

Railways and the Just Price

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Abstract

How much should one expect to pay for a railway ticket? This is a fairly simple question, but one which has vexed policymakers for almost two centuries. The difficulty for policymakers is that, once one departs from competitive economic models, it is very difficult to determine what the price 'should' be. This paper surveys responses made by policymakers throughout rail's history. It makes a qualified case for the use of fairness, rather than efficiency, as a key tool in regulation.

Introduction

This paper endeavours to address the question of how to price railway services when it becomes apparent that the market price is not appropriate. This is an issue which railways have faced, almost from their very inception, because they are natural monopolies with an incentive to price above marginal costs. Both conceptually and historically, there are three ways in which one might set prices when markets do not deliver desired results; by applying to notions of fairness, notions of equity and technocratic notions of efficiency. We examine all three notions, and make a qualified plea for greater use of fairness in determining railway prices in Australia.

Section Two of the paper outlines the theory and history of why railways require regulation in the first instance. Section Three outlines the three approaches which might be used, with a case-study illustrating each. Section Four outlines in more depth what might be meant by the notion of fairness, and Section Five examines the case for greater use of fairness in railway pricing. Section Six concludes.

Why Regulate Railways? Theory and History

From a theoretical perspective, the rationale for the economic regulation of railways is clear; railways are a natural monopoly. Since they are a monopoly, unconstrained they will produce less and charge more for their output than an equivalent competitive firm would. This results in both allocative and technical efficiency losses. The monopoly is 'natural' because high sunk costs mean barriers to entry are sufficiently high that it is highly unlikely (except on the most highly trafficked routes) that competition could be successfully introduced. For this reason, regulation is the only way in which uncompetitive pricing can be tempered.

Natural monopoly, at least as described above, was not the reason why regulation of railways began. Ironically, calls for railway regulation began in Britain in the middle of the 19th Century because railways started to price in the most efficient manner possible for an entity with high fixed and sunk costs facing heterogeneous demand; they began to price discriminate. Locklin (1933) provides an exposition of the emerging price discriminating behaviour of British railways in the 1830s and 40s and the reactions of their customers to this. Railways began to be accused of unfair pricing, particularly by those with inelastic demand who faced higher prices. They demanded action from government. In 1846, the British *Select Committee on Railway*

Act Enactments found that competition was simply not applicable to rail and that it could not be relied upon to keep fares down.

The immediate question facing British parliamentarians was what could be done about this. The Parliamentary Charters under which most railways had been established provided a mechanism (albeit an imperfect one) for controlling the railways, but did little to assist on the question of what the charges should be, if the market prices were unfair. Arguably, it is still unclear what prices 'should' be, but there have been a number of methods used to attempt and answer to this question. These are summarised below.

Governance Mechanisms

In essence, there are three ways in which one can judge the reasonableness of prices when market mechanisms fail to do so:

- By adopting a technocratic approach and using economic or engineering models to determine reasonableness benchmarks through an administrative body.
- By adopting a public service approach and determining prices which serve the 'public interest' rather than the needs of the railway.
- By adopting a judicial approach whereby railways set prices, but shippers have a right to complain and the fairness of rates is determined in a court-like body.

The latter mechanism was often the first to be used when railways had been developed with private monies, as an incremental case-law approach is often a useful way in which to move towards an answer to a new issue when that issue is not well understood. However, all three methodologies have been used in various contexts throughout the long history of railways. Below, we present three case studies which shed further light on the three approaches:

- Britain from 1873 to 1888: Judicial approach
- The US after 1906 and Australia today: Technocratic approach.
- Australia from 1884 to 1990: Public service approach.

Governance by Technocracy

Governance by technocracy refers to the case whereby an administrative body determines what the 'reasonable' price for the service should be and enforces this price. In a real-world sense, the prices are usually in the form of some kind of maximum or minimum. Australian railways have a revenue not a price limit. There is also usually an opportunity for both the service provider and customers to make representations to the administrative body, as well as an appeals process to a higher court, which adds a quasi-judicial element to the process.

There are, broadly speaking, two types of governance by technocracy. The first focuses on technical efficiency, with the assumption that technical efficiency will result in allocative efficiency, as per the standard neoclassical model. Such a process will focus on the cost side of the business; the regulator will commonly develop a model of the firm being governed and attempt to ascertain the marginal costs of the firm, which will then form the basis for pricing. Australia today is a classic case of

technical efficiency regulation. Europe is the same, and even the US has a technical efficiency model lying behind its regulation.¹

The other approach is to focus directly on allocative efficiency, by trying to ensure that various freight tasks are carried by the 'right' mode of transport. In a non-regulatory sense, the current transport pricing inquiry by Australia's Productivity Commission is an example of this process. The Interstate Commerce Commission (ICC) also adopted an allocative efficiency approach to its pricing determinations, using the value of a service rather than the cost of its provision as an important determination of the reasonableness of rates, right through until the 1960s, when it was castigated for doing so by a Senate Committee and began developing the concept of long run marginal cost and cost-based regulation. Hoogenboom & Hoogenboom (1976) provide a detailed historical overview of the ICC and its pricing decisions, and there is a large literature on the (usually negative) impacts of this allocative efficiency approach, including Friedlaender (1969), Levin (1978) and Boyer (1977, 1987).

Technocracy Case Study: The 1906 Minnesota Price Determination

In 1906, the Minnesota Railways and Warehouses Commission undertook to value all of the railway infrastructure in its jurisdiction. Virtue (1909) outlines an approach which was followed in Minnesota (and very similar to earlier reviews undertaken in Wisconsin and Michigan). The process is almost identical to that followed a century later by Australian rail regulators.

The trigger for the review was an attempt by the State to impose a two cent fare and a commodity charge on the railways, which it thought the railways would accept but which they fought in the courts. The courts determined that the railways were entitled to a 'reasonable return' on a 'fair valuation' of its assets, but it did not specify what either of these terms meant. Rather than rely upon the railways to provide the data to the courts, the Minnesota Railways and Warehouses Commission took a proactive data-gathering approach. Forms were prepared and sent out to the railways for reporting, and then engineers in the Commission went out and physically verified the condition of the infrastructure against the reports.

