger difference between results when *NoRev* is assumed to be exogenous and when it is endogenous compared to the regulators' decisions, indicating more serious endogeneity concerns in this case. This implies that the OLS estimates in Table 4 are likely to suffer from larger biases than those displayed in Table 3.

4.4 Consistency between theory and evidence

In this section we calculate predicted values of eqs. (3) and (4) for different levels of regulator experience and case complexity. This allows us to calculate net effects including interactions and square terms, which are not intuitive when inspecting the results visually.

Predicted values of $\frac{P^R}{P^F}$ based on estimates in column (3) of Table 3 are presented in Table 5. Here we use the following combinations of values: $NoRev = \{5, 30, 60\}$ and $Complex = \{1, 3, 5, 7\}$. While our sample contains values of *NoRev* varying from 1 to 95 and *Complex* varying from 1 to 11, we restrict the simulations to the maximum value of the interaction between them. We are cautious about evaluating out-of-sample predictions since some of the specifications include squared terms that easily produce absurd outcomes when input values are extrapolated.

Our theoretical prediction (i) states that regulators set lower prices when cases are relatively uncomplicated. Our results for both inexperienced and more experienced regulators are indeed consistent with this prediction. Predictions (ii) and (iii) postulate that experienced regulators set lower prices and respond more strongly to complexity, i.e. that they increase the price at a higher rate as complexity increases. Both those predictions are also confirmed.

Table 5. Price-setting by regulator based on results in column (3) in Table 3.

Complexity	P^R/P^F when regulator has chaired 5 reviews	P^R/P^F when regulator has chaired 30 reviews	P^R/P^F when regulator has chaired 60 reviews
1	0.8266 (0.0277)	0.7483 (0.0131)	0.6545 (0.0172)
3	0.8824 (0.0231)	0.8426 (0.0120)	0.7949 (0.0202)
5	0.9383 (0.0281)	0.9369 (0.0190)	0.9353 (0.0361)
7	0.9941 (0.0391)	1.0312 (0.0287)	1.0757 (0.0545)

Notes: Standard errors in brackets are calculated using the Delta method.

Table 6. Price-setting by court based on results in columns (3) and (4) in Table 4.

Complexity	Based on column (3) in Table 4		Based on column (4) in Table 4	
	P^C/P^R when regulator has chaired 5 reviews	P^C/P^R when regulator has chaired 30 reviews	P^C/P^R when regulator has chaired 5 reviews	P^C/P^R when regulator has chaired 30 reviews
1	1.0244 (0.0136)	1.0137 (0.0059)	1.0446 (0.0390)	0.9854 (0.0200)
3	0.8473 (0.0290)	0.8906 (0.0140)	0.8697 (0.0416)	1.1415 (0.0763)
5	0.6703 (0.0599)	0.7676 (0.0296)	0.6949 (0.0704)	1.2975 (0.1591)

Notes: Standard errors in brackets are calculated using the Delta method.

When calculating predictions of $\frac{P^C}{P^R}$ we also restrict maximum input values based on the maximum of the interaction between *NoRev* and *Complex*, conditioned on appealed cases. The two first theoretical predictions regarding the court's decisions are: (iv) when regulators are inexperienced and when cases are complex, the court reduces the regulator's price, and (v) when regulators are experienced and when cases are relatively simple, the court sets the same price as the regulator. These predictions are confirmed when using both the linear and non-linear versions of eq. (4). The last theoretical prediction says that the court increases the regulator's price when the regulator is experienced and when the case is complex. Here we observe distinctly different outcomes when using the linear and the non-linear specifications. The linear specification suggests that the court reduces the price, whereas the non-linear specification gives the opposite result. It is easy to argue in favour the non-linear specification given that all *NoRev* and *Complex* terms are significant at least at the 5% level in both non-linear models. Taking a cautious stand, we can at least conclude that there are good indications for consistency between theory and data.

Eq (4) also allows us to simulate final prices if all regulatory decisions had been appealed. It turns out that the court would have lowered prices for the non-appealed decisions by 10% on average, if those decisions had been appealed. This casts doubts on the view held by many practitioners that regulators are biased in favoured of the consumers. Instead, it seems more likely that regulators are influenced by other objectives, such as error minimisation.

5. CONCLUSIONS

This paper postulates that regulators dislike their decisions being overturned by courts and explores the consequences of such dislike for regulatory outcomes. Our results show that there is a strong relationship between the theoretical predictions and the results from the reduced form estimations.

In particular, our empirical results suggest that regulators set lower prices when cases are relatively uncomplicated. We have also provided empirical evidence supporting the theoretical prediction that experienced regulators set lower prices and respond more strongly to complexity, i.e. that they increase the price at a higher rate as complexity increases. Moreover, we have shown empirically that when regulators are inexperienced and when cases are complex, the court reduces the regulator's price, and that when regulators are experienced and when cases are relatively simple, the court sets the same price as the regulator. The only theoretical proposition that we partly fail to support empirically is the prediction that the court would increase the regulator's price when the regulator is experienced and when the case is complex.

