**ADSTEAM MARINE LIMITED** 

Submission to the

Productivity Commission Inquiry Into The Economic Regulation Of Harbour Towage And Related Services





## **PART B - ECONOMIC INDUSTRY REPORTS**

## **Report 1**

Harbour Towage in Australia: Competitive Analysis and Regulatory Options CoRE Research (Professors Joshua Gans and Stephen King) April 2002

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## Harbour Towage in Australia: Competitive Analysis and Regulatory Options

A Report on behalf of Adsteam Marine Ltd

Joshua Gans and Stephen King

The analysis here represents the views of CoRE Research Pty Ltd (ACN 096 869 760) and should not be construed as those of Adsteam Marine Ltd.

22<sup>nd</sup> April, 2002

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The following reports constitute Part B of the Adsteam Marine Limited's initial submission to the Productivity Commission Inquiry into the Economic Regulation of Harbour Towage and Related Services. These reports are ordered as follows:

- *Harbour Towage in Australia: Competitive Analysis and Regulatory Options* CoRE Research (Professors Joshua Gans and Stephen King), April 2002;
- International Benchmarking of Australian Declared Ports: Harbour Towage Thompson Clarke Shipping Pty Ltd, April 2002;
- International Survey of Harbour Towage Arrangements Charles River Associates (Asia Pacific) Pty Ltd, April 2002; and
- Containership Charter Rates A consideration of Pricing Policy Howe Robinson Shipbrokers, March 2002.

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## **Executive Summary**

This report analyses potential competitive concerns in harbour towage and explores regulatory options for dealing with them. The competitive concerns arise from the fact that there is a single operator of towage in most ports in Australia today and that a substantial fraction of these ports are operated by a single firm, Adsteam. The Productivity Commission is addressing these concerns for the handful of larger ports that are declared and subject to prices surveillance.

Harbour towage in Australia appears to involve a natural monopoly production technology suggesting the single operator market structure is, in fact, efficient. Moreover, there appear to be few factors that could give rise to economies of scale; particularly amongst larger ports. Finally, while there are demand-side pressures on the value of towage (through technological change and some inter-port competition), entry barriers remain low from an economist's point of view. Specifically, the evidence suggests that the sunk costs involved in becoming a towage provider in any given port are low both in terms of capital (tugs) and labour (training).

More importantly, harbour towage is one element of the set of port services that ship operator's value. Those customers care about the total cost of each element as well as the service quality (i.e., timeliness) of their port usage. This means that the pricing and investment choices of towage operators will both impact and be impacted by other elements. Importantly, port authorities themselves have the power – sometimes explicitly implemented but otherwise acting as an implicit constraint – to determine the capitalisation of towage operators within a port as well as their pricing conditions. That power combined with the competitive constraint from potential entry by other towage operators, means that incumbent operators in Australia are likely to earn few economic rents with prices equalling average costs and service quality driven by other parties. In the end, service quality will deviate from a socially desirable level not because of the market power of towage operators but because of the regulatory pressure from other market participants.

In this environment, prices surveillance will have little effective role and price regulation itself is likely to harm service quality levels even farther from their socially efficient levels. This is because a lower regulated towage price can allow other port service providers to improve their own pricing conditions while leaving less room for investments that may give rise to socially desirable improvements in service quality.

Ultimately, if there is any problem regarding high costs through Australian ports, it is unlikely that the driving factor is any competition concerns with harbour towage. Any policy predicated on that factor alone may do more harm than good.

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## 1 Background

Harbour towage in Australia is subject to prices surveillance in seven key ports. The stated reason for this are concerns about the extent of competition in those ports; all of which have a towage operator owned by Adsteam Marine Ltd. Adsteam is also the sole provider of towage services in many other ports around Australia. Conventional definitions of market structure would describe this as a monopoly or dominant position.

The continued price surveillance will be reviewed later in 2002. Prior to that review the Federal government has asked the Productivity Commission to examine the extent of competition in harbour towage. Conventional wisdom, reinforced by a recent court case, has it that harbour towage involves a natural monopoly production technology (given the relatively small level of demand for shipping through Australia). With this technology, it is efficient to have a single provider of a service. Thus, observations of a monopoly position do not simply translate into textbook concerns about competition. Competition within the market is simply not viable in the long-term.

In this report, we examine competition in harbour towage. We find that harbour towage is very similar to many service industries; although it is not characterised by substantial sunk entry costs that might be seen in other monopolistic industries. In addition, it is subject to price and service quality pressure from port authorities who have the power to exclude towage operators in their respective ports. This means that competitive analysis of this type of monopoly departs from a traditional textbook analysis.

Our report proceeds as follows. First, we examine more closely the economic characteristics of harbour towage – in particular, the nature of costs and the regulations imposed by complementary input providers. In section 3, we then turn to consider the extent of competition in harbour towage. This analysis is supported by our technical appendix which provides a formal model of economic interactions within the port industry and allows us to understand the determinants of towage prices and service quality. Section 4 then evaluates the regulatory options open to those who consider any monopoly position by incumbent towage providers to be a problem. We demonstrate that traditional forms of price regulation are likely to be either ineffective or undesirable in this industry. A final section concludes.



It should be emphasised that our purpose here is to set the framework for appropriate competitive analysis of harbour towage in Australia. While we deal comprehensively with calls for more price regulation of harbour towage, the other regulatory options we canvas are for completeness and are not examined in all of their complexity. Such an analysis would require a more elaborate theoretical model, capable of handling the real world nuances, costs and benefits of those options as well as a more comprehensive examination of empirical evidence regarding their likely success or otherwise.



## 2 Economic Characteristics of Harbour Towage

At its heart, harbour towage is a service provided to ocean-going cargo ships and liners to enable them to arrive and depart ports in a safe manner. As such, towage is an input into the production of the transport of goods by sea. As a consequence, the economic characteristics of towage are similar to a variety of other 'input' services in the economy; especially in relation to variability of customer demand and the derived nature of that demand.

In this section, we outline the nature of the demand and supply of harbour towage in Australia. As we demonstrate in the next section, understanding these characteristics is essential before an appropriate analysis of competitive conditions in the industry can be carried out.

## 2.1 Demand

Prices cannot rise beyond the value customers are willing to pay for a service. In addition, prices are constrained by the value these customers might derive from substitutes to the service as well as by competitive pressures.

Leaving the issue of competition to Section 3, here we outline the sources of customer value for harbour towage as well the substitutes to that service. This will assist in providing a definition of the market, critical to the analysis of competitive pressures and market power.

## 2.1.1 Nature of the Service

Harbour towage is an excellent example of *derived demand*.<sup>1</sup> Ships require towage because they are providing a general transportation service. Demand for towage will, in general, be driven by many factors including the state of the world economy, exchange rate movements, and other factors that make up the cost of shipping goods and by the final customer demand for those goods.

<sup>&</sup>lt;sup>1</sup> As noted by many others (e.g., ACCC, 1995).



The exact type of towage required depends both on the size and manoeuvrability of the ship as well as on weather conditions and local conditions of a particular port. These factors drive the quantity of towage required, in terms of the number of tugs used and the time required for a particular ship. Moreover, this quantity variable is not under the direct control of the towage or ship operator. In Australia, pilots – with regard to established towage guidelines – determine the number of tugs required for a particular ship on any given day. This is a key driver in the cost of towage.

The other dimension of service that drives customer value is, of course, *timeliness* or, more broadly, service quality.<sup>2</sup> Ship operators place a high value on being able to arrive and depart a port in a timely manner as each day waiting adds considerably to the total cost of transporting goods as well as the efficient utilisation of cargo ships themselves. Obviously, the more responsive are tug operators to meeting this quality dimension of demand, the more the costs of shipping are reduced. However, as we will note below, the ability of a tug operator to improve this dimension is fundamentally limited by choices made by others at a port (Adsteam, 2002).

In this respect, the actual price of towage services is a minor component in the total cost of shipping. Thus, the short-run demand for towage is likely to be relatively price inelastic. Over the longerterm, however, high towage charges or low service quality at a particular port may cause operators to shift between ports or alter the way in which they ship goods (i.e., in terms of the size of ship used and the towage requirements of those ships). Therefore, as with most goods and services, it needs to be recognised that the long-run price elasticity of demand is considerably more elastic than short-run demand. The issue for competitive analysis is whether prices and service quality are determined by longer run demand factors; a topic we return to in Section 3.

## 2.1.2 Substitutes

If we take as our starting point the provision of towage services at a particular port, there are two possible dimensions of substitution for a ship operator.

First, the ship operator may be able to berth at another port if overall cost and service quality from so doing are superior. The scope for inter-port competition varies depending upon the ship and the nature

<sup>&</sup>lt;sup>2</sup> Service quality includes the logistic simplicity that arises when tug crews work effectively with pilots and other port service providers (see Adsteam, 2002).



of its cargo. Recently, larger ports have been visible in competition with one another. They suggest that the use of land transport gives shippers options as to their initial port of call. For example, even if the ultimate recipient of cargo is in Sydney, a shipper may prefer to land goods in Brisbane and use road or rail to complete the consignment. The relative costs of the two ports as well as their relative service quality would drive this choice (along with the cost of land transport). Further, for some large cargoes with intended recipients all over the country, no single major port may offer geographical advantage over another and so individual port terms and quality may be important determinants of the port used by shippers.