The original intent of the Commission was to use the historical cost of building the railways, or Depreciated Actual Cost (DAC), in current Australian regulatory terminology. However, many of the original records had been destroyed, and it was thus decided to estimate costs based upon the efficient costs of a new railway replicating the old track. This was then depreciated. In essence, they undertook what Australian regulators would term a Depreciated Optimised Replacement Cost (DORC) calculation for the asset base. At the time, this approach was denounced as being 'arrant economic moonshine' by its critics (Virtue, 1909).

In making the valuations, there was considerable controversy over a number of items. One of these was the treatment of expenses; some of the railways had paid for roadbed expenses out of operating expenses, for example, when they should have been capitalised. A more fundamental issue, which has taxed the minds of Australia's

¹ In the US, shippers can lodge a complaint if a price is more than 180 percent of the variable cost of the railway. This provides the railways with more pricing freedom than other systems, but the variable cost calculations made by the Surface Transport Board are based in a technical efficiency framework, as is the cost models they use to ascertain 'unreasonableness' in the event of a complaint by a shipper.

regulators recently, was the treatment of land values. The railways had bought the land as greenfield and, subsequent to their building the land, it had increased in value. They wanted to include this new inflated value in the asset base, but the Commission stuck to the original purchase price, although Virtue (1909) does not note if this was depreciated or not. In total, the asset valuation provided by the railways themselves was roughly US\$500 million (in dollars of the day), a figure which Virtue notes probably wasn't depreciated. By contrast, the Commission's final figure was around \$300 million, considerably lower.

Australian regulatory decisions sometimes exhibit similar variances in asset bases calculated by the regulated firm and the regulator. However, unlike regulatory agencies today, the Minnesota Railways and Warehouses Commission had an external checking mechanism for its valuation. The railways were private companies, which had issued stock. The Commission thus compared its cost base with the capitalised values of the railways, on a per-mile-of-road basis.

Under the Hepburn Act of 1906, railways were required to incorporate under Federal, rather than state law and the role of the ICC was greatly strengthened, at the expense of the states. Rate determinations such as those of Minnesota ceased, but the scientific methodology lived on. Prouty, a Commissioner of the ICC at the time, was firmly of the view that reasonableness could not be determined until and unless the value of the assets owned by the railways was known. Roosevelt shared this view. In 1913, Congress created the Bureau of Valuation, which Prouty left the ICC to head. This Bureau systematically valued every asset owned by America's railways. The process took 20 years, and cost hundreds of millions of dollars; a cost borne by the taxpayer and the railway. The Bureau found that the value of the asset base was roughly what the railways said it was at the outset of the process and that the railways had not in fact been earning large profits on account of inflated asset bases and stock watering (Hoogenboom & Hoogenboom, 1976). However, despite railway cost information being available in the Rail Form A from 1931, and despite this massive effort to value asset bases, it was not until the 1960s that this cost data was systematically used in price determinations.

Governance by Public Service

Governance based on public service usually means the government ownership and control of a railway. This has been the case in Australia (see below) as well as in post-war UK and in large parts of Europe from the 19th Century onwards. If government owns the railways, it can more easily control directly how those railways operate, and can more easily fund the loss-making public services it desires. However, government ownership is not necessary for this to occur; the first holistic attempt at railway control in England, Gladstone's *Railway Act* of 1844 required every railway company to run one passenger train (with carriages protected from the weather) down the full length of its line every day, and to charge a penny a mile for passage. US railways were also required to perform public service roles, such as intercity passenger transport, which cost the railways \$1.4 million a day in losses by the mid 1950s (Stover, 1997). Moreover, despite being private companies, their pricing and investment decisions were almost entirely controlled by the ICC prior to the *Staggers Act* reforms in 1980.

The main difference between government ownership and private ownership in the pursuit of public interest is that a private railway is limited in its capacity to do so by the size of any monopoly rents it may earn, whilst government ownership brings with it access to the public budget. However, the use of the public budget inevitably increases the politicisation of the railways.

Governing a railway for the purposes of the public benefit generally involves a notion of 'equity'. Equity is much broader than fairness, which underpins governance in a judicial framework (see below). Fairness requires that two parties in a particular contract each be treated equally; obtaining outcomes which are not necessarily equal to each other, but rather equal to any prior expectations of each party, or at least equidistant from such sets of prior expectations. It does not require the judge to take into account past history, or a broader social context.² Equity, however, requires both. For example, if a particular group of stakeholders has been disadvantaged in the past, a government might require a railway to offer them concession fares, or to build a transport link to their community even though it will not be profitable. Alternatively, if an agreement between a railway and a factory to build a siding might adversely affect the communities around the factory by increasing noise or the risk of crashes on the roads, then equity considerations might mean government disallows the siding, even though the terms of the agreement between the railway and the factory were considered fair by both parties to it.

Equity considerations are generally addressed by government, acting on existing legislation or creating new legislation. Since government can compel parties, this makes it a highly effectively tool in addressing equity concerns rapidly. However, ranged against this power is the bluntness of the tool; legislation which is intended to promote equity can have side-effects which are not understood by the drafters of the legislation, nor intended by it. This is because people, when faced with a new law, quickly establish how they can operate to their best advantage within the limits of the law, rather than necessarily changing their behaviour to reflect its spirit.

A second issue is the degree to which legislation actually reflects the will of the people, as it is intended. Often, issues of equity affect a small group of people to a large degree and a large group of people to a small degree. Thus, the benefits of legislation to address an inequity will be large to each of its beneficiaries and any costs will be small to the remainder of the community. Small coalitions are much more easily held together, and can thus become vocal in supporting issues which they see as inequities, but which are not perceived as such by the wider community. Stigler (1971) and Peltzman (1976) present models of this kind of 'regulatory capture'.

A final issue, and one which is perhaps of greatest concern, is one raised in the game theory literature. Mertens & Sorin (1994) examine a public goods provision game and find that the distribution of voting power and the distribution of outcomes are unrelated. In their example, a society divided into book lovers and TV lovers (where both goods are publicly provided) ends up with half of the resources available being diverted to the provision of books and half to TV programming, even when only the

² A judge might consider past history when assessing likely compliance with a request, and might consider the broader social context of what precedent her judgement might set for future judgements, but this is much narrower than the equity considerations of government policymakers.

TV lovers are allowed to vote. In the context of equity considerations, this raises the problematic issue that increasing the political empowerment of the disadvantaged might not necessarily result in the allocation of society's resources favouring them more than it otherwise would. Merten & Sorin's (1994) findings are driven by some of the assumptions underpinning the public goods game they outline, which suggests examination of the applicability of these assumptions to a real world case where equity is being pursued might usefully inform the process.

