Strategic Advice for IPART's Review of Water Regulation

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Executive Summary

This report provides some advice from an economist's "mechanism-design perspective" on the current and proposed water regulations in New South Wales. The report situates the current regulatory environment within the core lessons of the academic literature on regulation (both classic and more modern contributions).

The proposed "3Cs model" of regulation sits well relative to the academic literature, and it is tailored in the practical regulatory environment under consideration.

In addition to the standard models of regulation on which "building-blocks" are based, it is important to acknowledge that water regulation in NSW has elements of:

1. A dynamic regulatory environment where the ability of the regulator to commit to future policy plays an important role in addressing heterogeneity among regulated firms;
2. A "multi-dimensional" screening problem where both cost-efficiency and service-quality are relevant dimension of "type";
3. A "moral hazard" setting where financial incentives can play an important role;
4. An environment where "career concerns" of managers and Board directors provide important non-pecuniary incentives;
5. "Opacity" in incentive provision may help deter gaming of regulatory/ incentive schemes;
6. A setting where customer outcomes could be measured more effectively; and
7. An environment where behavioral considerations about "upside benefit" versus "downside risk" is important in understanding and providing incentives for incentivizing managerial actions.

The 3Cs framework developed thus far addresses these considerations well and, in my opinion, is well-suited to pushing water businesses in NSW to drive innovation, cost efficiencies, and improve customer outcomes in the years ahead.

All of these issues are discussed in more depth in the pages that follow.

Introduction

Regulatory Objectives

Water is an essential service that has strong features of "natural monopoly" making it an important candidate for regulation. New South Wales is not exception to this general statement. And, perhaps unsurprisingly given the economic geography of the state, there is significant heterogeneity among the water businesses regulated in NSW.

It is appropriate that, from time to time, regulatory arrangements are reviewed in light of:
1. Their existing performance and the outcomes generated;
2. The changing economic and technological environment; and
3. Regulatory practices in other jurisdictions.

IPART's review of the current water-regulation framework is a welcome and important exercise, and it is a privilege to be able to provide some thoughts on regulation in general, and water regulation in NSW in particular.

The Changing Nature of Regulation

Advances in information technology over recent decades—from personal computers and smart phones to real-time sensors and social media apps—have changed the nature of many existing businesses and facilitated the entry of new players as well as the advent of entirely new sectors.

Although costs of regulated entities may not have become significantly easier to measure, it is fair to say that the quality of customer outcomes has become easier to observe. Advances in technologies that allow customers to provide real-time feedback have emerged—and customers themselves have become more used to rating all kinds of customer-service experiences (such as ridesharing, food delivery, and many forms of retail products and services). This has led to a increased demand for regulation that extends beyond ensuring cost efficiency, but also toward high-quality service delivery as well.

National and International Trends

Perhaps the most obvious trend in recent years is toward a greater focus by regulators on customer outcomes provided by regulated water businesses.

For instance, a number of international regulated water business are now required to undertake substantial customer engagement. This is part of a secular shift towards customer preferences playing a larger role in the decisions made by these businesses—especially around price-quality tradeoffs. Examples of jurisdictions where this has occurred among water regulators and their regulated entities include England & Wales (Ofwat), Scotland (Water Industry Commission for

Scotland—WICS), South Australia (Essential Services Commission of South Australia—ESCOSA), and Victoria (Essential Services Commission—ESC).

It is also apparent that regulators in these jurisdictions have moved to an approach where the regulated entities themselves are responsible for customer engagement. This is typically done via the establishment of arms-length customer panels which report back to the relevant regulator. As CEPA noted in their June 2020 report prepared for IPART: "The intention of these approaches is also to ensure that companies take ownership of identifying and providing services that their customers value, rather than responding to regulatory direction."[1]

Perhaps closest and most relevant to the current IPART review was the regulatory-reform exercise undertaken by the Essential Services Commission (ESC) in Victoria, beginning in 2015. The framework the ESC adopted in 2018, known as PREMO (Performance, Risk, Engagement, Management, Outcomes) for the 5 criteria against which regulated entities are assessed, involves a focus on (quoting from Essential Services Commission (October, 2016), *Water pricing framework and approach: Implementing PREMO from 2018*):

1. Performance: have the performance outcomes to which the business committed in its price submission been met or exceeded?
2. Risk: has the business sought to allocate risk to the party best positioned to manage that risk?
3. Engagement: how effective was the business's customer engagement?
4. Management: is there a strong focus on efficiency? Are controllable costs increasing, staying the same, or decreasing?
5. Outcomes: do proposed service outcomes represent an improvement, the status quo, or a withdrawal of service standards?

This framework made three principal changes to the regulation-review process. As the May 19, 2021 internal note to the Tribunal observed, these three changes were:

> ***Greater customer engagement in water businesses' price submissions*** *– Water businesses needed to demonstrate that engagement informed their decisions, and the submission was focused on customer outcomes that the water businesses then reported annual performance against.*

> ***An incentive mechanism for determining the return on equity*** *– Water businesses must self-assess their proposal against the five criteria of Performance, Risk, Engagement, Management and Outcomes (PREMO) and the ESC then conducts its own assessment. On this basis a return on equity is determined for the business. PREMO is designed to incentivise businesses to submit their 'best offers' in terms of customer outcomes.*

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[1] CEPA (2020), "Economic regulation of water utilities – research".

Greater flexibility in the process and a shift away from a one-size-fits-all approach to regulation – Water businesses have the quality of the submission rated. 'High quality' submissions that are categorised as leading can potentially be fast-tracked to a draft or final decision with little or no changes to prices. The PREMO incentive also means businesses are no longer subject to a single weighted average cost of capital (WACC).

In light of these trends, it is timely for IPART to review water regulation in New South Wales.