In other cases, the scope for inter-port competition may be more limited. Key production or customer centres may be located much closer to one port and land transport options might be prohibitive. In this situation, ship operators will not be able to substitute one port over another.

The key point is that, where inter-port competition is possible, this will also impact upon a towage operator's ability to increase price or reduce service quality. As we discuss in Section 3, such inter-port competition may substitute for any lack of competition in towage at a given port.

The second dimension of substitution is technological. Ships can be built with integrated steering systems using bow and stern thrusters that do not require towage. These have already been adopted by cruise ships and there is increasing use for other traffic (Adsteam, 2002). In this respect, towage conditions are being factored into the investment decisions of ship operators. Where operators conduct a large proportion of their business through Australian ports, then the performance in terms of cost of towage operators will impact on this adoption in the long-run.

## 2.2 Technology and Costs

In the long-run, prices cannot fall below a level whereby a service operator recovers their costs. Invariably, cost factors will drive both pricing as well as the quality of service.

Here we describe the primary characteristics of technology and cost that play a role in determining the competitive pressures on towage operators. In particular, it will be demonstrated that harbour towage is a high fixed cost industry with relatively few sunk costs. This means that the technology of towage exhibits economies of scale at the port



level. In contrast, there are relatively few economies of scope that may benefit a multi-port operator.

### 2.2.1 Variable and Fixed Costs

There are two sides to variation in the intensity of towage usage. The first is related to the rate at which ships arrive and leave a port. The second is related to their composition (in terms of size). Some costs vary with the arrival and departure rate of ships while others vary with size.

As more ships are required to be towed over a given period of time, the towage operators costs in terms of vessel maintenance, insurance (including workers compensation), stores, oil and fuel all rise. In some cases, there are smaller ports (e.g., Cockatoo Island) where crews are flown in depending upon demand. In this case, crew costs would also be variable.

In contrast, the capital costs of tugs, statutory fees, docking costs as well as crew costs (where those crews are stationed full time with a particular tug), are all fixed costs. Given the number of tugs, these costs do not vary with the arrival rates of ships.

However, these costs do vary with the size of ships as well as the quality of service that might be provided. That is, a towage operator – when choosing the number of tugs stationed at a port – needs to consider the ability of larger ships to be serviced as well as multiple arrivals to be dealt with in a timely manner (including the ability to service ships when a tug is out for maintenance). So such costs are not fixed with respect to service quality and level.

#### 2.2.2 Sunk Costs

The ACCC (1995, p.43) reached the conclusion that the level of sunk costs in harbour towage was relatively high. The reasons for this were that (1) the market for second-hand tugs within Australia was relatively thin, (2) second-hand tug prices are lower than new tug acquisition costs because of their age and capacity; and (3) that Australian tugs are built for Australian-only conditions. They also argued that short-term leases were not available, training costs and redundancy payments for crews were high. Unfortunately, they did not provide evidence for this.

In contrast, Adsteam (2002) provides evidence of a healthy international market for second-hand tugs and also that their tugs are flexible and capable of being used in many ports both domestically



and internationally. In addition, there is no evidence that training costs associated with crews would be required each time a tug or tug operator was changed or that redundancy payments are on terms any different from many other industries in the country. Moreover, the key residual of port-specific knowledge lies with pilots and not with tug crews.

For these reasons, it appears to us that harbour towage could hardly be characterised as a high sunk cost industry (especially compared with other regulated industries such as energy, rail transport and telecommunications). The sunk costs appear to be minimal and even though many costs may be unrelated to a specific harbour towage operation, a substantial proportion of these costs could be recovered were the towage operator to curtail or shut down its operations in a given port.

Nonetheless, as we discuss in Section 3, the extent of sunk costs is a critical issue in the competitive analysis of harbour towage and one that we urge the Commission to make a thorough assessment of.

## 2.2.3 Economies of Scale

There appears to be consensus that harbour towage within a port is a *natural monopoly*.<sup>3</sup> This means that the nature of economies of scale is such that all harbour towage operations are best handled by a single operator. This is confirmed by observations that multiple providers usually only arise in the world's largest ports (Adsteam, 2002).

It is clear that where a port requires a single tug, there is little alternative to having a single provider. When more tugs are required, this is usually driven by demand to handle larger ships. In this situation, the roles of the multiple tugs would be highly complementary and it is generally expected that costs of coordinating them would be minimised when they were commonly owned.<sup>4</sup>

As will become apparent in Section 3, this makes competition 'onthe-water' both potentially unsustainable and also potentially costly relative to situations where there is a single provider.

<sup>&</sup>lt;sup>4</sup> See Milgrom and Roberts (1992) and Hart (1995).



<sup>&</sup>lt;sup>3</sup> See ACCC (1995), PC (1998) and Gans, Hanks and Williams (2001).

## 2.2.4 Economies of Scope

Economies of scope arise when a single operator across two or more markets can operate at a lower cost compared to a situation where each market had a separate operator. Usually, such economies arise when there are shared inputs across markets.

In Australia, few ports have towage operators that do not operate elsewhere.<sup>5</sup> While this is suggestive that there are economies of scope in operating harbour towage in a number of ports, it is difficult to identify the inputs that are shared.<sup>6</sup> Tugs themselves are generally stationed at a particular port and only in a few instances (where ports are very close) do they move between them. For instance, in Cockatoo Island, where there may be as few as 9 towage runs a year, a single tug is stationed there permanently with the single customer in that port bearing the capital costs associated with that placement. Crews are generally stationed with their tugs and are on standby all of the time. On occasion (again Cockatoo Island is a case in point), crews are flown in only when need arises. In those cases, there is clearly an economy of scope between those ports. However, shared human resources (whether for tug operation or maintenance) are something only seen between smaller ports.<sup>7</sup>

In any case, it is important to remember that the existence of the potential for sharing inputs does not require that ports have the same operator. Sharing can occur through markets as well as within firms (Teece, 1980). This has occurred through leasing and other arrangements for tugs in Australia and overseas.

An alternative avenue that might give rise to an economy of scope is savings in transaction costs when dealing with ship operators who use multiple ports. In this situation, there might be a common negotiation over towage rates and other issues. In Adsteam's case, this shared negotiation could give them some scope to offer greater discounts to customers who use several of their ports.

<sup>&</sup>lt;sup>7</sup> The Port of Bunbury's competitive tender was awarded to a firm that does not operate in other Australian ports. *Assuming that tender was awarded to the bidder with the lowest price and highest service quality*, this suggests that economies of scope between Australian ports are not significant.



<sup>&</sup>lt;sup>5</sup> These include Hay Point, Dalrymple Bay, Esperance, and Gove.

<sup>&</sup>lt;sup>6</sup> Indeed, the ACCC (1995) does not specify these except where ports are in close proximity despite concluding that economies of scope exist between ports.

## 2.3 Complementary Service Providers

Harbour towage is one element in a production system provided to ship operators. Other elements include mooring and unmooring, stevedoring, port-land interface and pilotage. These other elements are usually provided by firms other than the towage operator in a port. All of these functions make up the service that ship operators value – the timely movement of cargo in and out of a port.

Complementarity plays an important role in competitive analysis because the interaction amongst complementary service providers impacts upon the competitive pressures exerted on towage operators. Here we describe the nature of that complementarity as well as focussing on the economic role of port authorities and pilots.

#### 2.3.1 The O-Ring

To understand the role of complementarity in port services, it is useful to appeal to the 'O-ring' analogy (Kremer, 1993). The O-ring was the component on the booster rockets to the space shuttle USS Challenger that failed on a cold Florida morning in 1986 causing a chain reaction that destroyed the shuttle.

In port services, each element is like an O-ring. If towage, pilotage or any other element of port services fails, then there is costly delay to ship operators. What this means is that measured performance of any one element will depend on the performance of all the elements of port service. More importantly, investments in service quality on any one element will be driven by the level of service on others. There is no sense in putting extra tugs into ports if there are insufficient pilots to handle a faster rate of shipping.

As will be demonstrated in Section 3, the assessment of competition in towage requires a concurrent assessment of choices in other elements so that their complementary interaction is taken into account.

#### 2.3.2 Port Authorities

In addition to managing and providing certain services, port authorities play an important regulatory role. For our purposes here this is most relevant in the terms and conditions it places on towage operators it licenses to operate within its port. Those conditions include the number of tugs in port, elements of service quality and, in some cases, pricing and license fees.



Port authorities will, therefore, have a dual role in the economic analysis to follow. First, they themselves choose pricing and service quality that impact on the demand for shipping through a port. Second, they also can negotiate and sometime demand certain prices and performance from towage operators. This role sometimes involves those very terms being taken out of customer hands. As we will demonstrate this has an important impact on outcomes for towage across ports.