In terms of the application of a public services approach to the governance of a railway, the main manifestation of the approach is two-fold:

- Prices are based on the "social value" of the relevant service and not on the cost of its provision. This is determined through the political process, not by an actual or implied willingness to pay.
- Returns to capital are either less important or not important at all, and the main internal stakeholder for a railway is its labour force.

Public Service Case Study: The Case of Australia from 1884 to 1990

The Australian railways were created largely with public monies during the 19th Century, as the high risks involved in their building meant that even large land grants were often insufficient to attract the necessary capital from overseas. In this sense, they were public service railways from the outset. However, the early railways were controlled by the minister of the day in each colony. Not only was this technically troublesome, as the CEO had a lifespan of only a few years (typically) and the railways were the largest and most complex business in the colony, but it also left the system open to rampant political corruption. Such was the public outrage at this that Victoria decided to adopt a system of professional Railway Commissioners in 1884, followed by SA in 1884, NSW and Queensland in 1888 and WA in 1902.

The Commissioners, who ran the railways until the end of the 1980s were in control of the day-to-day management of the railways, but they did not have control over new investment decisions or pricing. They also had limited control over staffing, as railway employees were public servants, and had the rights pertaining thereto. The reason why government kept parliamentary control over pricing and investment was because railways, at least in the latter part of the 19th Century, were the engines of national development, and this was seen as the role of parliament. In 1896, Victoria's Commissioner obtained Community Service Obligation payments from Parliament in order to cover the non-commercial services which the railway was required to operate. However, there was enormous public opposition; transfers from one arm of government to another were seen as completely artificial. The Commissioner soon stopped asking, and such payments were not attempted again until the 1980s.

There were a number of public services which railways were required to perform. Passenger services, particularly inter-city passenger services, were just as unprofitable and just as difficult to close in Australia as elsewhere in the world, but were seen as serving a distinct public need in connecting communities to the country at large. Railways were also common carriers, and thus required to carry all goods presented for carriage, including less than container load freight, which had high handling costs that contributed to costs in a manner which vastly outweighed their revenues.

The prices railways charged were approved each year in Parliament, which made for an inflexible tool in the face of changing demand and competition from trucking. This was exacerbated by the fact that, in a busy parliamentary schedule, parliamentarians rarely had the time to research in detail the merits or otherwise of each change in rates proposed by the Commissioners. This meant that they could often be induced to veto a rate change by only a small amount of lobbying, and kept many rates in the Rates Books frozen for decades.

The investments made by railways were also affected by Parliamentary control. It became parliamentary practice to fund operational deficits as a matter of course, as failure to do so might cause the trains to cease operating, but capital investment still required approval by Parliament, which was often not forthcoming, given the high costs and operational deficits. This meant that Australian railways had a strong incentive to extend the working lives of their rolling stock, and resulted in the rolling stock being decades behind that of the US by the 1970s.

Railways were also beholden to broader public policy objectives. At the turn of the 20th Century, they played a crucial role in “nation-building” and in helping Australian agriculture reach world markets as cheaply as possible. In times of drought, farmers would often be provided with lower freight rates as relief, which then became politically difficult to remove when the rains returned. During the 1970s, railways became part of broader government attempts to control inflation, and had their prices frozen, whilst costs multiplied. The resulting debts left the railways virtually bankrupt in the early 1980s, and the industry fearing for its future.

Railway labour was employed under public service conditions and was strongly unionised. This gave it a powerful bargaining position in negotiations with government, and it had an incentive to use this, as many of the skills of its members were unique to the rail industry, lowering their employability outside it. Although railway employment peaked in 1950, it had only decreased 16 percent by 1970 (Stevenson, 1987). When railway reforms occurred in the 1980s and 1990s, most railways lost half of their staff, even as output doubled. Clearly, railways had been overstaffed for at least a number of decades. Railway workers were also able to maintain their real wages, even through the 1970s, when inflation was high, and railways were making large losses. Although state governments might have preferred to have a smaller and less costly railway labour force, the various public services that were provided within railway employment (such as the training done by mechanical workshops, for example) was a more important concern. This was in keeping with the public service ethos under which the railways operated.

Governance by Judiciary

Governance by judiciary refers to the use of a court or court-like body which hears the arguments of both sides of a contractual dispute and then makes a ruling based on a notion of fairness to both. The notion of fairness is an important concept, which is covered in considerable detail in the following section. However, in essence, it considers the interests of the two parties alone, rather than broader considerations of societal equity, and attempts to reconcile them.

The dividing line between a judicial and a technocratic approach is often blurred; most regulatory commissions allow for submissions from both the regulated firm and

its customers, and these assist in the regulatory process. However, this process is to obtain information for use in the regulatory process, rather than to make specific judgements on fairness. By the same token, judges will make use of expert witnesses, but again, only to inform the process, rather than to determine its outcomes.

A judicial approach is particularly useful when it is difficult to generalise. For example, commercial disputes are often solved by arbitration bodies because each contract is subtly different and, despite the best efforts of the transactions cost economics literature, there is not a general framework within which to assess a contract, in the same way as there is for the regulation of a utility like a railway.

A court is useful when little is known about the potential consequences of a decision. This can make using legislation, which is often hard to reverse, potentially dangerous; a judicial approach involves smaller decisions and precedent, which can allow a society to move forward more slowly towards an appropriate outcome, discovering along the way, more about what makes that outcome appropriate. Posner (2003) suggests that this means a court is more efficient, because it evolves towards a better outcome through the slow process of better cases winning in court. However, Hirschleifer (1982) suggests that cases win in court not just because of their intrinsic merits, but also because of the skills of the lawyers representing each case. He thus suggests that there is no intrinsic reason to suggest a court would evolve in a better manner than other governance mechanisms. In so doing, he highlights a key issue; just precisely what is meant by 'progress'? Rubin (2003) presents a useful survey of the arguments about the efficiency of courts.