The primary purpose of this report is to:

1. provide an economist's perspective on the economic and regulatory environment;

2. offer an economic framework—based on widely accepted and modern academic literature—for thinking about the regulatory problem of regulating NSW water businesses; and

3. assess the proposed IPART regulatory changes (or "3Cs model") relative to the prescriptions of the economic literature.

In doing this the report explicitly takes a *mechanism-design approach* to regulation. That is, it considers the regulatory problem as one of creating a game form (in the sense of the field of game theory), complete with a set of players, information structure, set and order of moves, and a payoff structure conditional on terminal histories of the game. This game form is designed to maximize a well-defined set of regulatory objectives.

In other words, the report takes a normative approach to considering the design of an optimal regulatory scheme tailored to the particular economic and institutional environment in question.

A theme which is emphasized throughout this report is that while long-used and well understood regulatory instruments and approaches (such as "building block regulation", for example) remain useful and important, the economic environment occupied by regulated water businesses in NSW means that there are multiple aspects to the regulatory problem that interact with each other in important ways.

This is part of the attraction of a mechanism-design approach, in that it seeks to take a holistic view of the economic environment, including (to highlight a few examples) the strategic interactions among the boards and managers of the water businesses, between the regulator and regulated entities over time, between the water businesses and their customers. This approach is also attentive to the informational environment and how the information available to various participants can be altered to improve regulatory outcomes.

Background

Scope of Work

In commissioning this work IPART provided me with the following background

*"The Independent Pricing and Regulatory Tribunal (**IPART**) is the economic regulator of monopoly water utilities in NSW. IPART:*

▼ *Sets maximum prices, about every four years, for the utilities. We use a building block approach with an efficiency review process.*

▼ *Recommends and monitors compliance with Licence Conditions. For some – but not all – of the businesses we price-regulate, we set service and other standards in an Operating Licence. We monitor compliance with the licence through an annual audit.*

We regulate a small number of monopoly service providers that vary greatly in terms of scale and sophistication.

IPART has initiated a review of our regulatory approach in water to make sure that it is continuing to achieve its objectives and, where appropriate, to improve its operation and ensure that it is best practice. In particular, we consider:

▼ *The utilities we regulate have delivered limited improvements in efficiency in recent years.[2]*

▼ *There is opportunity for the utilities (and IPART) to move to a more 'customer outcomes' focussed regulatory framework.*

▼ *There is a need for our regulatory framework to be reviewed to ensure the water businesses are able to adapt to meet the challenges of climate change and to promote environmental outcomes.*

Separate to this review, there is also a Water Industry Competition Act (WICA), and a third-party access regime (Cost Allocation Guide and Manual) to encourage competition in the NSW market (at wholesale and retail levels). While still important, this review takes the need for monopoly regulation (at some level) as required given the current state of the market."

I also spoke with the tribunal and employees of IPART and received certain briefing documents. Parts of the conclusions of this report are based on information provided during those discussions and in those documents.

Disclaimer

This report was prepared for the exclusive use of IPART.

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[2]   In addition, a voluntary incentive scheme that we introduced to encourage operating expenditure efficiencies (the Efficiency Carryover Mechanism) has not been used by the utilities to date.

An Economic Framework for Water Regulation in NSW

Overview

The purpose of this section is to connect the modern economic literature on regulation to the specific regulatory problem that the Tribunal faces. Much of this literature will be familiar as the insights from it have been integrated into the practice of regulation for many years.

In terms of formal economic models of regulation, this has antecedents in the work of Mirrlees (1971) on optimal income taxation. Many of the most useful formal models of regulation stem from the work of Jean Tirole and coauthors—especially his collaboration with Jean-Jacques Laffont.

Yet there are also important insights for regulation to be drawn from other parts of the Contract Theory literature dealing with principal-agent problems (including the "multi-task model"), the emerging literature that focuses on "gaming" of incentive schemes, and also an earlier but sometimes underappreciated literature initiated by Laffont and Tirole (1988) on dynamic adverse selection where the possibility that information is revealed over time means that: (i) from a technical perspective the revelation principle may not apply, and (ii) from an economic perspective the optimal mechanism can look very different than the optimal static mechanism.

The Economic and Regulatory Environment

An obvious but fundamental point to note is that the type of regulatory environment relevant to the NSW water regulation has several basic economic features.

First, there is *hidden information*. Regulated water businesses have superior information about their own cost structure and the ability to make cost-saving efficiencies through capital investment and managerial effort.

Second, there are *hidden actions*. Managers of regulated water businesses can take privately-costly actions that increase the quality of the service they provide to customer and/or reduce the cost of delivering that service.

Taken together, these first two points suggest that there are multiple dimensions to the regulatory problem. Both adverse selection and moral hazard are at play. And the "type" (to use the language of information economics and mechanism design) of the regulated firm has multiple dimensions (at a minimum, cost and quality). This is relevant for what economic framework best applies to the particular regulatory problem under consideration here.

Third, regulation takes place over time with both the regulator and the regulated being relatively long-run players that interact repeatedly. This opens the door to the use of reputational incentives and *relational contracts* (i.e. understandings between the regulator and regulated than can be self-enforcing rather than contractual/statutory).

Fourth, there are implicit incentives that managers of regulated water businesses *and* the member of their boards of directors already face. In particular, managers typically seek future employment at other regulated businesses, and directors typical seek future directorships. These *career concerns* (to use the language of Holmstrom (1982)) are potentially important sources of either managerial discipline, or alternatively may lead to distorting behaviors. Moreover, as will be discussed below, explicit financial incentives may crowd out the incentives generated by career concerns.

Asymmetric Information

Perhaps the canonical regulatory problem is an economic environment where a firm (the leading case is where there is a single monopolist in the relevant market) has superior information about its cost structure to the regulator. If the firm can be one of a number (even just two) different "types" then the regulator faces the problem of how it might be able to extract the private information of the firm in order to improve its (i.e. the regulator's) outcome.