#### 2.3.3 Pilots

The towage of larger vessels involves the use of a pilot who boards a ship to provide captains with critical information on local conditions at a port. In this regard, pilots play an important management role impacting on the costs of towage. Specifically, they determine – according to guidelines – the number of tugs required for a ship. Under current pricing arrangements for towage this can significantly impact on the shipper's towage costs.

Pilots make their decisions and set their own rates independently from towage operators. In so doing, their interaction with towage is similar to that of the ports when they set their own charges and service quality. Their role in determining tug usage, however, is similar to the role of ports when they include service quality elements in license terms.



## 3 Competitive Analysis

The economic regulation that currently exists for harbour towage in Australia was put in place because of concerns about the extent of competition in certain ports in Australia. Here we analyse these concerns using the tools of modern industrial organisation theory as well as current developments in harbour towage.

There is little evidence to suggest that harbour towage operators – Adsteam in particular – are behaving in a manner that one would expect from a firm with unconstrained market power (even given the regulation in place). Instead, there is evidence to suggest that towage operators are subjected to pressure from potential competition – specifically, in larger ports – whereas in smaller ports the potential welfare consequences from any lack of competition are likely to be small.

## 3.1 Market Definition

A first step in conducting a competitive analysis is to define the market that will be the appropriate focus for analysis. A market involves products that are close substitutes in demand or inputs that are readily substitutable in supply.

On the demand-side, customers who need to ship to a particular port must use towage services within that port. In this case, the supply of towage services to a port provides the relevant definition of the market. However, where customers can substitute between ports a wider definition might be appropriate. While there is some evidence that inter-port substitution occurs, in this report we take a conservative position and assume that there is little demand-side substitution between ports. This means that from an analytical perspective, our results will tend to overstate any competitive problems that might require regulatory intervention.

Should the market definition be any finer? In effect, towage operators provide multiple products – each one based on the number of tugs required to tow a given ship. Once it arrives, ship operators have little



option but to use the required number of tugs.<sup>8</sup> Should there be a separate market within each port for 'small' ships as opposed to 'large' ships?

Large shippers can, in many cases, readily divide their cargoes and utilise ships that require fewer tugs. Similarly, cargo placed on smaller ships could often be consolidated and placed on larger ships if there was an appropriate economic incentive. In this respect, the products provided by the towage operator are imperfect substitutes and can therefore be treated as part of the same market.

On the supply-side, when services can readily be supplied elsewhere, it is appropriate that the definition of the market take this into account. However, it appears that very little short-run switching of tug operations between ports occurs despite the fact that there is often a common tug owner. As it is the potential movement of factors that is relevant for supply-side substitution, it appears appropriate to limit our attention to what goes on in a particular port.

Given this, the economic characteristics of towage suggest that the appropriate definition of the market for competitive analysis is the *supply of towage services in a given port*. However, we must recognise that port operations are a set of complementary services of which towage is but one element. In this respect, our analysis must include a consideration of the entire supply of port services even if our focus is on the pricing and service quality of harbour towage.<sup>9</sup>

## 3.2 Behaviour of an Unconstrained Monopolist

To begin, imagine that there was a single supplier of towage services in a particular port. As a base case, it would appear that a monopoly provider of harbour towage services might wield a considerable amount of pricing discretion. A monopolist could potentially engage in what is called 'hold-up' whereby it waits for a ship to approach port before negotiating pricing terms. In so doing, it can potentially charge the ship a fee equal to the profits it expected to receive from unloading its cargo at the port. Only if there is another port that the

<sup>&</sup>lt;sup>9</sup> Again, it is worth remembering that this conservative approach will tend to overstate any competitive problems rather than understate those problems. If there is active inter-port competition then the case for any intervention in towage is diminished.



<sup>&</sup>lt;sup>8</sup> In contrast to arrangements that exist in some ports outside of Australia.

ship could unload its cargo at, would there be any restraint on the towage operator's pricing.

This unbridled use of monopoly power would really be of short-term value only. Given the sunk costs involved in terms of loading and the ocean crossing, such a situation may leave the ship operator with a net loss on the entire transaction. For this reason, the extreme holdup power of the towage operator is unlikely to be exercised over the long-term. The towage operator needs to find a means of committing not to charge an excessive price at the port's entrance. Otherwise, its own profits would suffer as ship operators curtail trading activities.

Instead, a monopolist towage operator will likely set a schedule of charges that reflects a mark-up over its marginal costs reflective of the sensitivity of long-run demand for trade through their port.

A monopolist towage operator would also choose the number of available tugs (i.e., capacity) as well as investing in methods by which service quality (i.e., timeliness) might be improved. Its decision to add an additional tug would be muted by its concern that such an action might depress prices. This is because a monopolist, under constrained capacity, is more likely to be able to sustain higher prices and resist pressures for discounting to larger ship operators.

A monopolist's decision on quality would also be muted unless its own decision had a substantial impact on the flow of traffic through the port. As noted in Section 2, this impact also depends on the pricing decisions of pilots and the port authorities. In general, as is explained in the technical appendix, when each provider sets its own prices, the total cost of operating a ship through a port is likely to be too high relative to the case where there is an integrated port firm (coordinating all functions of the port). This situation also means that other providers can essentially receive some of the benefits of improvements in towage service quality while the towage operator bears all of the costs of such improvements. Because of this externality, the towage operator's choice of service quality will be below that of an integrated firm and also less than the port authority and pilots would like.<sup>10</sup>

<sup>&</sup>lt;sup>10</sup> Basically, independent pricing by firms that supply complementary goods has the opposite effect to such pricing by firms supplying substitutable goods. In the case of substitutes, coordinated pricing leads to higher prices (closer to the monopoly level) and gives rise to competition concerns. In contrast, for complements, coordinated pricing lowers prices at the same time as raising profits. In this case, it eliminates 'double marginalisation' and improves welfare (Economides and Salop, 1992).



Thus, a monopoly towage operation that sets its own prices and service quality would lead to higher overall port costs of shippers as well as too slow a port operation constrained by shortages of available tugs.

## 3.3 Regulation by Port Authorities

In Australia, this model of an independent towage operation is, in general, not realistic. Even in the absence of prices surveillance regulation, towage operators are sometimes licensed by the port authority that, in effect, demands certain service levels from the towage operator (and in some cases prices as well).

In this situation, the port authority has the power to set service levels, using the threat of withdrawing the license from the towage operator. Recent examples from Western Australia, have demonstrated that port authorities can exercise this threat. As is demonstrated in the technical appendix, the port authority will use this threat to impose higher service quality levels than the towage operator would ordinarily choose. Indeed, those levels will likely exceed that of an integrated firm. That is, the port authority insists that the towage operator have too many tugs available in the port with the cost of such inefficiency being borne by shippers in terms of higher towage and port charges.<sup>11</sup>

On occasion, ports use a tender process to determine both towage service quality and their charges. The technical appendix demonstrates that this would result in both lower towage prices *and* service quality than the case where ports simply demand service quality. However, in this case, service is under- rather than overprovided relative to the social optimum. We will return to discuss this outcome in more detail when we compare it to the case of customer contestability below.

In summary, when examining the prices and choices of towage operators, it is critical that the important role of port authorities in determining service quality is recognised. What this means is that towage operators act in a manner distinct from textbook examples of firms, even with monopoly power. Instead, that power is transferred, in part, to ports (and other complementary service providers) that does not necessarily make demands consistent with the interests of consumers (i.e., shippers). As we demonstrate in Section 4, this

 $<sup>^{11}</sup>$  There is some evidence that there is such excess capacity in Australian ports (see ACCC, 1995).



interaction has an important impact on the consequences of various regulatory options for harbour towage.

## 3.4 Customer Contestability

While, in some instances, it is ports that exert pressure on towage prices and service quality, in other situations such pressure comes from customers. This pressure can come in two forms, each of which generates essentially the same outcome. First, larger customers or groups of customers may be able to negotiate contracts with towage companies over price and perhaps service quality conditions. Those customers have power over any one towage company as they can threaten to offer such contracts to other providers. They can also credibly sponsor new entry by underwriting their costs. Thus, customers through contract negotiations can pressure towage providers in a similar manner to ports through license conditions.

The second form of competition comes directly from the threat of entry. While the threat of replacement is used explicitly in any contract or license negotiations, entry may be triggered simply by the fact that a towage provider is earning economic profits over the short to medium run. Even where such provision is a natural monopoly, this possibility makes markets contestable; giving towage providers an incentive to keep the mix of charges and service quality such that entry does not occur.

Below, we will comment on the reasonableness of these types of contestability outcomes - whether it be through contracts or the implicit threat of entry. Here, however, consider what would happen if customers could essentially dictate terms to a towage provider. As is demonstrated in the appendix, towage prices will reflect the average costs of towage. This means that the towage provider is essentially indifferent as to the level of service quality provided. A higher service quality raises the contestable towage price while a lower service quality reduces it. However, given that towage prices simply recover costs, both customers and the port authority are interested in minimising the total costs of towage given that the port authority still sets its charges independently. Because of this, regardless of whether customers or the port authority determine service quality, the same level of service will be chosen. That level will be less than the social optimum as the total rate of shipping through the port remains constrained by the port authority's market power.