A court approach, however, faces the issue of lobbying and its costs. Demsetz (1968) suggests that parties bidding for a monopoly franchise will pay the equivalent of the monopoly rent in order to receive the concession. However, as Baysinger & Tollison (1980) note, in a regulatory hearing, there is a customer and a service provider. The latter will expend the monopoly rent to try and convince the judge to back its price, whilst the former will potentially spend the same amount to avoid a monopoly price.³ This potentially results in a double-inefficiency from a judicial approach. However, the amount of losses from lobbying may be lessened by making a regime more certain and hence providing fewer points about which to argue. Moreover, regulatory approaches also provide avenues for comment and input by the regulated firm and its customers, and hence the differences in efficiency losses may not be so great.

Of potentially greater concern in the use of a court or court-like approach is an imbalance of power between parties to a dispute. This concern underpinned the rise of the regulatory state in the US more than a century ago, when it became apparent that a large industrialist and a small farmer were not necessarily equal in a court of law. This remains an issue for any approach based on fairness today. However, against this, a major part of the problem in the 19th Century stemmed from the fact that the court system is adversarial. It is not necessarily the case that a system based on fairness needs to have at its core an adversarial approach. To the extent that it does not, relative size of participants becomes less of an issue.

³ In fact, the customer may be willing to spend more, as if its time horizon is shorter than that of the railway, it is not interested in the replacement of long-lived assets, and may thus push for a price equivalent to short run, rather than long run marginal cost.

There are a number of other advantages and disadvantages to courts, and indeed a literature has developed studying their efficiency (Rubin, 2003) and also the economic consequences of different institutional arrangements like courts (Djankov, Glaeser, La Porta, Lopez-de-Silanes and Shleifer, 2003). These involve broader issues than that of the 'right' price and are beyond the scope of this paper.

Judicial Case Study: The Railway Court of Britain, 1873 to 1888

Mavor (1894) provides a detailed and useful summary of railway history in Britain from its inception to the 1890s. He divides this history into four periods. The first two of these, he characterises as ones where government was unable to exercise effective control over the railways. This changed with the passage of the *Railway Traffic Act* of 1854, which had the aim of securing facilities for through traffic and ensuring equal treatment for those people and articles carried. Whilst it increased control over the railways, they still had considerable autonomy over their pricing, and it was in the interests of both the railways and many of their customers to keep it this way. However, during the rapid economic expansion of the late 1860s and early 1870s, the large profits made by the railways shifted the balance and agitation increased for a better solution. The question which most vexed policymakers at the time was that of undue preferences and of the reasonableness of rates.

The railways had begun charging different rates for different commodities and classes of passenger from the late 1830s, as they realised the virtues of price discrimination by a monopolist. However, at the same time, customers began to suspect that the prices they were being charged did not really reflect the cost of their carriage. The Acts of Parliament under which the railways were established (some 900 in all, according to McWilliams, 1923) each prescribed maximum rates and tolls in exchange for the right to establish and appropriate land. However, these proved ineffective as a control over prices, as did the many subsequent acts of legislation which were intended to do so. As something of an experiment, the Railway Commissioners Court was established in 1873 to act as an alternative to seeking restitution in the ordinary courts.

The role of the Railway Commissioners Court was to adjudicate on rates disputes, and attempt to provide some clarity on what reasonable rates might mean and to hopefully reduce the plethora of rates which had been created. It did so by hearing complaints from individual shippers, upon whom the burden of proof lay. The basic criteria was that like services should be priced alike, although the Commission was also required to take into account public interest arguments that today seem ill-suited for a court to consider. The Commission used two sets of rate principles; competition as an explanation for diversification in rates and the costs of providing a given service in determining reasonableness (McLean, 1905). It thus straddled both the cost of service and value of service approaches adopted later by technocratic regulators in Australia and the US (respectively). The Commission was not established to reduce rates or to actively intervene in rate-setting, but rather to hear disputes on rates.⁴ It was, however (unlike the ICC in America), able to make a final determination and limitations on the ability to appeal existed, both by virtue of its being a court.

⁴ Even after it was provided greater powers in the 1892 legislation, it resolutely refused to set rates (McLean, 1905)

Whatever success the Commission may have had in adjudicating cases resulting in fairer rates on an individual basis, it was singularly unsuccessful at addressing the broader issue of the proliferation of rates. By the 1880s, there were some 4000 classes of goods under the Railway Clearing House classification scheme. When the differential charges for quantity, distance travelled, speed, route and extra services (such as terminal and handling charges) were added, the number of rates reached well into the hundreds of millions (Mavor, 1894). This made it almost impossible to determine what the charge for carriage would be. Much of this expansion had occurred precisely because governments kept trying to restrict price discrimination by passing acts which required charges to be related to costs, which the railways countered by finding new costs to justify their charges.

It was also unsuccessful in lowering the overall level of rates. The railways had engaged in a large-scale expansion of their infrastructure during the 1870s, during a period of economic prosperity, and could not reduce their prices during the depression of the early 1880s by as much as shippers desired because they needed sufficient revenue to cover their fixed costs.

Thus, Parliament decided to adopt a more direct route to establish rates, by passing the *Railway and Canal Traffic Act* in 1888, empowering the Board of Trade to investigate both the level of rates and the rates schedule to ensure both were 'fair and reasonable'. The Board could not agree with the railways on the new set of charges, so a revised inquiry was held and eventually, a new set of classifications and maximum rates were passed into law in August 1892, which superseded the plethora of maximum rates established in the Parliamentary charters and subsequent legislation. For the first time, rates had been determined on an holistic basis.

The passage of the 1892 legislation did not see the demise of the Commission; indeed, its roles was strengthened and it became more formally a court, continuing to make railway judgements until the railways were taken over by government in the First World War. The main significance of the 1888 Act and subsequent maximum prices of 1892 was the recognition that it was no longer possible to rely upon a piecemeal collection of maximum rates and a court to establish rates which were reasonable, but that periodic, wholesale intervention would be necessary to ensure rates remained reasonable. The second such wholesale intervention occurred some 30 years later, when a rates tribunal was again established to ascertain the appropriate rate levels and rates structure, following the fundamental changes to the British railways and economy that war had brought (McWilliams, 1923).

Mavor (1894) does not, however, regard rate-making adjudication by the Railway Commissioners Court as a failure, and this seems a common view at the time. Indeed, with the benefit of hindsight and the subsequent experience of the ICC in America, it is not difficult to perceive the problem. The issue is not that the Commission was a court per se; the ICC was not and similarly failed to establish rates which sustained the rail industry in the 20th Century and the publicly-owned railways of Australia suffered the same fate. Rather, the key issue seems to be that railways are a complex system, and any method of price-setting which relies upon fixing up a price here and a price there will work for a time, but will eventually fail to keep pace with changes in the system and will begin to constrain, rather than enhance it.