Formal economic models of this phenomenon have become known as *screening*. In recognizing the contributions of George Akerlof, Michael Spence, and Joseph Stiglitz to information economics, the Nobel Committee observed that Akerlof pointed out how asymmetric information can lead markets to unravel; Spence had showed how the informed party can improve their outcome through *signaling*; and Stiglitz (along with Michael Rothschild) had pioneered the analysis of *screening* whereby the uninformed party can improve their payoff.

Rothschild and Stiglitz analyze an insurance market where companies don't know the risk profiles of the individuals that might purchase insurance from them. They show that these companies can improved their payoff by offering *menus* of contracts—in their setting different combinations of premiums and deductibles. When certain assumptions are satisfied, and the premium-deductible pairs are chosen optimally, it can be show that customers voluntarily "self-select" the policies intended for them by the insurance companies—thereby improving the payoff of those companies despite their informational disadvantage. As the Nobel Committee noted, this "screening through self-selection is closely related to Vickrey (1945) and Mirrlees (1971) analyses of optimal income taxation, where a tax authority (unaware of private productivities and preferences) gives wage earners incentives to choose the right amount of work effort)." In fact, the key notion underpinning this self-selection is that of *incentive compatibility* due to later (2007) Nobel laureate Leonid Hurwicz (Hurwicz, 1972).

A classic formal treatment of the regulation problem is Baron and Myerson (1982). For completeness a textbook-type treatment of the Baron-Myerson framework with 2 types is contained in Appendix A of this report. But the economic logic is by now familiar. The regulator does not know which of two "cost types" of firm they face. By offering a menu of contracts the regulator can cause it to be in the interests of the firm (of either type) to select the regulatory contract intended for them, thereby revealing their private information in equilibrium. The first-

best (i.e. the level of economic efficiency obtained in the absence of private information) is not obtainable, but the constrained second-best is obtained through the optimal menu of contracts.

In this static setting it is the "downward" incentive-compatibility constraint(s) that bind. Later in this section when we briefly discuss dynamic adverse selection and screening, we will see that in such a dynamic environment this need no longer be the case.

Moral Hazard

Basic Theory

As we discuss in more details at various points later in this report, there are also important features of the regulatory problem under consideration here that involve "hidden actions". Indeed, in the context of modern NSW water regulation this is arguably even more important than the standard regulatory theory emphasizing "cost types" of firms. This class of problems has come to be known as the "Principal-Agent problem" or "moral-hazard problem" (classic references include Mirrlees (1975), Grossman and Hart (1983)).

In the classic principal-agent problem a risk-neutral principal hires a risk-averse agent to perform an action (or vector of actions). The action is privately costly to the agent, and this is non-contractible. The principal does not observe the action the agent chooses but do observe outputs/profits which are a noisy signal of the action(s). The agent's action choice induces a probability distribution over outputs with a "harder" action coming at a larger private cost to the agent.

Contracts can be written on outputs, but because of the stochastic relationship between action and output, incentives for the agent to choose a harder action impose risk on the risk-averse agent. There is thus a tradeoff between incentive and insurance in the second-best optimal contract between principal and agent. As is discussed below, in the practical regulatory setting in question, it is important to strike the appropriate balance between risk and return for the regulated entity and then to allocate responsibility for managing that balance to the business.

An important elaboration of the standard principal-agent model is the so-called "multi-task" principal-agent model due to Holmstrom and Milgrom (1991). Holmstrom and Milgrom emphasize that when the agent performs two or more tasks, and those tasks are related in their cost of effort function (e.g. they are technological substitutes due to time limitations) then incentives on one task can crowd-out incentives on other tasks. This idea—which has come to be known as the *effort substitution problem*—is of great practical significant. From a positive perspective it helps explain why we sometime observe low-powered incentives that may, in fact, be optimal. For instance, school teachers are typically not given explicit performance pay. But viewed through the lens of the multi-task model this arguably make sense. Teachers perform some tasks (like teaching students basic skills such as reading and writing) which are relative easy to measure (even if measurement is imperfect). On the other hand, they also impact "higher-learning skills" and intangibles like "a love of learning" that are extremely hard to measure. Financial incentives for student performance on

standardized tests can lead teachers to substitute effort away from higher-learning skills toward basic skills, to the detriment of students and society.

In business settings more akin to the water firms at issue in this regulatory review, managers at those firms may exert effort that affects both the costs of the firm and also the quality of their service (i.e. the "customer experience".) Incentives, if they are to be provided implicitly or explicitly, must be carefully calibrated so as not to crowd out the incentives that already exist (e.g. through reputational or career concerns).

Moreover, viewed through the multi-task-lens, incentive schemes must be conscious of the precision with which performance can be measured, and also the background incentives that already exist.

Behavioral Biases

One important consideration that has gained traction in recent years is the impact of individual psychological (or "behavioral") biases in making economic decisions. This idea, dating to the work of Kahneman and Tversky, as well as many notable contributions by Thaler, that individual decision-makers do not act according to the standard "expected-utility" framework traditionally used in economics has been shown to have important theoretical and practical implications for many areas of economics.

This literature is vast, and it is beyond the scope of this report to summarize it. But one key area where it is highly relevant to the regulatory problem at hand is in the area of incentives for managers of water businesses. Kahneman and Tversky's notion of "prospect theory" (Kahneman and Tversky, 1979) implies that individuals—as a positive matter—tend to suffer more in utility terms from losses than they do from equivalent-sized gains.

This has an immediate implication for how individuals respond to incentives. It suggests that they may be more responsive to "downside incentives" rather than "upside incentives". To the extent that financial incentives tend to be about gains/upside and reputational incentives (i.e. career concerns) tend to be about losses/downside, then prospect theory implies that career concerns have more purchase for the same size of incentive than financial incentives.