## 3.5 Sunk Costs and Entry Barriers

The above discussion demonstrates that when towage prices are pushed towards average towage cost, service quality tends to be under-provided relative to the social optimum; however, it may be well below that chosen by a port if it was unable to put pressure on towage pricing directly.

Pressure on towage prices – whether it is from port authorities or customer contestability – relies on the ease of replacement of the incumbent towage operator. Critically, the incumbent towage operator will be able to maintain prices above average cost so long as there are substantial sunk costs involved in entry and exit.<sup>12</sup>

As noted in Section 2, regulators appear concerned that there are barriers to entry into harbour towage. One source of these barriers is the costs of acquiring tugs themselves. However, as we noted there, while these costs are substantial in accounting terms, there is reason to believe they are relatively low in economic terms. This is because tugs themselves can be re-sold if their operation in Australia proves to be unviable, commercially. A healthy, international re-sale market exists and, indeed, towage operators themselves base their capital valuations on the amount they would receive for their tugs on that market.

Another entry barrier is supposedly vertical integration. Vertical integration can be a barrier to entry when an incumbent firm controls a key resource that other competitors need access to in order to compete effectively. However, in harbour towage, the main key resources are a port license and the ability to work with pilots – each of these are not owned or controlled by towage companies. Adsteam does act as a shipping agent. This, however, would only be a potential bottleneck if a high proportion of customers used that agent and had no ability to switch agents as the need arose. There is no evidence to suggest that either of these conditions apply in the Australian case.

<sup>&</sup>lt;sup>12</sup> See Baumol, Panzar and Willig (1982). Dasgupta and Stiglitz (1988) argue that even small sunk costs might harm contestability. Their argument is that an incumbent can keep prices up and credibly threaten to drop prices should entry occur. An equally efficient entrant would be deterred by such a strategy. In the case of harbour towage, while this strategy might mean that implicit constraint from the threat of entry is not likely, contestability through customer contracts or port authority license conditions would still be possible. Each mechanism can effectively coordinate entry and remove any first-mover advantage. This would both explicitly and implicitly constrain towage charges.



## 3.6 Conclusion

While towage in most ports in Australia today is provided by a single firm, the simple textbook monopoly case is not likely to describe the behaviour in those ports. First, pricing occurs in the shadow of port authority pricing and those of other complementary service providers. Second, port authorities themselves impose license conditions on towage operators that drive both pricing and, importantly, service quality levels. Both of these, in turn, drive customer demand for shipping through a port.

When sunk costs are low, as they appear to be in harbour towage, both ports and customers can exert considerable pressure on towage providers. Ports tend to drive service quality higher while larger customers will insist on prices close to average towage costs. In so doing, it is the market power of the ports themselves that plays a significant role in terms of setting towage conditions.

A key issue is whether this role for ports in influencing towage operating conditions and charges is a good one. In effect, they too supply port services and have market power. In contrast, in competitive markets, such pressure on suppliers normally comes from customers.

One advantage of port authority pressure is the coordination benefit it affords. It can put pressure on towage providers in a way disorganised customers may find difficult. However, in so doing, the port will find it easier and profitable to direct the benefits towards the demands of larger customers, perhaps at the expense of smaller customers who partly fund the higher resulting service quality (in terms of the number of tugs stationed at a port).

More significantly, it is perhaps customers who have greater knowledge of their own value on towage services – especially since they choose the size of shipments as well as the technology of shipping itself. Thus, there is a danger that if port authorities determine towage conditions – instead of customers – insufficient account will be taken of the impact of such conditions on the investment decisions of ship operators. This is especially the case for new technological improvements in shipping that directly impact on the need for towage.

Nonetheless, the competitive analysis here suggests that the bottlenecks in port services are perhaps least significant in harbour towage relative to other parties who themselves have the power to regulate towage.



## 4 Regulatory Options

The competitive analysis highlights that, in the absence of significant inter-port competition, towage charges and service quality may not be socially optimal even where, as it appears, the sunk costs of towage operation are low. The reason is that the port authority (and pilots) has market power that distorts both their own pricing and towage conditions from the social optimum.

Nonetheless, the precise conditions in ports around Australia are varied, in particular, with regard to customer contestability (also exerting pricing pressure of towage operators) and the extent to which ports choose to use license terms and conditions to regulate harbour towage.

To be sure, the case for regulating harbour towage depends on the ability of either port authorities or customers to drive towage charges. Recent replacement of towage operators in Australian ports as well as substantial discounting to larger shippers below posted tariff rates indicates that each is important. Moreover, the pattern of prices appears to be driven more by average rather than marginal towage costs; suggestive of contestable rather than monopolistic behaviour.

If, however, it is assessed that sunk costs are high or other entry barriers exist for harbour towage in Australia it is useful to carefully consider potential regulatory options. That is the purpose of this section. As will be demonstrated, the fact that towage is but one element that makes up port services drives the potential effectiveness of regulation in controlling any assessed towage market power. Indeed, in some situations, conventional remedies to constrain that power, if implemented in a piecemeal fashion, may harm customers and social efficiency rather than the opposite.

## 4.1 Prices Surveillance and Monitoring

At present, in terms of explicit government policy, the main regulatory constraint in harbour towage comes in the form of prices surveillance on the declared ports of Port Jackson, Port Botany, Newcastle, Melbourne, Brisbane, Adelaide and Fremantle. Interestingly, these are ports that have been identified as most likely being subject to inter-port competition, have the largest demand to



support entry, and in some cases have port authorities and customers that have exercised or credibly threatened to exercise their threat of replacement of the incumbent towage operator. In terms of our analysis to date, such ports would be those with the lowest competitive concerns.

In any case, towage in these ports is only subject to prices surveillance. This means that whenever any towage operator in those ports changes its listed prices, those prices are subject to an ACCC review. That review makes an assessment as to the reasonableness of the changes but otherwise imposes no constraint on the towage operator. Therefore, apart from issues regarding public relations, there is no real pressure on the incumbent towage operator to refrain from implementing its proposed pricing.

Where constraint does come to play, especially given that public relations damage may be short term, is in the frequency with which prices might be changed and especially with respect to how prices might decline. More frequent changes means more frequent regulatory and public relations costs. Reducing prices in the short-run similarly creates a regulatory problem as an increase at a later date may be subject to surveillance. Thus, a towage operator is likely to put their posted rates higher than might otherwise be the case and use rebates and other forms of discounting to handle flexibility. Ironically, this makes prices less rather than more transparent in the industry.

Price monitoring creates similar issues. The real powers are not great but the implicit constraints serve to raise the costs of adjusting prices. Moreover, in each case, this mechanism seems to stand in contrast to open moves by port authorities and customers to themselves pressure port operator pricing and service quality conditions. The latter is not really taken into account in prices surveillance at all.

## 4.2 Price Regulation

Given the lack of real effectiveness of prices surveillance, one might be tempted to argue that price regulation would be a more appropriate solution. This could be achieved by giving regulators the power to cap towage charges in each port and prevent them rising above that level for a fixed period.

In the appendix we analyse this possibility, taking into account the fact that the towage operator negotiates with port authorities over service quality (or chooses it themselves) and other complementary



service providers with some degree of market power are themselves setting their own port service prices.

It is demonstrated there that price regulation (by which we mean reducing price below that which would otherwise be chosen by the towage operator) reduces the profits of the towage operator. However, at the same time it may increase the prices charged by port authorities and complementary service providers. They can profitably do this as customers care about the total price of shipping through a port of which towage charges (now lower) are only one part. Thus, towage price regulation can raise port authority profits.

What is more significant is what happens to service quality. Because towage provider profits are lower, it has less room to move on service quality. As these are heavily weighted towards fixed costs, these must be reduced as towage revenues fall. Consequently, regardless of whether service quality is the purview of the towage provider or the port, there will be lower service quality if there is price regulation.

In the end, the reduction in service quality could be such that customers are worse off as a result of regulation. This is especially the case if service quality were under-provided in the absence of price regulation.

The basic issue is that towage is one part of the production system that provides value to customers. Regulating a single part of that system when there are other providers with market power serves mostly to redistribute rents to those providers while muting potential compensation mechanisms for high service quality.

## 4.3 Integration

One option not usually discussed in harbour towage regulation is the possibility of integration between the towage provider and other elements of the port production system. In the appendix, we demonstrate that the integration of port authority and towage operator may reduce towage and port charges to customers as well as yielding a level of service quality closer to the social optimum than is likely to exist at present.<sup>13</sup> This is because the integration can eliminate the double marginalisation problem in pricing that occurs when two complementary providers with some degree of market power are separate entities.

<sup>&</sup>lt;sup>13</sup> This includes integration by customers who might purchase towage operators.