Notions of Fairness

Economists are concerned mostly with the efficiency of results. Competitive pricing is ‘fair’ in the sense that it is Pareto Optimal; it is not possible to make anyone better off without making someone else worse off. However, there are more fundamental notions of fairness than this. Exploring them, particularly in the context of the pricing of natural monopolies, is useful; currently in Australia, it is presumed that the pursuit of economic efficiency will result in fairness, but it may be equally true that the pursuit of fairness directly results in economic efficiency. If this is so, and both approaches do result in the same outcome, then the choice is not one of which theoretical paradigm is most appropriate, but is rather which approach causes the fewest difficulties in its practical application.

Below, we consider two notions of fairness. The first, that of a “just price” comes not from modern economics but rather from the Medieval Scholastics who preceded it, and has a long history. The second comes from game theory, which endeavours to determine the outcomes of strategic interaction between players, and encapsulates some very precise notions of fairness in the outcomes of the games studied.

The Just Price

Modern economics traces its origins to Adam Smith and the philosophers of the Enlightenment. However, this does not mean that economic analysis began at this point. For the purposes of this paper, the aspect of pre-modern economic analysis which is of most interest is the pursuit of some understanding of how economic exchange operates and, in particular, what makes prices fair and unfair. The question of a ‘just price’ was widely debated in the pre-modern era.

Underlying the notion of a fair or just price is the notion of a contract between two parties. Contracts are not the only way in which to organise societal relations, so it is useful to digress slightly and examine why they have become so fundamental to the Western legal and social tradition. Almost all cultures have bargaining in the marketplace, but a unique aspect of Western Culture is that the relationship between humanity and divinity is based not on subjection or obligation, but on a contract; the covenant of the Old Testament. This notion of a divine contract was not unique to the ancient Jews, and indeed may have been transmitted to them by the Zoroastrians during their exile in Babylon from 586-539 BC. Watson (2005), examining a treaty from 1400 BC between the Hittites and Mitani, which mentions the god Mithra (ancient Persian for ‘contract’) suggests that the notion of a divine contract might have originated with the Indo-Aryan people who spread east and west from the lands between the Levant and India some 3000 years before Christ.⁵

Whatever its origin, the implications of a divine contract are two-fold. Firstly, it raises the profile of the contract as a means of societal organisation in the human consciousness. Secondly, and perhaps more importantly, it provides a powerful benchmark for more mundane contracts, by raising the spectre of blasphemy over contracts which are unfair.

The notion of a fair contract was known to the ancient Greeks, and indeed the Sophists developed the secular notion of the organisation of society by a social

⁵ From whom the Mitani are descended.

contract. However, they went further, examining what makes exchange fair and goods valuable. Most important amongst the Greek philosophers in this regard was Aristotle, as it was the rediscovery and interpretation of his writings by the Scholastic writers of the 13th to the 15th Centuries which developed the notion of a just price. Aristotle did not write about economics per se, but rather about the polis, and how best to organise it. His main concern, writing in a turbulent time in Greek history, was stability of the polis, which required justice in the relationships between its members. In exchange, a key concept was commutative justice, whereby a man gave what he received. In an example involving a doctor and a peasant negotiating over the construction of a house, Aristotle makes it clear that he does not mean the objects of trade should be identical, but he does not make it clear what he means. This has led to much speculation on this issue, but as Schumpeter (1954) suggests, it may be that Aristotle simply did not have a detailed theory of exchange. Aristotle also separated value into the concepts of value in use, and value in exchange, commenting that the latter somehow depended on the former. A lack of definition of what ‘somehow’ meant, led many writers to hypothesise that he had in mind some deeper, absolute value (Finley, 1970). A final contribution of Aristotle of interest to economic regulators was that he was the first to define a monopolist as the single seller of goods, and also the first to declare such practices unjust.

The Romans, not as adept at philosophy as the Greeks, made their contributions to economic law, rather than economic theory. Roman law was not created by judges, who were lay people who had the law explained to them for each case, but by members of the leisured elite who would provide opinions on points of law when asked to do so by the courts. This *corpus juris*, was codified by the emperor Justinian in the 6th Century AD, later forming the basis of Scholastic legal teaching and thence entering the modern Western legal tradition. Two concepts stand out in Roman law in relation to price. The first is the legal principle of “Restantum valet quantum vendi potest scilicet communites” or “A thing is worth what it can be commonly sold for”. This is an eminently practical concept, with no notion of inherent value or of an ethical dimension to price. Augustine, whom the Scholastics also analysed with fervour drew a similar conclusion, noting that things were valued for their use and not for their nature, and thus that insentient things like loaves of bread might be valued more highly than sentient things such as mice. The second concept was that of *Laesio Enormis*, which stipulated that if a seller of land parted with it for less than half its fair price, then he was entitled to sue for the remainder or annul the contract.

Between Rome and the Scholastics, the Romanists and the Canonists (both sections of the Church, like the Scholastics) made some contributions to the notion of a just price. The Romanists extended the notion of *Laesio Enormis* to all goods, and to buyers as well as sellers. The Canonists examined some of the practices of economic exchange and their acceptability under Church canon, or law. For example, they declared that merchants deserved a reward for taking risk and craftsmen for transforming objects, but they condemned the practice of buying low and selling high as sinful.⁶ They also declared that labour was worthy of its hire and further, since labour was the only factor of production which involved the application of human will, that it was the only acceptable road to wealth (Henderson, 1955). They didn’t develop a labour theory of value, however; that took a further thousand.

⁶ Tomas Aquinas later reduced this practice from a sin to something that was inadvisable.

The Scholastics were a group of religious scholars, active in medieval universities between 1100 and 1500 who sought to reconcile the philosophy of the ancient world with Christian theology. They did so by deconstructing the arguments in texts, and examining the two sides of an argument could be made whole. One such ancient text they studied was Aristotle's *Nicomachean Ethics*, writing some 70 commentaries on it. From the perspective of the just price, the three most important commentators were Albertus Magnus (d1280 – who reconciled Aristotle's model of commutative justice by suggesting the equal value was related to the perception of each party and suggested a just price would cover labour and expenses), Thomas Aquinas (1225-74 – who did the most to develop the idea of the nature of the just price) and John Duns Scotus (1266-1308 – who advanced a cost-based theory of just price that was not well accepted by later Scholastics but which many later commentators believed lay behind the Scholastic conception of a just price).