There are three important caveats to this, nonetheless correct, statement. The first is that financial incentives are endogenous to the regulatory problem and, so too to some degree, are career-concern incentives since the regulator making information about the performance of regulated entities directly affects the reputation of managers (and to some extent board members) of those entities. The second is that the *size* of these incentives is also endogenous. Nothing about prospect theory—or any other theory based in psychology & economics of which this author is aware—suggests that sufficiently large financial incentives do not have an impact on behavior. The third caveat is that financial incentives can be crafted to provide "downside incentives"—say though changing default compensation to be larger, but at risk and based performance levels (e.g. customer

outcomes) being above a certain threshold. It is worth noting that this latter type of incentive provision takes prospect theory *very* seriously, and this author is not aware of any field or laboratory experimental evidence suggesting that such incentive schemes work either well or poorly.

Having said that, one reason for optimism about the efficacy of using larger penalties relative to rewards comes from the literature on optimal prize structures in rank-order tournaments. In particular, Akerlof and Holden (2012) show that in a range of such tournament-settings it is "optimal to give rewards to top performers that are smaller in magnitude than corresponding punishments to poor performers."

There are thus good theoretical reasons to believe that downside incentives could be a useful regulatory tool, and a cautious but systematic development of such incentives may be a tool that the Tribunal wishes to consider.

The Laffont-Tirole Framework

Having highlighted both adverse selection/hidden information problems as well as principal-agent/hidden action problem it is also worth noting that the contribution of Laffont and Tirole (1986). The Laffont-Tirole framework is also very instructive—even though the setting is in some ways closely related to Baron-Myerson—and has rightly played an important part in practical regulation. In the Laffont-Tirole framework regulation is treated as a principal-agent problem, with the regulator as the principal, and the regulated firm as the agent (in their model it is really the manager so as to avoid a tiered principal-agent problem between the board of the regulated firm and the manager and between the regulator and the board of directors).

The regulator observes realized production costs, but not the effort that the manager has exerted toward cost reduction (this is a hidden-action problem). A larger amount of privately-costly effort by the manager leads to stochastically lower costs. Crucially, in addition to this the manager/firm has superior knowledge about its costs-reduction technology than the regulator (this is a hidden information problem.

The optimal (static) regulatory mechanism that Laffont-Tirole derive involves three key features:

1. Firms/managers self-select by truthfully revealing their cost type;

2. Each type provides less effort than in the first-best; and

3. All types receive an information rent.

An important implication of Laffont-Tirole—and it bears directly on how "high-powered" incentive schemes for NSW water businesses should be—was described by the Nobel Committee in the advanced materials for Tirole's 2014 Prize as follows:

> *Laffont and Tirole (1986) was published at a time when different regulatory schemes were hotly debated. Some policies were recognized to have poor incentive properties, leading to huge cost overruns. The trend was to abandon rate-of-return regulation in favor of price-cap regulation, where in effect the firm becomes the residual claimant for cost savings…While the poor incentive properties of rate-of-return and cost-plus regulation had already been recognized, the Laffont-Tirole model highlighted a subtle problem with price caps: high-powered incentives imply large rents to efficient firms, which is very costly if public funds are raised by distortionary taxation, or if the regulator has distributional objectives. To reduce these rents, optimal regulation will generally not induce first-best levels of cost-reduction. Thus, observing unnecessarily high production costs does not necessarily reflect badly designed regulation. This important fact plays a key role in dynamic regulation.*

Transparency versus Opacity

A common concern with incentive schemes of various types in the possibility of "gaming"—that is, the recipient of incentives exploiting an incentive scheme to her own advantage to the detriment of the objectives of the incentive designer.[3] As Ederer, Holden, and Meyer (2018) observe: "Gaming can take numerous forms, among them (i) diversion of effort away from activities which are socially valuable but difficult to measure and reward, toward activities that are easily measured and rewarded; (ii) exploitation of the rules of classification to improve apparent, though not actual, performance; and (iii) distortion of choices about timing to exploit temporarily high monetary rewards even when socially efficient choices have not changed…The costs of gaming are exacerbated when the agent has superior knowledge of the environment: this makes the form and extent of gaming harder to predict and hence, harder to deter."

Ederer, Holden and Meyer (EHM) analyze a multi-task principal-agent model in the spirit of Holmstrom and Milgrom (1991), but where the agent has superior knowledge of the economic environment. They show that opacity/lack of transparency of the incentive scheme can reduce gaming. Of particular relevance to the water regulation problem at hand, EHM highlight that opacity can induce the agent to *balance* her efforts across multiple dimensions of performance.

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[3] There is now a large empirical literature documenting this phenomenon. Some prominent examples include: Burgess, Propper, Ratto, and Tominey (2017), Carrell and West (2010), Gravelle, Sutton, and Ma (2010), Oyer (1998), Larkin (2014), and Forbes, Lederman, and Tombe (2015).

It seems clear that effort by managers of regulated water entities affects multiple dimensions of performance over which the public has a legitimate interest. At a minimum, such effort affects: the cost of water provision, the service and other quality to customers, and the environmental impact of supply. Moreover, the public (and hence the regulator) are likely to want *balance* across these performance dimensions—and hence somewhat balanced effort from the regulated entities. For instance, very low-cost water that is so low quality as to be unsafe or undrinkable is of no value. Similarly, high-quality water delivered according to superior service standards might be deemed unacceptable (and hence of little or no value) if it comes at too great an environmental cost.

In such settings where there are important complementarities along the different dimensions of effort, EHM show that an opaque incentive scheme can dominate a transparent scheme. One way to implement such opacity is to be unclear *ex ante* about the weights that will be applied to various dimensions of effort/output. For instance, one could say that each of three dimensions will receive a weight between 0 and 50% of the total incentives to be provided, with the three *ex post* weights summing to 100%. The actual mix of those weights would be determined at the end of the relevant measurement period. Indeed, a perfectly well-defined method of determining the *ex post* weights is to choose them to minimize the total incentive payments (this is the scheme that EMH call "ex post discretion".