Port authorities in Australia are, for the most part, government owned with other functions left to the market. In this sense, integration could involve nationalisation – with port authorities doing their own towage – or privatisation – with towage operators purchasing ports. However, the merits of privatisation are not something we pursue here.

Options such as integration, that involve changes in ownership or governance structure, do of course generate other changes apart from the ability to coordinate pricing. In particular, they can change the mix of investment incentives and also the alignment of incentives between owners and managers (Hart, 1995). Finally, such options need to be evaluated against more elaborate contracting arrangements that may replicate similar outcomes.



## 5 Conclusion

While for the purposes of competitive analysis, the focus is on the market (in this case the supply of towage services in a given port), when it comes to the evaluation of the effects of regulation, the appropriate focus is an industry one (i.e., the operation of port production system as a whole). This is because the choices and operation of each element in a port impacts upon all others.

What this means is that competition concerns and potential remedies cannot be confined to a single element of port operation. Thus, when considering regulatory options for harbour towage on its own, one has to take into account what impact this will have on performance in other port services. We believe that say price regulation will not lead to reductions in the overall cost of shipping through a port and could merely redistribute rents through the chain of port production. Moreover, the end result may be lower customer welfare as service quality is reduced.

What this suggests is that approaches to regulation that consider a single element are unlikely to be effective in improving the efficiency of shipping through Australian ports. For example, price regulation in towage should not be considered in an independent manner to price regulation of all other port services. Piecemeal reform is likely to be either ineffective or potentially harmful. If there are real competitive problems in ports they should be addressed at an industry level rather than on a single dimension.

Even so, the case that there is a particular competitive problem in harbour towage has yet to be proven. Structural barriers to entry appear to be relatively low while actual behaviour suggests considerable constraints on the ability of towage operators to choose their own terms and conditions. In this situation, it appears that current industry arrangements satisfactorily address most concerns that would otherwise arise as a matter for competition policy.



## 6 Technical Appendix

In this appendix, we consider a simple formal model of the interactions between a Towage Company (t) and a Port Authority (a). The Port Authority includes the pilots, stevedoring, berthing and any other port functions not supplied by the Towage Company. For simplicity, we treat all these non-towage functions as if they were controlled by a single profit maximising entity.

The Towage Company and the Port Authority supply complementary products to shippers. Due to the different and, generally, non-substitutable nature of these products, we assume that a shipper requires both a fixed amount of Towage Services and a fixed amount of services from the Port Authority. These services are charged separately by the Towage Company and the Port Authority, and we denote the prices of these services by p and r respectively. Thus, a 'representative ship' that wishes to use the relevant Port needs to pay p dollars for towage services and r dollars for other complementary port services. The total price for port services to the shipper (including towage) is p + r.

Demand for port services depends on both the total price of port services and the quality of those services. Obviously the quality of towage, pilot services and other port services all matter to shippers. However, the focus here is on the towage companies so we will focus on their service. We denote the service level by the towage company by *s*. We assume a simple linear demand for shipping services. This is convenient as it allows for simple numerical analysis. However, our key results are robust to more general well-behaved demand functions.

Demand for port services by shippers is given by Q = A + s - (p+r)where Q is the quantity of services sold by the port and A is a constant representing the vertical intercept of the demand curve.

As discussed in the body of the report, the quality of towage services generally relates to fixed costs such as the standing number of tugs available. The greater the number of tugs in a port, the shorter will be the expected waiting time for any ship wishing to enter or leave the port. Thus, we denote the cost of service level *s* by a fixed charge, F(s). We assume that there is both a lowest and a greatest feasible level of service. The lowest level of service is simply set to 0, while the greatest feasible level is set to  $\overline{s}$ . We set F(0) = 0 and assume that



the marginal cost of increased service is positive and increasing so that F'(s) > 0, F''(s) > 0 and the limit of F'(s) as s approaches  $\overline{s}$  is given by infinity.<sup>14</sup>

Both the Towage Company and the Port Authority also have variable costs for additional ships. For simplicity, we assume that the marginal cost of providing services to an additional ship is constant. We denote these marginal costs by *c* and  $\theta$  for the Towage Company and the Port Authority respectively. To ensure that there is always some demand for the port services, we assume that  $A > c + \theta$ .

The profit of the Towage Company and of the Port Authority respectively are given by  $\pi_t = (p-c)Q - F(s) + T$  and  $\pi_a = (r-\theta)Q - T$ . At a number of stages of the analysis below, we allow for transfers between the Port Authority and the Towage Company, and these are denoted by T.

## 6.1 Benchmark cases

We begin by establishing two benchmarks for latter analysis. These are the integrated port benchmark and the socially-efficient marketbased benchmark. These benchmarks will differ in our framework because the port as a whole faces a downward sloping demand. Thus, our model allows for imperfect competition between ports but not for perfect competition between ports.

Given the demand for port services, an integrated port will seek to maximise the sum of profits. As it is the sum of prices, p + r that matters for demand, the integrated port will simply set this sum to maximise joint profits. For a given service level, the optimal prices are  $p_i + r_i = \frac{1}{2}(A + s + c + \theta)$ . The profit maximising service level is implicitly defined by  $s_i$  such that  $A - c - \theta = 2F'(s_i) - s_i$ . Note that by our assumptions, this optimal service level is well defined and unique. The integrated port profit given is by  $\pi_i = \frac{1}{2} (A + s_i - c - \theta)^2 - F(s_i).$ 

<sup>&</sup>lt;sup>14</sup> These conditions simply make sure that there is always a well defined optimal level of service. Because service raises both demand and cost, it is important to constrain the problem so that it is not optimal to always offer an arbitrarily high level of service. This could occur is demand rises 'faster' than costs as service increases. Our assumptions rule out this possibility at sufficiently high levels of service.



The socially-optimal market-based benchmark will involve setting price to the lowest possible level to just cover costs and then setting service quality to maximising social surplus.<sup>15</sup> For any service level, *s*, let *Z* be the minimum total price that allows both the Port Authority and the Towage Company to cover costs. Thus  $Z = c + \theta + \frac{F(s)}{Q}$ where the total quantity purchased, *Q* itself depends on the price *Z*. Thus, Q = A + s - Z. Noting that the social welfare will just be the welfare of shippers, given by the area under their demand curve, the optimal pricing and service levels are found by setting *s* and *Z* to maximise  $\frac{1}{2}(A+s-Z)^2$  subject to  $F(s) = (A+s-Z)(Z-c-\theta)$ . The first order conditions are:

 $A + s - Z + \lambda (Z - c - \theta) - \lambda F'(s) = 0, \text{ and}$  $-(A + s - Z) - \lambda (Z - c - \theta) + \lambda (A + s - Z) = 0.$ 

Adding these two equations gives Z = A + s - F'(s). Substitution then gives the socially optimal service quality implicitly defined by  $s^*$ where  $A - c - \theta = F'(s^*) + \frac{F(s^*)}{F'(s^*)} - s^*$ .

It is useful to compare the market-based socially optimal level of service with the level of service provided by an integrated port. The equations that implicitly define both of these service levels have the same left-hand-sides. Thus, the relative level of service depends on the variables on the right-hand-side of the equations. In particular, note that  $s^*$  can be greater or less than  $s_i$ . In other words, an integrated port may offer a level of service higher or lower than the market-based social 'first best' level of service. This reflects the fact that the integrated port is interested in service to the extent that it raises the marginal willingness-to-pay of shippers. In contrast, from a social perspective, raising service quality has both marginal and inframarginal effects.

<sup>&</sup>lt;sup>15</sup> This is a market benchmark in the sense that it requires pricing in a market such that the Port Authority and the Towage Company cover their costs. Because investment in service is a sunk cost, an unconstrained social optimum would involve  $Z = c + \theta$  (i.e. marginal cost equals price) with a service level implicitly defined by  $A - c - \theta = F'(s) - s$ . Note that this unconstrained level of service is higher than the market-based social optimum and is unambiguously greater than the service level associated with an integrated port. However, it is inconsistent with any linear market prices in the absence of a government subsidy.



The result, that a firm with market power can set a level of service either above or below the market-based social first-best is well known in economics.<sup>16</sup>

Given these benchmarks cases, we are now able to examine the activities in actual ports in Australia. This will enable us to consider how the behaviour of the parties differs as their relationship alters.

## 6.2 Non-cooperative bargaining over quality

The interaction between Towage Companies and Port Authorities in Australia might best be described through the following steps. First, the Port Authority and Towage Company negotiate over service levels that the Towage Company will provide. Then the Company and the Authority independently set the prices for their services.

The outcome of this process will depend on the bargaining process and relative bargaining strengths of the two parties. At one extreme, it can be argued that the Port Authorities (and pilots) unilaterally impose significant service requirements on the Towage operators.<sup>17</sup> The case where the Port Authority can unilaterally impose service levels is one extreme of a continuum of bargaining positions. The other extreme is where the Towage Company can unilaterally set service levels. These two extremes represent the 'outer limits' for bargaining. Other bargaining solutions will occur between these extremes.