The fundamental text which began the examination of the issue of the just price was the canon Placuit of 884 AD, incorporated into canon law by Raymond of Pennaforte (1180-1278) which instructs priests to tell their flocks not to charge wayfarers prices higher than those charged in local markets and, if they do, to hear an appeal from the wayfarer and determine a price based on humanity (DeRoover, 1958).⁷ To ascertain how best to judge how prices might be determined with "humanity", 13th Century Scholars turned to the works of Aristotle which, as Schumpeter (1954) points out, saved them around a hundred years of scholarship.

Precisely what the Scholastic writers meant by a just price has been a matter of considerable misunderstanding, due both to the conflicting arguments they themselves made but also due to the efforts of later scholars (including the early economists) to distance themselves from the Scholastic writers, which they did in part by creating straw-men of their arguments. It is important to note that the Scholastic writers were men of the Church and hence had a moral and ethical focus to their analyses which no longer exists in economics today. They also had a strong sense of the social organism and sought to maintain its stability; like Aristotle, they wrote in turbulent times. Finally, they had a strong belief in the freedom and dignity of the human spirit (many had risen from humble beginnings in the Church) which they were wary of allowing secular power to crush. These factors influenced their thinking on price, and produced a notion of just price, which is perhaps best summarised by Scaccia, writing just after the Scholastic period (Pigou, 1920 p375):

"The just price is the price which is commonly sought in regard to any object by one who is not in want and is equal to that which can be obtained from one not in want who knows the condition of the object and has full age and a sound mind"

In essence, the Scholastic writers believed that the price in a market, fully-informed and free from compulsion, was just. Scaccia uses the term "price commonly sought", but, as DeRoover (1958) points out, the Scholastics used the common estimate of price (communis aestimo) interchangeably with the market price (aestimo fori). The fact that a market price was usually just did not mean that it was always so. DeJuan & Monsalve (2006) point out two situations where a market price is not just; where it

⁷ This canon also instilled in the Scholastics a strong dislike of price discrimination.

had been obtained by fraud or deceit and where it had been obtained by force or need and not by the free will of the contracting parties. In such instances, it was not only the right but the duty of the state to step in and set prices. These “legal prices” were as just as the “common prices” set in the marketplace. In fact, some Scholastic thinkers went further; a French Scholastic, Jean Gerson (1362-1428) suggested that all prices be set by the state, reasoning that none could presume themselves wiser than the lawmaker. However, as DeRoover (1958) suggests, this notion was not widely accepted, and legal prices were generally (in the minds of the Scholastics, at least) for exceptional cases rather than the norm. Given the time in which they wrote, when feudalism dominated and princes ruled by divine right, this is perhaps surprising.

One form of economic activity which attracted particular approbation from the Scholastics was the activities of monopolies, which to their minds included cartels and the guilds of craftsmen, whom they opposed. Their approbation of monopolies sprung from the belief in the sterility of money, and they characterised what modern economists would call monopoly rents as a form of usury. The Belgian Jesuit Leonardus Lessius (1554-1623) who produced a great deal of the Scholastic work on monopolies, said that, despite their shortcomings, a prince could authorise the formation of a monopoly were other public benefits might accrue from doing so, but that he had an obligation to enforce fair prices when he did so. DeRoover (1958) suggests this forms a basis for modern thinking on competition policy.

The contribution of this long history of analysis of the fairness, or justice of pricing mechanisms is two-fold. Firstly, it establishes the primacy of the contract as the fair means of interaction between parties; something so fundamental that it is rarely commented upon in economic analysis. Secondly, and of more direct relevance to modern regulatory economics, the connection between market prices and fairness in price, made by the Scholastics, has firmly established itself in economic analysis and provides something of a benchmark for alternate pricing mechanisms, such as those which might be employed by a regulator. The work of the Scholastics suggests, albeit indirectly, that aiming to determine an outcome which is fair leads inevitably to an outcome which is characterised by a competitive market. Further clarity on these links had to wait a few hundred years, until the advent of game theory.

Modern Notions from Game Theory

The main focus of study of modern game theory is strategic interaction between players. By specifying with mathematical precision, notions of how interaction occurs, game theorists endeavour to predict what the results of interaction between strategic players (ie – those who take the reactions of others into account when forming their own strategies) might be. This gives rise to a number of different solution concepts, which are sketched briefly below:⁸

- The Nash Equilibrium: an equilibrium whereby no player can benefit by unilaterally deviating from his predicted random strategy profile.
- The Bargaining Set: The set of outcomes whereby each objection to a strategy by one player can be met by a counter-objection by another player, which effectively

⁸ See Myerson (1991), from which this summary is drawn, for a far more comprehensive overview of solution concepts and their mathematical derivation. This brief summary does not do them any real justice, eschewing an examination of their precise nature and of the relationships between them.

means that no player has an incentive to block the strategy of another for fear of being counter-blocked himself.

- The Core: The set of coalitions whereby no coalition or sub-coalition of players in the game could be formed to create a reward which, when divided amongst its members, gives them a better outcome than they can currently obtain.
- The Kernel: If two players are in the same coalition, the kernel is the where the highest excess that the first can make without the second is equal to the highest excess that the second can make without the first.
- The Nucleolus: A special case of the kernel whereby the excess returns to a coalition are minimised, meaning that the maximum 'rewards' of that coalition are distributed to its members.
- The Value: A weighted average of the marginal value a player adds to each coalition he might join in a game. First discovered by Shapley (1953) but with later iterations in other contexts, including that of Harsanyi (1963) in games where utility cannot be transferred (also studied by Shapley, 1969) and of Myerson (1977) in games which have an underlying structure of communication.

The first question to ask about these solution concepts is whether they are fair. This is a topic of much debate amongst game theorists. In the narrow sense that they are the best that a player can hope for under the set of assumptions underpinning a game, they are fair. However, a Nash Equilibrium need not be fair as it is not necessarily Pareto efficient and Prisoner's Dilemma games can give rise to Nash equilibria which are manifestly not in the interests of either player. The core can be empty or very large, meaning that the game has no solution or so many that prediction is pointless, or may not be particularly robust to small changes, which might seem unfair.