It is important to note that opacity here is in terms of the incentive weights on different measures of performance, not on the measures of performance themselves. Furthermore, there is complete transparency about the process of providing incentives and the objectives of the regulator. In this sense such strategic opacity does not conflict with commonly-invoked understanding of the virtues of transparency in public administration.

Dynamic Screening

When regulation takes place over time—as is almost always the case in practice—the clean separation of types that is the hallmark of the optimal static mechanism (both the Baron- Myerson and Laffont-Tirole frameworks exhibit this feature) no longer applies.

To see this, first note that if the regulator can commit to a mechanism at every future period, then the dynamic problem becomes stationary—i.e. just a sequence of one-period static problems.

If the full separation from the static case were to apply in a dynamic setting, then all types would be revealed in equilibrium in the first period. But then—in the absence of commitment by the regulator, this information would be used against the most efficient types of firms.

Realizing this, firms would need to be paid a very large "information rent" in order to reveal their type. But, and this is the final step in the chain of logic, having received such a large rent they may simply exit the market—leaving only the inefficient types participating in the market.

This clearly can't be part of an equilibrium regulatory strategy because the regulator would never find it optimal to pay a large rent only to have efficient types "take the money and run" (as this strategy was dubbed by Laffont and Tirole (Econometrica, 1988) in the follow-up to their 1986 Journal of Political Economy paper).[4]

This leaves open the question of "how much pooling" (of types) there is in equilibrium—and Laffont and Tirole (1988) provide conditions under which there is a "lot" of pooling. In particular, when uncertainty about types is small, this characterization holds. An important implication of this analysis is, as they put it

> *The leitmotiv of our paper is that full separation becomes impossible or very costly in a repeated relationship without commitment. The economic consequence is that in such circumstances agents can only be given "low- powered" incentive schemes.*

These observations have a number of implications for the regulatory problem at hand. The first is that commitment to future regulatory behavior is an important determinant of being able to sustain a separating equilibrium and therefore to the ability to provide meaningful incentives for cost reduction (and innovation, in a richer model of firm behavior). A prerequisite for this is providing sufficient detail about the design and implementation of the regulatory scheme. To the extent that the regulator is a long-run player with a well-defined objective and strategy, such commitment may be more feasible—at least in part.

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[4] This can be made into a theorem that for any first-period menu of contracts there cannot exist a fully separating continuation equilibrium. The proof follows from the fact that Simple intuition: for any type μ there exists a type $\mu + d\mu$ who would like to mimic in the first period. Doing so entails a second-order loss in the first period (by the Envelope Theorem). But it generates a first-order gain in the second period because they are believed in equilibrium to be a lower type.

The second implication is that poor performance by regulated firms—as some believe has occurred among water businesses in NSW in recent years—may be partly due to the inability to offer an effective menu of contracts that separates efficient from less efficient types.

Both commitment power (essentially credibility of the side of the regulator) and a well-designed menu of contracts are crucial to providing for greater separation of different types of firms, and hence better outcomes in terms of both cost efficiency and service quality.

It is important to note that all of the preceding discussion of the dynamic aspects of regulation assume that the types of the regulated firms are fixed over time. So, for example, low-cost types stay low cost types forever. This is not very realistic, and relaxing this assumption has important theoretical and practical implications. It is beyond the scope of this exercise to go into these in detail, but the practical implications include: (i) understanding the extent to which types naturally tend to become more or less efficient over time; and (ii) the ways in which the regulatory scheme itself can endogenously affect how types change.

Regulatory Instruments

In mapping the academic literature on regulation into a practical regulatory approach it is useful to highlight the suite of instruments that the regulator has available.

Among those instruments are:

1. A standard price-cap based building block model of regulation.

2. Direct revelation mechanisms where the regulated entity is asked to make a report (or "self-assess") and the choices they subsequently face and payoffs they ultimately receive depend (in part) on this report.

3. Financial incentives to firms based on some number of observable performance measures. These performance measures could be related to financial performance or realized costs, and also based on customer satisfaction surveys or other measures of the quality of service-delivery. The *structure* as well as the *magnitude* of these incentives are important. The structure includes the relationship between performance measures and financial outcomes (which may be highly non-linear), the timeframe over which the incentives are provided, and other design features.

4. Reputational incentives through the publication of performance by regulated according to various performance measures. In addition to this, the "grading" of proposals under a direct revelation mechanism can be useful in terms of bolstering reputational incentives.

This is part of the reason that the language used in those assessments (e.g. "leading" or "standard") is important.

5. Commitment power / a strong reputation of the regulator.

Summary

The modern economic theory of regulation is based, at its core, on insights developed from important contributions in the 1980s. Chief among these is that menus of contracts can be used to achieve a separating equilibrium among different "types" of firms in a setting where firms can be completely characterized according to one dimension (e.g. cost).

Since that time these insights have been preserved, supplemented, and also modified to some degree. Screening in settings where types are multidimensional (not discussed in this report, but for an excellent overview see Rochet and Stole (2003)) typically leads to less clean separation of types and more "bunching". Dynamic screening (e.g. regulation that takes place over time) also leads to (potentially much less) separation than under the optimal static mechanism.

In practice the regulatory screening problem is both multidimensional (cost and quality both matter, at a minimum) and it is clearly dynamic. This suggests that it will be optimal in practice for there to be less-than-clean separation of types.

Furthermore, contract theory more generally provides insights about both hidden information problems, hidden actions problems, and the interactions between them. While the Laffont-Tirole (1986) workhorse regulatory framework is premised on a moral-hazard problem, richer principal-agent models are also instructive, and may not have been sufficiently incorporated into regulatory practice in water or other sectors around the world.

The "3Cs Model"

Overview

The "3Cs model" that has been proposed involves a focus on three elements of the regulatory problem: customer value, cost efficiency, and credibility. As a practical matter this means that water businesses would need to demonstrate a commitment to meeting customer outcomes, do so in a cost-efficient manner, and have made commitments that are credible. These would happen through a "self-assessment" process that is then assessed by IPART.