In each situation, given the agreed service level *s*, the Port Authority and the Towage firm will independently set prices to maximise their individual profits. The individually optimal prices can be determined by simultaneously maximising the two profit functions  $\pi_t$  and  $\pi_a$ . The optimal prices are given by  $p_t = \frac{1}{3}(A+s+2c-\theta)$  and  $r_a = \frac{1}{3}(A+s+2\theta-c)$ . The total price for port services is given by  $r_a + p_t = \frac{1}{3}(2A+2s+c+\theta)$ . It is easy to confirm that this price exceeds the price that would be charged by an integrated port given the same service level. This is a standard result whenever two firms independently price complementary inputs.<sup>18</sup>

<sup>&</sup>lt;sup>18</sup> See Economides and Salop (1992)



<sup>&</sup>lt;sup>16</sup> See Spence (1975).

<sup>&</sup>lt;sup>17</sup> See Adsteam (2002).

Substituting these prices back into the profit functions, we see that for a given level of service  $\pi_t = \frac{1}{9}(A+s-c-\theta)^2 - F(s)$  and  $\pi_a = \frac{1}{9}(A+s-c-\theta)^2$ .

We are now able to consider the level of service.

# 6.2.1 Service when the Port Authority has all bargaining power

This outcome will arise whenever the Port Authority is able to set the service level for the Towage Company. It can be argued that this is the current situation in at least some ports in Australia. It would also be the result if Ports tendered out for towage service where the tender contract required specified service levels but allowed for the successful tender to set its own towage prices.

Note that the Port Authority's profit is increasing in service. In particular, because the Authority can demand higher service, gains the benefit of this service through increased demand, but does not have to pay directly for that service, the Port Authority will demand the highest feasible level of service subject to the constraint that the Towage Company cannot earn negative profits in the long-run. In other words, the Authority will demand service level  $s_a$  such that  $\pi_t$ 

is just driven to zero. That is  $\frac{1}{9}(A+s_a-c-\theta)^2-F(s_a)=0$ .

This service level may be higher or lower than the integrated port service level (and hence higher or lower than the social first-best service level). Essentially this is an empirical matter. However, guidance in this matter can be found by considering the integrated port profit. At its optimal service level, integrated port profit is  $\frac{1}{4}(A+s_i-c-\theta)^2-F(s_i)>0$ . If an integrated port is expected to be highly profitable then it is likely that  $s_a > s_i$ . In other words, if a port is relatively unconstrained by inter-port competition, then it is likely that the Port Authority will demand a very high level of service from the Towage Company. In contrast, if inter-port competition is strong, the port may be unable to require a high service level. In such a situation, inter-port competition is essentially limiting the Towage company's profits and the Port Authority has little leverage to demand higher service levels.

The tendency for the Port Authority to require over-servicing can be socially wasteful, in the sense that it tends to use up all the profits of the Towage Company for what might be little social return. In particular, the Port Authority has an incentive to demand improved



service even if the marginal cost of that service is large compared to the marginal benefit to the customer. This can be seen by noting that the service level does not depend on the marginal benefits and costs of improved service.

# 6.2.2 Service when the Towage Company has all bargaining power

In this situation, the Towage Company will unilaterally set s to maximise its own profits,  $\pi_t$ . Differentiating this means that the service level is implicitly given by  $A-c-\theta = \frac{9}{2}F'(s_t)-s_t$ . It is clear that this level of service is below the level that would be offered by an integrated port facility.

The outcome here reflects a standard free-rider problem with complementary inputs. If one producer of a complimentary input raises quality then they increase demand for both their own input and the complementary input. However, it is only the return from own sales that raises profit. Each firm will tend to ignore the spill-over to the other firm's profit in their quality decision and as a result too little quality is produced.

### 6.2.3 General outcomes for service negotiation

The service levels  $s_a$  and  $s_a$  represent the extreme outcomes. In general negotiation between the Towage Company and the Port Authority will lead to intermediate levels of service. There is likely to be tension between the Towage Company and the Port Authority over service levels. The Towage Company will wish to lower service levels in general while the Port Authority will wish to raise service levels. For example, the Port Authority will tend to want the Towage Company to have more tugs available. They may wish to have a level of availability that is wasteful from a social perspective.

In contrast, the Towage Company will wish to lower service levels below the level that would maximise the profits of an integrated port. The towage company will also prefer to set a level of quality below that set if the Port Authority and the Towage Company could cooperatively agree on the service levels. In such a situation, the service level will be set to maximise the joint profit  $\pi_t + \pi_a$ . The firms will also set transfers T to share profit between the two firms. In this situation, the cooperative service level will be implicitly defined by  $A - c - \theta = \frac{9}{4}F'(s_c) - s_c$ .



Figure 6.1 summarises the potential range of service levels when these are negotiated between the Port Authority and the Towage Company. The lowest level of service will be when the Towage Company can unilaterally set the service level. The highest service level involves the Port Authority unilaterally setting the service level. As drawn, this level is above the integrated port service level. It should be noted that the higher the negotiated service level, the higher the total price of port services paid by shippers.

#### Figure 6.1: Equilibrium Service Levels



#### 6.2.4 Conclusions

The above analysis has a number of implications. First, it is not possible to say whether the socially first-best level of service will or will not be provided by negotiations between the Port Authority and the Towage Company. In fact, even an integrated port may overprovide or under-provide service form a social perspective. This said, it is more likely that there will be a socially inappropriate level of service if one or other firm has significant bargaining power.

Secondly, comparisons of port quality provide a useful way of inferring the relative degree of power held by the Port Authority and the Towage Company in otherwise similar ports. A high level of service is likely to reflect that the Towage Company is in a relatively weak bargaining position. The reverse holds for low levels of service. Similarly, movements in service levels over time are likely to reflect changes in the relative bargaining power of the firms.



## 6.3 Effects of competition in towage

We now turn to consider four alternative forms of competition that might exist for towage. First, we consider the effects of on-the-water competition, where there are multiple Towage Companies in a single port. Secondly, we consider the implications of customer contestability, where potential users of towage services (either customers or the Port Authority themselves) have the potential to provide towage services if they wish. Thirdly, we consider the implications of competitive tendering and licensing by the Port Authority for towage services. Finally, we consider case of integration by the customers into towage operations.

## 6.3.1 On-the-water competition

The effects of on-the-water competition will depend on the degree of co-operation between the towage operators. For example, suppose that there were two independent towage operators, each of which could offer full service. Due to the economies of scale, we would expect, in that situation, price to be driven down to marginal cost. Towage companies would compete vigorously for shipping until one firm exited the market. Given the relatively low sunk costs in towage, we would expect that exit to be fairly rapid. This suggests that we would only expect to see long-term on-the-water competition if either the towage companies co-operated with each other or if the port was large enough so that any relevant economies of scale would be exhausted. In the former case, towage operators would have, say, two tugs each. They might compete vigorously for some small jobs but most of the time they would need to co-ordinate there operations (e.g. where there is one ship needing four tugs or where two ships each needing two tugs both desire to be moved). In the latter case, if for example a port had sufficient shipping to support eight or more tugs, then two towage companies could provide a 'full service' in competition with each other. Such competition would however reflect price competition with capacity constraints and pricing would generally exceed marginal cost (e.g., Kreps and Scheinkman, 1982).

In this sub-section, we focus on the case of 'co-operative' on-thewater competition. We do this for two reasons. First, it is our understanding that this is most likely to reflect the relatively small size of Australian ports. Secondly, it is our understanding that cooperation has historically been part of on-the-water competition where it has existed in Australia (Adsteam, 2002).

To analyse co-operative on-the-water competition, suppose that there are two independent towage operators but they co-ordinate in the



sense that they share tugs. Thus, if a ship requires four tugs, each operator only needs to have two tugs available and each only bears its share of the marginal and fixed costs. In this situation, each operator sets their own price but effectively spends half the fixed and variable costs and supplies half the quantity of services demanded.

If we denote the towage operators by t=1 and t=2, then each operators profit is given by  $\pi_t = (p - \frac{c}{2})Q - \frac{1}{2}F(s)$ . The Port Authority's profit is unchanged at  $\pi_a$ . For any given level of service quality, all three firms simultaneously set their price to maximise their own profit. Solving, this means that  $p_1 = p_2 = \frac{1}{4}(A+s+c-\theta)$  while  $r_a = \frac{1}{4}(A+s+3\theta-c)$ . The total price of port services is  $p_1 + p_2 + r_a = \frac{1}{4}(3A+3s+c+\theta)$ . It is easy to confirm that this total price is *higher* than in the absence of on-the-water competition.

The reason for this result is simple. Because the companies are cooperating in sharing tugs, there is not any real competition. However, there are now three complementary inputs rather than two. This increases the incentive for each towage operator to raise its prices.

While price will be higher for each level of service, it is likely that the negotiated level of service will change under on-the-water competition/co-operation. Bargaining power is likely to shift to the Port Authority. The authority will tend to demand higher levels of service, as it can threaten to exclude an individual operator if they do not comply. As a result, this form of competition is likely to lead to both higher prices and higher service levels.