The solution concept which is often used in the context of fairness is the Shapley Value. Its underlying notion that the rewards one should expect from playing a game are related to what one brings into the game are intuitively appealing as a notion of fairness. In cost allocation problems, the fairest way of apportioning costs is the Shapley Value. For example, Littlechild and Owen (1973) examine fair cost allocation mechanisms for the funding of a runway when that runway is to be used by aeroplanes needing different runway lengths. The solution they derive seems intuitively fair; all aeroplanes should share equally in the costs of building a runway which could serve those aeroplanes needing the shortest runway, all bar these short-runway planes should share equally in the marginal costs of extending the runway to accommodate the next shortest class of planes, all bar the first two classes should share in the marginal costs of the next shortest class and so on until one has a runway of sufficient length that all aeroplanes involved can use it. Upon making such calculations, Littlechild and Owen (1973) found that their cost allocation methodology corresponded exactly with the Shapley Values of the players (planes) concerned in a cost allocation game.

Young (1994) presents a survey of work in this regard in relation to the sharing of costs, but perhaps of greater interest to the Australian railway industry is the work of Fragnelli, Garcia-Jurado, Norde, Patrone & Tijs (1999) who adapt Littlechild & Owen's (1973) model to devise a fair means of charging for railway infrastructure.

It seems, then, that it is possible to find fair solutions to instances of strategic interaction modelled as a game. Since interactions in the rail industry are strategic, it

seems in principal, possible to make them fair. However, is it possible to do more? The neoclassical paradigm suggests that it is possible to ascertain efficient prices, which are then held to be fair by virtue of their being Pareto efficient. However, is the converse true? Can one find a fair solution which is also efficient? Aumann (1964) proves that one can, showing that the core of a continuous game (one with an infinite number of players, mathematically equivalent to perfect competition) coincides exactly with the equilibrium of a competitive market. Following this, a large literature has developed, extending the example to games with finite numbers of players (which find that the core contains the competitive market equilibrium and shrinks around it as the number of players becomes larger) and to games without transferable utility (see Mertens & Sorin for a survey). Aumann and Shapley (1974) show that the Shapley Value and the core coincide at the competitive market equilibrium for a continuous game, and the Shapley Value asymptotically approaches (for both transferable and non-transferable games) the competitive equilibrium as the number of players increases (Hart, 1977). Both Farrell (1970) and Shitovitz (1973) show that games where two or more players have a large weight and the remaining players have none converge to the competitive equilibrium as the number of powerless players increases and the number of powerful players stays fixed. This result, which seems to contradict the findings of neoclassical economics, obtains because both authors allow for coalitions to form amongst the powerless players which can then allow them to collectively gain advantage against the powerful players. Unions are one real-world example where this model has application.

Game theoretic techniques can provide outcomes which are fair and efficient, but are they equitable? The nucleolus is often described as an equitable solution and, since it involves a minimisation of losses to the losing coalition, from a Rawlsian perspective, it maximises social welfare. Where other solution concepts coincide with the nucleolus, these might also be considered equitable. Shields, Towinsk & Kent (1999) examine a model for resolving land use conflicts, and advocate the use of the Shapley Value, which coincides with the nucleolus in their modelling framework.

The discussion above suggests that fairness is a potential route towards broader societal goals. However, it does not suggest that simply pursuing any notion of fairness will be sufficient to do this. Rather, the lesson from the game theory literature is that careful consideration of what is meant by fairness, and careful application of the right framework is what is necessary to achieve broader results. This is somewhat more difficult than merely pursuing any route deemed fair by some decision-making body. With this in mind, it is worthwhile to consider whether there is a case for fairness, which is the topic of the following section.

Is there a Case for Fairness?

The previous section suggests it is possible to derive the same results whether one uses tools related to efficiency or to fairness. It would be desirable to use fairness tools if doing so were easier, or could be demonstrated to solve some of the known problems of using tools designed to facilitate efficiency.

Addressing the question of ease of implementation from the perspective of political and societal acceptability, an approach based in fairness seems easier. Outside the field of academic economists, almost no-one actually understands what economic efficiency is and how it operates. Most particularly, there seems to be little

understanding that economic regulation is designed to reduce deadweight efficiency losses from monopoly, not to direct resources from producers to consumers. This is fuelled by the political process of economic reform, whereby reform is sold to the public solely on the basis that it will result in reduced prices. However, fairness is a concept which is widely understood and can be easily explained to stakeholders.

From the perspective of ease of interpretation, there is an obvious first hurdle in training would-be regulators in the use of game theory, which contains mathematics more formidable even than economic theory. However, game theoreticians use complicated mathematics to prove their results. Actually implementing them often requires quite simple mathematics. For example, the Shapley Value is based on a simple formula which can be calculated easily in a spreadsheet.

Whether an approach based in fairness would be less costly than one based in efficiency is difficult to judge without knowing exactly how the approach would operate. However, the informational requirements of an approach based in fairness are less than one based in efficiency, which seems to suggest it may be less expensive to implement. This, of course, is on the proviso that the method would provide only limited scope for expensive lobbying.

Thus, there seems to be scope for hoping that an approach based in fairness might be easier to implement than one based in efficiency. It remains to examine whether it could solve some of the problems associated with the efficiency approach. There are three key problems examined below:

- Information asymmetries.
- The problem of second best.
- The issue of regulatory risk.

Informational Asymmetries

Perhaps the most pervasive issues associated with technocratic regulation is that of the information asymmetry. Put simply, it is impossible for a regulator (or indeed anyone external to the firm) to accurately observe the internal cost structure of the firm and, more particularly, its marginal costs. This means there is some uncertainty in exactly what the price should be, giving regulated firms a strong incentive to overstate their costs to the regulator. It also means that technocratic regulation inevitably incurs costs as it hires the services of experts to reduce the information asymmetry.

Approaches based on fairness allocate total costs, rather than attempting to calculate marginal costs. This is less informationally demanding and seems likely to involve fewer information asymmetries. Moreover, since the overall approach is fair, the regulated firm may have less of an incentive to hide its costs. The exact extent to which this is true, will naturally depend upon the characteristics of the institutional design. However, whichever approach is chosen, it seems unlikely that informational asymmetries would increase, compared to the current efficiency model.