As part of this, explicit incentive mechanisms would be used, through a combination of reputational incentives, cost-based incentives, and customer-service incentives.

As the 19 May 2021 note to the Tribunal observed, this approach would adopt three criteria compared to the five used by the Essential Services Commission (ESC). The 3Cs model aims to make core changes similar to those adopted by the ESC, but in addition seeks to emphasize:

1. Promoting stronger engagement with customers by regulated water businesses;
2. Provide meaningful incentives for at least a subset of the water businesses that have the highest-ranked proposals; and
3. Ensure that the regulatory framework is suitable for the degree of heterogeneity among the NSW water businesses—which is substantially greater than those in Victoria.

It appears that one of the weaknesses of Victoria's PREMO framework is that it seeks to provide incentives for high-quality proposals but that if water businesses subsequently do not meet the proposed outcomes the consequences are unclear. It has also been observed by the Tribunal that, despite the PREMO framework being in place for several years, it remains unclear how the extent of customer engagement by water businesses is measured, assessed, and incentivized.

From a practical perspective, the 19 May note outlines a regulatory process as follows

> *In addition to currently having a price-cap based building block model to regulate water business, IPART adopts a propose-respond process in assessing water businesses proposals. The propose-respond framework is commonly used by several regulators.*

> *The propose-respond framework means that water businesses lodge a pricing proposal, where they make evidence-based requests for expenditure and tariff structures for services. At times, in the absence of separate processes dealing with changes to the regulatory framework, water businesses have also used*

the pricing proposal to request changes to the existing regulatory treatment of certain services.

The same note highlights how the proposed regulatory framework would capture each of the 3Cs. Quoting directly from that note:

Customer value: *A service target performance incentive scheme (STPIS) operates so that there are incentives for maintaining and improving network performance, to the extent that consumers are willing to pay for such improvements. In energy this has normally related to reliability levels looking at the duration and number of outages. The customer service incentive scheme (CSIS) encourages regulated businesses to engage with their customers, identify the customer services they want improved, and then set targets to improve those services.*

Both schemes are consistent with identifying and promoting what customer want and enhancing customer value. The schemes also operate so that businesses are rewarded to the extent they achieve such outcomes and suffer financial loss if they are unable to meet the required levels. This is consistent with what would be expected in an effectively competitive market, and results in water businesses better accounting for and appreciating the price-quality trade-off in their service offerings.

IPART has also proposed that water businesses graded as standard should still monitor annually their performance against service performance and customer outcomes. The key difference being that there are no financial incentives tied to these. Given some of the smaller and less mature businesses may not have the capability to suggest performance and customer outcomes that should be measured, it may be beneficial for IPART to consider issuing some "boiler plate" services performance and customer outcomes that water businesses could monitor in the first instance. The more established and mature water businesses could adapt these outcomes and add to them based on their own research and monitoring capabilities.

Cost efficiency: *Cost incentive schemes for opex and capex provide the business with rewards for undertaking effort resulting in productivity improvements that reduce controllable expenditures. This is consistent with what happens in an effectively competitive market and incentivises regulated monopoly businesses to pursue the most efficient overall cost solution with the appropriate trade-off of opex and capex.*

These incentives will be stronger, the longer the timeframe over which cost savings can be carried. That is, an efficiency benefit sharing scheme of opex where the carryover is aligned to a longer regulatory period will provide more powerful incentives for business to pursue cost reduction, as they receive a greater share of the benefits.
The benefit to customers is that over time, they will experience lower prices for service at an appropriate quality level, as there are greater efficiency gains achieved over the longer term that are shared with customers.

Over time, businesses that respond to cost incentive schemes and pursue ongoing productivity improvement also have a strong incentive to truthfully reveal their costs. This could provide the added benefit of requiring a less intrusive efficiency review by the regulator in the longer term. A similar incentive for cost efficiency exists under a TOTEX scheme.

As already noted, to balance the pursuit of cost efficiency at the expense of service levels for customers, such cost incentive schemes should also be complemented by service performance incentive schemes or customer service incentive schemes. This will ensure cost savings are not being pursued at the expense of consumer outcomes.

In addition to cost incentive schemes where businesses are rewarded for managing their controllable costs, it conversely holds that regulated monopoly businesses should neither be punished, nor benefit, from unanticipated material cost changes (up or down) that are outside of their control.

To the extent there are material unanticipated cost increases, which in water business can arise form changes in government policy within the regulatory period, these should be passed on to customers when they are incurred. Cost passthroughs or contingent cost mechanisms (for more uncertain projects) have the benefit that the business does not propose charges to customers on the expectation that the costs might arise, the customer only pay for such costs if and when they occur.

If done correctly, cost passthroughs and contingent cost mechanisms are also consistent with effectively competitive market outcomes. That is, in competitive markets businesses often pass-through material increases/decreases in cost – such as large exchange rate increases on imported good – but also absorb such costs where they are immaterial.

A key challenge for any regulator is make sure that it sets the level of materiality of costs correctly. In the absence of that, and where there are extensive cost passthrough mechanisms provided, the regulator will be at risk of creating something akin to a more low-powered incentive cost-of-service regulatory regime. IPART will need to consider this balance carefully in how it treats the different businesses.

***Credibility:** The business achieves a higher dividend or return to the extent it provides what IPART considers to be high-quality proposal that meets the 3Cs.*

As noted, a challenge with the ESC's PREMO framework is that while a higher return on equity may be provided for a high quality price submission, if the business does not fulfill its promises or commitments there is no internal correction mechanism for the business to have its return reduced. It would require the ESC to intervene mid-period based on performance or rely on the fact that in a repeated game setting, the ESC is unlikely to provide such a higher return on equity in the next proposal.