It is easy to confirm that towage operator profits are lower for any service level under on-the-water competition than if the companies formed a joint-venture and jointly set their prices (i.e. acted as a single operator). Further, given the level of service, such co-operation will lower the total price of port services to shippers. Thus, there are strong incentives for on-the-water competitors to join over time as either a joint venture or through merger. It is our understanding that this has occurred in Australia. Further, such merger can benefit both the firms and the customers, subject to maintaining service levels.

### 6.3.2 Customer contestability

If the relevant port is dominated by a few large customers (e.g., ship owners, exporters and/or importers), then those customers could threaten to sign contracts with an alternative towage company to facilitate entry. There has been at least one example of such entry in Australia (in Newcastle). This form of entry is essentially equivalent



to a contestable market. In other words, we would expect only one towage company to continue in the long-term. Thus, either the threat of entry will keep down towage prices or, if entry occurs, it will lead to lower prices and exit by either incumbent or the entrant.

To see the effects of long-run contestability, note that in the longterm, towage prices must equal cost. Denote this price by  $Z_t$  where  $Z_t = c + \frac{F(s)}{Q}$ . The customers know, given the cost and quality of towage, that the Port Authority will set the price of other port services to maximise its profit. Thus,  $r = \frac{1}{2}(A + s - Z_t + \theta)$ .

There are two alternatives available for service levels. First, the customers could contract directly with the towage operators for a particular quality of service. Alternatively, the service level might be set in advance by the Port Authority and enforced, for example, through conditions relating to pilots. We consider these two alternatives in turn.

#### 6.3.2.1 Customer contestability with contracted service

First, suppose that the service level can be set by the contract between the customers and the Towage Company. In this case, the customers will contract with the towage operator to provide an optimal level of service (from the customer's perspective) given the pricing behaviour of the Port Authority. The customers will seek to maximise their total surplus. Noting that  $Q = A + s - r - Z_t$ , the contestable contract will set *s* and  $Z_t$  to maximise  $\frac{1}{8}(A + s - Z_t - \theta)^2$  subject to  $\frac{1}{2}(Z_t - c)(A + s - Z_t - \theta) = F(s)$ . This is solved in an analogous way to the first-best problem presented above. Thus, we find that the contestable level of service is implicitly defined by:  $A - c - \theta = \frac{F(s)}{F'(s)} + 2F'(s) - s$ .

Comparison to the social first-best level of service shows that the level of service chosen by the fully contestable contract will be below the first-best level of service. Similarly, comparison with the integrated port solution shows that the contestable level of service will be below that provided by an integrated port. In this sense, contestability will still lead to an *under-provision* of service.

Notice that this under-provision of service is not due to any market power by the Towage Company. In fact, the Towage Company's service level here is set by the customers. Rather, the distortion arises due to the market power of the Port Authority. The Port Authority has an incentive to raise price even though this reduces demand. Knowing this, the customers themselves prefer to invest less in



towage service levels. This service will be used over a relatively smaller quantity than in the social first-best, so that it is not desirable to invest as much in service levels.

While service levels are less than first-bet in the contestable case, we do know that the benefits to shippers are higher than in any situation where the Towage Company and the Port Authority both have market power. Any additional market power will simply further distort the market.

#### 6.3.2.2 Customer contestability with pre-set service

Alternatively, suppose that the Port Authority sets service quality before the customers negotiate with the Towage Company. As before, the final quantity purchased by the customers will be  $Q = A + s - r - Z_t$  and the Port Authority will set its price, after  $Z_t$  is determined, at  $r = \frac{1}{2}(A + s - Z_t + \theta)$ . Thus, the quantity of Towage services purchased given service level *s* is given by  $Q = \frac{1}{2}(A + s - Z_t - \theta)$ . Profit for the Port Authority is given by  $\pi_a = \frac{1}{4}(A + s - Z_t - \theta)^2$ . The Port Authority will set the optimal level of service to maximise its profit subject to the zero profit constraint for the Towage Company,  $\frac{1}{2}(Z_t - c)(A + s - Z_t - \theta) = F(s)$ . But solving this optimisation problem gives the same level of service as under the fully contestable contract.

The outcome of customer contestable contracts is the same whether the service level is set exogenously by the Port Authority prior to contracting or when the service level is part of the contracting process and is set by customers. Mathematically, this can be seen by comparing the customers' objective function and the Port Authority's profit. The latter is simply twice the former in our model. This exact relationship is driven by the linear demand assumption of our model. However, the basic principle – that under customer contestable contracts for towage there is no conflict between the Port Authority and the customers over service standards – is more general.

Economically, when there are customer contestable contracts for towage, the return to the customers and to the Port Authority are aligned. Customers wish to set an optimal service quality to maximise consumer surplus, taking the cost of increased service into account. The Port Authority also wishes to maximise consumer surplus in the sense that through its own pricing policies it will turn some of that surplus into profit. The Port Authority has no incentive to either under-provide service or over-provide service as this harms customer



benefits and, as such, harms the authority's ability to seize profits from customers.

## 6.3.3 Towage tendering and licensing

Competition between towage companies can occur through the Port Authority calling for tenders to provide those services and then licensing the successful tender to supply towage services to the Port. Because of economies of scale we expect that there will only be a single Towage Company chosen through the tender and operating at the port.

The exact outcome from exclusive contracting will depend on the parameters that can be negotiated between the Port Authority and Towage Companies. There are two simple cases. First, suppose that the Port Authority can write any contract with a Towage Company, including any form of non-linear transfer payments between the Authority and the Company and any price p to be charged to shippers. Then the outcome of the tender process will be identical to the outcome of an integrated port. To see this note that competition between Towage Companies for the license will eliminate all Towage Company profit. Further, the Port Authority can simply set lump-sum transfers to or from the successful company to ensure that its profit is zero with the desired service level and towage prices. As such, the Port Authority can effectively directly set p, r and s. Further, maximising its own profit is the same for the Port Authority as maximising joint profits, given that the Towage Company profit is zero. Hence the tender process is likely to lead to an outcome identical to that of an integrated port. As with the integrated port, the specific prices p and r cannot be determined although the sum of these prices, p + r and the level of service s are all well-defined.

Second, suppose that the Port Authority can contract *only* on the basis of service level and the price that the successful company will charge the shippers and there can be no other transfers between the Port Authority and the successful tender. In this situation, the outcome under exclusive contract is identical to the customer contestability outcome. Under both, competition will push Towage Company economic profits to zero. The successful tender price for towage can be denoted by  $Z_i$  where this is a 'break-even' price. Given this price and service quality the Port Authority will then set its price. Thus, from an analytical perspective, the problem that faces the Port Authority is identical to the contestable customer contracts with preset service quality. The exclusive contracting process will lead to the exact same outcome.



## 6.3.4 Integration of towage by customers

Finally, it is possible for customers to integrate into towage operations. The customers could simply buy a Towage Company or form a Towage Company. Such a company could be a joint venture between the customers.

In contrast to arms-length contracts under customer contestability, with integration, a variety of transfers can occur under integration. For example, under a joint venture, the partners can have a wide variety of rules governing payments to the Towage Company.

Under a joint venture the customers will set the service level s and ration towage services internally by setting a marginal price t. There is no requirement that the total revenues collected through the price t cover total costs. If they do not, then the joint venture partners share any residual cost between themselves as fixed payment. Of course, the price t might more than cover the costs of towage, in which case the excess revenues are a lump sum receipt to the partners.

The importance of the internal price, *t*, is that this price will influence the behaviour of the shippers and, in turn, will effect the price charged by the Port Authority. As before, given *s* and *t* the Port Authority will set its price *r* such that  $r = \frac{1}{2}(A+s-t+\theta)$ . The joint venture will set *s* and *t* to maximise the total surplus accruing to the joint venture which is  $\frac{1}{2}(A+s-t-r)^2 - F(s) - (c-t)(A+s-t-r)$ . Substituting for *r* and solving gives  $t = F'(s_j) + c$  and  $A-c-\theta = 3F'(s) - s$ .

A joint venture by the shippers will tend to involve a lower level of service quality than an integrated port. In other words, if the shippers themselves are able to write any towage contracts, then they will choose to provide a lower level of towage service than an integrated port. The reason for this is that it is desirable for the shippers to set the internal price of towage, t, above marginal cost. The reason for this is that the shippers are facing a Port Authority with market power. By raising the internal price t and thus restricting their demand for port services, the shippers are able to exercise countervailing power against the Port Authority. Limiting demand tends to lower the Port Authority's price r. But because they are using less port services, from the shippers' perspective it is not worthwhile investing as much in towage quality. Thus, as t rises, r falls but s also falls.

Note that the shippers could mimic the result of an integrated port by setting t = c. They chose not to do this. By revealed preference, the



shippers must be better off if they integrate towage operations rather than if the Port Authority integrated towage operations.