Overall, our key contribution is to provide both a simple theoretical model and supporting empirical evidence, that the nature of the regulators' preferences and behaviour can have a number of consequences for regulatory outcomes. This evidence argues in support of promoting positive models of regulatory economics, where emphasis is placed on how regulators, as individuals, interact with the regulatory framework. This ought to complement the normative models that determine what regulators should do in order to maximise social welfare.

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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, does not know the true realised costs and so 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

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

Note that $U\left[p^R = c_L \mid E = 0\right] > U\left[p^R = c_H \mid E = 0\right]$ 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

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

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

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

■

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

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

and

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

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

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

This inequality holds, for example, whenever the probability that the regulated high cost 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 surplus is large.

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

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

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 is reduced to c_L. Similarly,

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

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

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

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

and

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

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

$$\bar{U} > -\Gamma + \frac{(1-q)(1-\gamma) + q(1-\delta)(c_H - c_L)}{-(1-q)\gamma + \delta q} \qquad (2)$$

and this inequality does not always hold as long as $\frac{q}{1-q} > \frac{\gamma}{\delta}$. (Since we need the denominator to be positive so that the sign won't change when we divide the inequality by it). Finally, whenever (2) is satisfied, the regulator will choose effort ε (and $p^R = c_L$) over 0 effort (and $p^R = c_H$) whenever

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

or

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

■

Appendix 2.

Table A2.1. Descriptive statistics.

Variable	Description	No. of obs.	Mean	S.D.	Min	Max
NoRev	Number of reviews chaired by regulator.	293	39.365	25.362	1	95
Complex	Number of customers affected by a connection.	293	2.0424	1.9786	1	11
LegnLess60	Indicator for when total line length is shorter than 60 metres.	293	0.2730	0.4463	0	1
LengLong560	Indicator for when total line length is longer than 560 metres.	293	0.1911	0.3939	0	1
LengTot	Total line length (metres)	293	320.82	414.04	0	3500
Urban	Indicator for when connection is in urban area	293	0.1741	0.3798	0	1
ThreeLar	Indicator for when firm is one of three largest (Vattenfall, E.On, Fortum).	293	0.6109	0.4884	0	1
NoPrec	Number of previous decisions made by the court.	293	87.577	80.917	1	189
CustCorp	Indicator for when customer is corporation.	293	0.4164	0.4938	0	1
P^F	Amount claimed by firm (SEK).	293	88 497	118733	8 960	1 348 187
P^R	Amount awarded by regulator (SEK).	293	64 828	77 852	6 981	696 812
P^C	Amount awarded by court (SEK).	141	75 117	86 463	6 981	696 812

Appendix 3.

This Appendix contains first stage results when eqs. (3) and (4) are estimated using 2SLS.

Table A3.1. First-stage results of eq (3), using 2SLS. Main results are presented in Table 3.

Variable	Main results in column (3)	Main results in column (3)	Main results in column (4)	Main results in column (4)	Main results in column (4)	Main results in column (4)
Dep. Var.	*NoRev*	*NoRev × Complex*	*NoRev*	*$NoRev^2$*	*NoRev × Complex*	*$NoRev^2$ × Complex*
Complex	2.07444	44.337 ***	2.77996 *	165.815	53.5348 ***	2584.57 ***
	(1.33785)	(2.86534)	(1.59055)	(157.734)	(3.25038)	(229.494)
LengLess60	2.96403	4.62247	2.77218	118.676	2.67190	226.638
	(2.61626)	(5.60338)	(2.51848)	(249.757)	(5.14666)	(363.383)
LengLong560	-3.07656	-8.08917	-2.06037	-413.976	-0.98689	-494.700
	(3.73756)	(8.00491)	(3.62597)	(359.586)	(7.40988)	(523.178)
LengTot	0.00279)	0.00669	0.00267	0.40771	0.00303	0.47001
	()0.00374)	(0.00801)	(0.00361)	(0.35833)	(0.00738)	(0.52135)
Urban	-1.26731	-3.29791	-0.63043	26.2159	-2.07280	-21.3988
	(2.88102)	(6.17043)	(2.76969)	(274.669)	(5.66001)	(399.628)
ThreeLar	0.79020	-10.545 **	1.85016	310.653	-6.65805	-164.177
	(2.16951)	(4.64654)	(2.10050)	(208.306)	(4.29249)	(303.073)
NoPrec	0.86241 ***	1.44920 ***	0.62440 ***	28.2746	0.66372	16.2133
	(0.20425	(0.43743)	(0.20320)	(20.1513)	(0.41525)	(29.3190)
Mech_NoRev	0.96647 ***	3.68395 ***	1.68988 ***	192.393 ***	4.82431 ***	361.842 ***
	(0.18868)	(0.40411)	(0.37961)	(37.6461)	(0.77576)	(54.7730)
Mech_ *$NoRev^2$*	-0.00074	-0.02184 ***	-0.01635 **	-2.60503 ***	-0.04912 ***	-3.84471 ***
	(0.00125)	(0.00269)	(0.00723)	(0.71747)	(0.01478)	(1.04388)
Mech_ *$NoRev^3$*			0.00008 **	0.01372 ***	0.00016 **	0.01288 **
			(0.00004)	(0.00366)	(0.00008)	(0.00532)
Mech_NoRev × Complex	-0.10105 **	-1.45666 ***	-0.19397 *	-12.4396	-2.46385 ***	-102.852 ***
	(0.05138)	(0.11004)	(0.11630)	(11.5334)	(0.23766)	(16.7804)
$Mech\_NoRev^2$ × Complex	0.00073 *	0.01458 ***	0.00246	0.15685	0.03636 ***	1.00402 ***
	(0.00040)	(0.00086)	(0.00234)	(0.23225)	(0.00479)	(0.33791)
$Mech\_NoRev^3$ × Complex			-8.1e-6	-0.00050	-0.00012 ***	0.00041
			(0.00001)	(0.00127)	(0.00003)	(0.00184)
Regulator FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
R2	0.658	0.821	0.608	0.550	0.838	0.820
No obs	293	293	293	293	293	293