A strength of the menu regulation framework used in the UK is that businesses that are standard and wrongfully categorise themselves as leading, should ultimately achieve a lower risk-adjusted rate of return during the regulatory period. There is effectively an internal correction mechanism that exists, which incentivises businesses to be truthful about their position and recognise their existing shortcomings.

IPART's regulatory framework is proposing to make sure that a similar menu is in place for businesses. That is, to the extent a standard business for reputational reasons pretends to be a leading business, then the combined incentive schemes would operate in concert with the opex and capex allowances to ensure that despite getting access to a higher dividend or return on equity, the actual return achieved will ultimately be below that WACC it would have received if it had truthfully revealed itself just to be a standard business. This means that there is a strong incentive of truthful information revelation, which would also then go to less of a need for a more intrusive review of costs.

The menu approach means that the business needs to be credible and realistic in any proposal it makes, as it risks a financial penalty over the course of the regulatory period. The Board of the State Own Corporation that pursues such a strategy of supporting a proposal that pretends a business is leading when it is not, will also not be meeting their fiduciary obligations, so there will be strong incentives for greater Board involvement and challenge of the business' pricing proposals than probably exists today.

Assessment Relative to the Economic Framework

The 3Cs framework as outlined above incorporates most of the key features of the economic framework laid out in the previous section of this report.

At its core (with the "Customer Value" component) the 3Cs approach acknowledges the multi-dimensional nature of the regulatory problem and embraces the fact that driving cost efficiencies is not the sole object of successful water regulation in NSW. Customer outcomes reflect the "quality" component discussed above. Moreover, the 3Cs approach follows existing practices in other jurisdictions in using multiple measures of customer satisfaction to assess this dimension of performance by water businesses. This seems prudent.

One opportunity for expansion on the existing proposal is to consider the degree to which the exact weighting given to various customer satisfaction criteria should be made explicit to the regulated entities, or whether some degree of "strategic opacity" (in the spirit of Ederer, Holden and Meyer discussed above) may help deter gaming of this aspect of incentives.

The focus on a "menu approach" in the 3Cs framework is also important, and consistent with the modern economic theory of regulation. Our understanding of dynamic regulation is also

instructive about how one should view the results of these menus. One should not expect full separation immediately—and perhaps not at all.

Moreover, to the extent that different NSW water businesses—at least in some sense—reflect different "types" we should not expect them to all slot into a neat "pecking order" in the proposal-response process.

The desire to get greater Board involvement in the "credibility" component of the 3Cs approach is sound, and it reflects an attempt to help alleviate the principal-agent problem between the board and managers of water businesses. *A good outcome flowing from the review is that, to a greater degree than is currently the case, regulatory incentives can facilitate and be a complement to sound corporate governance of water businesses*.

Reputational incentives that already exist within water businesses (operating at the managerial and board levels) are consistent with—and can be strengthened by—the proposed 3Cs framework. This is important and encouraging.

Finally, the ability for proposals and the performance of water businesses to be highlighted more publicly than is the case at present has the promise of leveraging these reputational incentives.

Summary

The 3Cs framework is strongly consistent with the best modern academic literature on regulation, and it aligns with the practical experience of, and feedback from, regulation in other jurisdictions. This is especially and including of the recent Victorian experience with the PREMO framework adopted in that jurisdiction by the Essential Services Commission.

Moreover, the focus in the 3Cs framework of providing incentives for higher-quality customer-service outcomes is a welcome feature, and one which is nicely articulated in the plan.

Finally, each of the 3 elements of the proposed framework work well together and are complementary components of a sounds regulatory regime.

Summary and Conclusion

In this report I have tried to summarize the current state of the relevant contract-theory academic literature—as relevant to regulation in general, and water regulation in NSW in particular.

I have highlighted the surely familiar literature on regulation of a monopolist due to Baron-Myerson and Laffont-Tirole, but also emphasized some other relevant work from both a similar period and also considerably more recent developments.

In addition to the standard models of regulation on which "building-blocks" are based, it is important to acknowledge that water regulation in NSW has elements of:

1. A dynamic regulatory environment where commitment power on the part of the regulator plays a crucial role in determining the optimal amount of "separation of types";
2. A "multi-dimensional" screening problem where both cost-efficiency and service-quality are relevant dimension of "type";
3. A "moral hazard" setting where financial incentives can play an important role;
4. An environment where "career concerns" of managers and Board directors provide important non-pecuniary incentives;
5. "Opacity" in incentive provision may help deter gaming of regulatory/ incentive schemes;
6. A setting where customer outcomes could be measured more effectively; and
7. An environment where behavioral considerations about "upside benefit" versus "downside risk" is important in understanding and providing incentives for incentivizing managerial actions.

One way to capture the regulatory problem, the virtues of the 3Cs framework, and how additional regulatory instrument can be brought to bear, is to think about the market failures that exist in the NSW water market, and how regulatory tools respond to those.

Market Failure	How addressed by 3Cs	Additional instruments
Asymmetric information about cost / efficiency	Ex ante screening	
Asymmetric information about service quality	Ex ante screening, public information	
Hidden action / moral hazard	Incentives, firm reputation	Strategic opacity
Market power	Ex ante screening and price caps	

The 3Cs framework developed thus far addresses these considerations well and, in my opinion, is well-suited to pushing water businesses in NSW to drive innovation, cost efficiencies, and improve customer outcomes in the years ahead.

References

Akerlof, Robert, and Richard Holden. 2012. "The Nature of Tournaments", *Economic Theory* 51(2): 489-513.

Akerlof, Robert, and Richard Holden. 2016. "Movers and Shakers", *Quarterly Journal of Economics*, 131(4): 1849-1874.

Ederer, Florian, Richard Holden and Margaret Meyer. 2018. "Gaming and Strategic Opacity in Incentive Provision", *RAND Journal of Economics* 49(4): 819-854.