## 6.4 The effect of direct price regulation

There a variety of ways that the government could intervene in the interactions between the Towage Company, the Port Authority and the shippers. In this section, we consider the effects of simple price regulation on the Towage Company. In particular, what happens to the provision of port services when the price of Towage is constrained by government regulation?

Regulation is only sensible when competition is inoperative. As such the analysis in this section considers the effect of price regulation when both the Port Authority and the Towage Company have some market power and bargain over service levels before setting individual prices. As before, the 'bounds' for the outcome in the market will be given by the case where the Port Authority has all the negotiating power and the case where the Towage Company has all the negotiating power.

Throughout this section we assume that the price regulation is binding. In other words, the regulatory authority sets a price for towage that is below the price that would otherwise be set by the Towage Company. From section 6.2, we know that the unconstrained price of towage is  $p_t = \frac{1}{3}(A+s+2c-\theta)$ . Thus, in what follows we assume that the regulated price of towage,  $\overline{p}_t$  is below this unconstrained price. We will be interested in how the total price of port services and the quality of service alters as the regulation tightens or weakens in the sense that  $\overline{p}_t$  falls or rises.

For any service level, given the regulated price, the profits of the towage company simply depend on the price of other port services, as set by the Port Authority. In other words,  $\pi_{t,g} = (\overline{p}_t - c)Q - F(s)$  where, given *s*, the quantity of services demanded is  $Q_g = A + s - r - \overline{p}_t$ , which depends on the level of charges set by the Port Authority, *r*. The Port Authority will set these charges to maximise its own profit  $\pi_a = (r - \theta)Q$ . Solving for the optimal price for the Port Authority gives  $r_g = \frac{1}{2}(A + s - \overline{p}_t - \theta)$  and  $\pi_{a,g} = \frac{1}{4}(A + s - \overline{p}_t - \theta)^2$ , where the



subscript *g* refers to the government regulated outcome. The profit of the Towage Company is  $\pi_{t,g} = \frac{1}{2} (\overline{p}_t - c) (A + s - \overline{p}_t - \theta) - F(s)$ .

A number of points about the effect of regulation follow directly from this. First, for any given service level,  $\frac{\partial r}{\partial p_t} = -\frac{1}{2}$ . Thus, as the regulation becomes tighter ( $\overline{p}_t$  falls), the price of other port services tends to rise. The regulation reduces the market power of the Towage Company but at the same time increases the market power of the unregulated Port Authority.<sup>19</sup>

The Port Authority's profit increases as the regulation on Towage tightens, but unsurprisingly, the profit of the Towage Company falls as the regulation tightens. To see latter point note that  $\frac{\partial \pi_{t,g}}{\partial \overline{p}_t} = \frac{1}{2}(A+s-\theta+c) - \overline{p}_t$ . Noting that, as the regulation is binding,  $p_t < \frac{1}{3}(A+s+2c-\theta), \frac{\partial \pi_{t,g}}{\partial \overline{p}_t} > \frac{1}{6}(A+s-\theta-c) > 0$ . Thus, as the price regulation weakens (tightens) the Towage Company's profit rises (falls).

While tighter regulation raises the market power of the Port Authority, it also affects the quality of the service provided. As before, we consider that service quality is set by negotiation between the Port Authority and the Towage Company, and characterise the range of negotiated outcomes by considering the 'extreme' bargaining outcomes. As we show below, under either extreme, the service quality falls as price regulation tightens. This strongly suggests that price regulation of towage will lower the quality of service provided by towage companies.

# 6.4.1 Service when the Port Authority has all bargaining power

Given the regulated price of towage, the Port Authority's profit is increasing in the level of towage service. Thus, if the Port Authority has all the bargaining power, it will set a service level that just forces the Towage Company to have zero economic profit in equilibrium. Thus, for all  $\overline{p}_t$ , the service level *s* will be implicitly defined by

<sup>&</sup>lt;sup>19</sup> It can also be noted that, given s the quantity of port services sold rises as regulation tightens. However, this observation is somewhat misleading, as we will see below that the level of service quality falls as regulation tightens.



 $(\overline{p}_t - c)(A + s - \overline{p}_t - \theta) - 2F(s) = 0$ . Totally differentiating this expression gives,  $\frac{ds}{d\overline{p}_t} = \frac{A + s - 2\overline{p}_t - \theta + c}{2F(s) - (\overline{p}_t - c)}$ .

To determine whether this is positive or negative, note that when the price regulation just binds,  $\overline{p}_t = \frac{1}{3} (A + s + 2c - \theta)$  and  $\frac{ds}{d\overline{p}_t} > 0$  if  $A - \theta - c < 6F'(s) - s$ . But this last inequality must hold as the profit maximising level of quality for the Towage Company when the price regulation just binds is given by  $A - \theta - c = \frac{9}{2}F'(s) - s$  and the level of service quality set by the Port Authority will be at least as high as the profit-maximising level for the Towage Company. Further, note  $\frac{ds}{d\overline{p}_t} = 0$ that only holds when  $\overline{p}_t = \frac{1}{2} (A + s - \theta + c) > \frac{1}{3} (A + s - \theta + 2c)$ . Thus, as  $\frac{ds}{d\overline{p}_t} > 0$  when the regulated price for towage is at its maximum value,  $\overline{p}_t = \frac{1}{3} (A + s + 2c - \theta)$ , then  $\frac{ds}{d\overline{p}_t} > 0$  also holds for lower regulated prices. 20

In summary, if the Port Authority has all the bargaining power over service levels, placing price controls on the Towage Company and increasing these controls will tend to result in lower service levels than in the absence of price regulation.

# 6.4.2 Service when the Towage Company has all bargaining power

If the Towage Company has all the bargaining power over service levels, then it will simply set *s* to maximise its profit,  $\pi_{t,g}$ . The first order conditions from this optimisation problem mean that the service level is implicitly defined by  $\frac{1}{2}(\bar{p}_t - c) = F'(s)$ . As this holds for all regulated prices, the condition can be totally differentiated yielding  $\frac{ds}{d\bar{p}_t} = \frac{1}{2F'(s)} > 0$ . Thus, as the price regulation tightens, the level of service quality falls. In this situation, tighter price controls on the Towage Company will lead to unambiguously lower service levels than in the absence of price regulation.

<sup>&</sup>lt;sup>20</sup> There is an issue at very low price regulation and low service levels as the derivative of the service level with regards to the regulated price might not be well defined.



#### 6.4.3 Summary of outcomes under direct price regulation

When price regulation is imposed on the towage company, then this will tend to reduce the level of service offered by the Towage Company. In terms of the range of negotiated service outcomes, this range will tend to shift to lower service levels regardless of the relative bargaining power of the Port Authority and the Towage Company. In other words, as would be expected, tighter price regulation on towage will tend to lower towage service levels when the towage company has most of the say in determining service. Less intuitively, but more importantly for Australian ports, tighter price regulation on towage will tend to lower the service quality of towage even if the Port Authority sets the service levels.

The intuition behind this latter outcome is as follows: price regulation reduces towage company profits for any service level, but at the same time raises the prices charged by Port Authorities. When negotiating over service quality, therefore, the towage company has 'less room to move.' A high service level can make it unviable. As a result, bargaining pressure moves towards lower service levels.

Price regulation of towage reduces towage quality and tends to reduce the profits of the Towage Company. But depending on the rate of change of towage service, increased price regulation of towage may also make the Port Authority worse off and may reduce demand for port services overall. Both the Port Authority's profit and the quantity of port services demanded will fall as price regulation increases if  $\frac{ds}{dp} > 1$ . This cannot be ruled out in our model.

More generally, price regulation of towage can hurt shipping companies if (1) towage prices are relatively less important to shippers than service quality and (2) if service quality tends to fall relatively quickly as price regulation tightens. Both of these are, of course, empirical matters. However, it is our understanding that the first condition may hold with the cost of waiting times due to poor towage service being large relative to the cost of towage.



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## **Consultant Profiles**

## **JOSHUA GANS**

Joshua Gans graduated in 1994 with a Ph.D. in Economics from Stanford University. His thesis concentrated on the determinants of economic growth and the role of technological progress. He returned to Australia as a lecturer in the School of Economics, University of New South Wales. In 1996, he moved to Melbourne to take up a position as an Associate Professor at the Melbourne Business School, University of Melbourne where he now holds the Chair of Management (Information Economics). At present, Joshua is Economics Editor of the Australian Journal of Management and on the editorial board of Information Economics and Policy.

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Joshua has also had extensive consulting experience working on competition issues for several law firms, private utilities and government agencies including the Australian Competition and Consumer Commission. His work spans a wide variety of industries including telecommunications, electricity, gas, pharmaceuticals, banking and financial services. He currently is Managing Director of CoRE Research.

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Stephen King graduated with a Ph.D from in University Harvard 1991. His specialisation was in Applied Microeconomic Industrial Organisation and Theory. Regulation. Upon graduation, Stephen joined the Department of Economics at the University of Melbourne as a Lecturer where he remained until 1994. Stephen then took up a position as Research Fellow, Economics Program, Research School of Social Sciences at the Australian National University.

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