Notes. **p*< 0.10, ***p*< 0.05, ****p*< 0.01. Default standard errors (SE) are in brackets.

Table A3.2. First-stage results of eq (4), using 2SLS. Main results are presented in Table 4.

Variable	Main results in column (3)	Main results in column (3)	Main results in column (4)	Main results in column (4)	Main results in column (4)	Main results in column (4)
Dep. Var.	*NoRev*	*NoRev* × *Complex*	*NoRev*	*NoRev*^{2}	*NoRev* × *Complex*	*NoRev*^{2} × *Complex*
Complex	2.40545	71.8653 ***	9.38043	1195.28	66.6474 ***	4568.26 ***
	(5.79445)	(7.24443)	(14.42993)	(1394.01)	(16.7188)	(1537.20)
LengLess60	3.26386	8.63302	2.72816	37.1375	6.98615	352.290
	(5.29928)	(6.62535)	(5.31295)	(513.26)	(6.15568)	(565.982)
LengLong560	-4.16178	-1.43546	-5.56272	-872.499	-4.94982	-885.977
	(5.98844)	(7.48697)	(5.94390)	(574.213)	(6.88670)	(633.196)
LengTot	0.00609)	0.00193	0.00840	1.00988 *	0.00907	1.10480
	()0.00573)	(0.00716)	(0.00576)	(0.55645)	(0.00667)	(0.61361)
Urban	-1.06577	-1.61938	0.07879	84.1668	-0.90629	40.7550
	(5.85219)	(7.31662)	(5.86599)	(566.687)	(6.79644)	(624.897)
ThreeLar	0.66865	-0.58046	-0.24437	165.612	-1.28049	113.832
	(3.59065)	(4.48916)	(3.56174)	(344.083)	(4.12669)	(379.427)
NoPrec	0.17481	0.26563	-0.10357	-42.556	-0.22862	-54.9830
	(0.43816	(0.54781)	(0.45306)	(43.768)	(0.52492)	(48.2636)
Mech_NoRev	1.17195 ***	2.24223 ***	4.24717 **	416.304 **	6.09903 **	602.518 ***
	(0.19161)	(0.23955)	(2.14375)	(207.098)	(2.48378)	(228.371)
Mech_ *NoRev*^{2}			-0.10430	-10.7287	-0.19842 **	-19.6184 **
			(0.08029)	(7.75657)	(0.09303)	(8.5533)
Mech_ *NoRev*^{3}			0.00102	0.10762	0.00237 **	0.22452 **
			(0.00083)	(0.08002)	(0.00096)	(0.08824)
Mech_NoRev × *Complex*	-0.09935	-1.00632 ***	-1.85381	-243.432	-3.78323	-435.682 **
	(0.14456)	(0.18073)	(2.00333)	(193.532)	(2.32109)	(213.412)
Mech_NoRev^2 × *Complex*			0.08074	9.81136	0.18301 **	19.3100 **
			(0.07855)	(7.58883)	(0.09102)	(8.36836)
Mech_NoRev^3 × *Complex*			-0.00092	-0.10476	-0.00233 **	-0.22574 **
			(0.00083)	(0.07979)	(0.00096)	(0.08799)
Regulator FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
R2	0.458	0.668	0.493	0.461	0.734	0.572
No obs	141	141	141	141	141	141

Notes. **p*< 0.10, ***p*< 0.05, ****p*< 0.01. Default standard errors (SE) are in brackets.