Forbes, Silke, Mara Lederman and Trevor Tombe. 2015. "Quality Disclosure Programs and Internal Organizational Practices: Evidence from Airline Flight Delays." *American Economic Journal: Microeconomics* 7: 1–26.

Gravelle, Hugh, Matt Sutton and Ada Ma. 2010. "Doctor Behaviour under a Pay for Performance Contract: Treating, Cheating and Case Finding?" *Economic Journal* 120: F129–F156.

Grossman, Sandford J. and Oliver D. Hart. 1983. "An Analysis of The Principal-Agent Problem," *Econometrica* 51: 7-45.

Holmstrom, Bengt. (1982, 1999). "Managerial Incentive Problems: A Dynamic Perspective", *Review of Economic Studies* 66(1): 169–182.

Holmstrom, Bengt and Paul Milgrom. 1991. "Multitask Principal-Agent Analyses: Incentive Contracts, Asset Ownership, and Job Design," *Journal of Law, Economics, & Organization* 7(special issue): 24-52.

Hurwicz, Leonid. "On informationally decentralized systems", in Radner and McGuire, *Decision and Organization*. North-Holland, Amsterdam. 1972.

Kahneman, Daniel and Amos Tversky. 1979. Prospect theory: An analysis of decision under risk. *Econometrica*, *47*, 263-291.

Laffont, Jean-Jacques and Jean Tirole. 1986. "Using Cost Observation to Regulate Firms," *Journal of Political Economy* 94: 614-641.

Laffont, Jean-Jacques and Jean Tirole. 1988. "The Dynamics of Incentive Contracts," *Econometrica* 53: 1153-1175.

Larkin, Ian. 2014. "The Cost of High-Powered Incentives: Employee Gaming in Enterprise Software Sales." *Journal of Labor Economics* 32: 199–227.

Mirrlees, James. A. 1975. "The Theory of Moral Hazard and Unobservable Behavior: Part I," mimeo, Nuffield College Oxford.

Nobel Committee. *Advanced Information for the 2001 Prize in Economic Sciences.* Available at https://www.nobelprize.org/uploads/2018/06/advanced-economicsciences2001.pdf

Nobel Committee. *Advanced Information for the 2007 Prize in Economic Sciences.* Available at https://www.nobelprize.org/uploads/2018/06/advanced-economicsciences2007-1.pdf

Nobel Committee. *Advanced Information for the 2014 Prize in Economic Sciences.* Available at https://www.nobelprize.org/prizes/economic-sciences/2014/advanced-information/

Nobel Committee. *Advanced Information for the 2016 Prize in Economic Sciences.* Available at https://www.nobelprize.org/uploads/2018/06/advanced-economicsciences2016-1.pdf

Oyer, Paul. 1998. "Fiscal Year Ends and Nonlinear Incentive Contracts: The Effect on Business Seasonality." Quarterly Journal of Economics 113: 149–185.

Rochet, Jean-Charles and Lars Stole. 2003. "The Economics of Multidimensional Screening", in *Advances in Economics and Econometrics:* Theory and Applications—Eighth World Congress. Dewatripont, Mathias, Hansen, Lars Peter and Turnovsky, Stephen J.(eds.). Cambridge University Press. Cambridge, U.K.

Rothschild, Michael and Joseph E. Stiglitz. "Equilibrium in Competitive Insurance Markets: An Essay on the Economics of Imperfect Information", *Quarterly Journal of Economics* 95, 1976: 629-649.

Tirole, Jean. *The Theory of Industrial Organization*. MIT Press (Cambridge, MA), 1988.

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Appendix A: Baron-Myerson

Appendix A: Baron-Myerson Framework

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- Baron & Myerson (Econometrica, 1982)

- The regulator/government is ignorant but the firm knows its type

- Firm's characteristic is $\beta \in \{\underline{\beta}, \overline{\beta}\}$ with probabilities ν_1 and $1 - \nu_1$

- Cost is $c = \beta - e$

- Cost is verifiable

- Cost of effort is $\psi(e) = e^2/2$

- Let $\Delta\beta = \overline{\beta} - \underline{\beta}$ and assume $\Delta\beta < 1$

- Government wants a good produced with the lowest possible subsidy - wants to minimize expected payments to the firm

- The First-Best is simply
$$\min_e \left\{\beta - e + e^2/2\right\}$$

- The FOC is $e^* = 1$ and the firm gets paid $\beta - 1/2$

- Can we sustain the FB?

- No because $p_L = \beta_L - 1/2$ and $p_H = \beta_H - 1/2$

Second-Best

- Two cost levels $\underline{c}$ and $\overline{c}$

- Two price levels $\underline{p}$ and $\overline{p}$ (payments)

- Government solves

$$\min \left\{\nu_1 \underline{p} + (1 - \nu_1)\overline{p}\right\}$$
$$s.t. (i)\ \underline{p} - \underline{c} - e^2/2 \geq \overline{p} - \overline{c} - (\overline{e} - \Delta\beta)^2/2$$
$$(ii)\ \overline{p} - \overline{c} - \overline{e}^2/2 \geq 0$$

- noting that $\underline{e} = \overline{e} - \Delta\beta$ (from cost equation and low type pretending to be high type)

- Define $\underline{s} = \underline{p} - \underline{c} = \underline{p} - \underline{\beta} + \underline{e}$ and $\overline{s} = \overline{p} - \overline{c} = \overline{p} - \overline{\beta} + \overline{e}$ (these are the "subsidies")

- The government's problem is now

$$\min \left\{\nu_1\left(\underline{s} + \underline{\beta} - \underline{e}\right) + (1 - \nu_1)\overline{s} + \overline{\beta} - \overline{e}\right\}$$
$$s.t. (i)\ \underline{s} - e^2/2 \geq \overline{s} - (\overline{e} - \Delta\beta)^2/2$$
$$(ii)\ \overline{s} - \overline{e}^2/2 \geq 0$$