The Problem of Second Best

The reason for regulation is that prices in a monopoly industry will deviate from their efficient and social-welfare maximising level, resulting in allocative inefficiency. It might be assumed (and indeed is assumed in regulatory policy, at least implicitly) that moving prices in the monopoly industry would result in an increase in welfare for the

society as a whole. Unfortunately, this is unlikely to be the case, as Lancaster and Lipsey (1956) suggest in their theory of second best, which shows that, if one has situations where prices deviate from marginal cost in numerous industries, then the situation where fewer prices are at marginal cost does not necessarily result in lower social welfare than a situation where more prices are at marginal cost.

In fact, from a social welfare perspective, if there are several industries where prices are above marginal cost and one of these has its pricing controlled by government, the optimal response is to set the price of the government controlled firm above or below its marginal cost depending upon whether it is a substitute or complement to the other goods, with the margin being dependent on the margin for the other good. The rationale for this is that, since the other goods are priced above marginal cost, resources are substituted away from them and hence one can only achieve allocative efficiency if the government controlled substitute is also priced above marginal cost or the government produced complement is priced below marginal cost, which makes the alternate good more attractive (Turvey, 1971 and Webb, 1976). Unfortunately, in a real world situation, the number and nature of complements and substitutes can be difficult to ascertain, and this may explain why regulators have ignored the theory of second best. However, the fact that solving the problem is difficult does not necessarily mean that the problem is unimportant.

A regulatory system based on fairness rather than efficiency would not solve the broader issue of allocative inefficiency in the economy. However, if all parties to a negotiation on the price of the regulated good bring the effects of the inefficiencies they experience to the negotiating table (and do so in a truthful manner), and the fair allocation mechanism is indeed Pareto efficient, then there does seem to be scope for hoping that a fair allocation mechanism might improve the social welfare and avoid Lancaster and Lipsey's (1956) problem of the second best.

Regulatory Risk

One issue widely cited in Australia concerning the efficiency approach is that of regulatory risk. Railways are reticent about making investments which are risky because of the potential that a future regulatory decision, made when the future has happened and hence the risks at the time of investment have disappeared because demand is known, might apply an efficiency benchmark which removes the upside potential of the risky decision, when this would not occur in the event of the downside risk becoming reality. Railways might seek to mitigate this by sharing the risk with their customers, but customers are unwilling to commit capital to the project for the same reason; their future rival might be able to use the infrastructure without having incurred the capital cost. The resulting catch-22 reduces investment in the industry.

An approach based on fairness would appear to alleviate this problem, because it is designed quite specifically with the apportionment of costs between all those who benefit in mind.⁹ Also, by specifying clearly what is meant by fairness, current customers are provided with a solid methodological grounding to contest as unfair the

⁹ If a future customer arrives, the reallocation of costs will leave incumbent customers with lower prices, not higher ones. A risk does exist if an incumbent leaves, however; whilst it is simple mathematically to reallocate costs fairly to reflect the new situation, it may be less possible to do so politically, as firms may resent paying more because a rival has failed due to demand being less than expected. The efficiency model, however, faces this same problem.

future decisions of a regulator, if they believe such decisions to be unfair. From this perspective, an approach based on efficiency might improve certainty in the industry.

Conclusions

This paper examines methods of determining prices when markets fail, considering three alternatives involving fairness, efficiency and equity. In so doing, it shows that the results of all three can, in principal, be achieved by an approach based on fairness, if such an approach is carefully constructed. It thus makes a qualified case that further consideration of regulatory approaches based in fairness might prove useful in the context of Australian railways, and indeed other regulated utilities.

Bibliography

- Aumann, RJ & Shapley, LS, 1974, *Values of Nonatomic Games*, Princeton: Princeton University Press.
- Aumann, RJ, 1964, "Markets With a Continuum of Traders", *Econometrica*, 32 39-50
- Baysinger B & Tollison, RD, 1980, "Evaluating the Social Cost of Monopoly and Regulation", *Atlantic Economic Journal*, 12:1 13-19
- Boyer, KD, 1977, "Minimum Rate Regulation, Modal Split Sensitivities and the Railroad Problem", *Journal of Political Economy*, 85:3 493-512
- Boyer, KD, 1987, "The Costs of Price Regulation: Lessons from Railroad Deregulation", *RAND Journal of Economics*, 18:3 408-16
- De-Juan, O & Monsalve, F, 2006, "Morally Ruled Behaviour: The neglected contribution of Scholasticism", *European Journal of the History of Economic Thought*, 13:1 99-112
- Demsetz, H, 1968, "Why Regulate Utilities?", *Journal of Law & Economics*, 11 55-66
- DeRoover, R, 1958, "The Concept of the Just Price: Theory and Economic Policy", *Journal of Economic History* 18:4 418-34
- Djankov, S, Glaeser, EL, La Porta, R Lopez-de-Silanes, F & Shleifer, A, 2003, "The New Comparative Economics" *NBER Working Paper 9608*, available from <http://www.nber.org/papers/w9608>
- Farrell, MJ, 1970, "Edgeworth Bounds for Prices", *Economica*, 37 342-61
- Finley, MI, 1970, "Aristotle and Economic Analysis", *Past and Present*, 47 23-25
- Fraginelli, V, Garcia-Jurando, I, Norde, H, Patrone, F & Tijs, S, 1999, "How to Share Railway Infrastructure Costs?" in I Garcia-Jurando, F Patrone, & S Tijs, S (eds) *Game Practice: Contributions from Applied Game Theory* Dordrecht, Kluwer
- Friedlaender, AF, 1969, *The Dilemma of Freight Transport Regulation*, Washington DC, Brookings Institute
- Harsanyi, JC, 1963, "A Simplified Bargaining Model for the n-person Cooperative Game" *International Economic Review*, 4 194-220.
- Hart, S, 1977, "Asymptotic Values of Games with a Continuum of Players", *Journal of Mathematical Economics*, 4 57-80
- Henderson, JP, 1955, "The Retarded Acceptance of Marginal Utility Theory: Comment", *Quarterly Journal of Economics*, 69:3 465-73
- Hirshleifer, J, 1982, "Evolutionary Models in Economics and Law" in P. Rubin and R. Zerbe (Eds.) *Research in Law and Economics*, Greenwich, CT: JAI Press.
- Hoogenboom, A & Hoogenboom, O, 1976, *A History of the ICC: From Panacea to Palliative*, New York, WW Norton & Co
- Lancaster, K & Lipsey, RG, 1956, "General Theory of Second Best", *Review of Economic Studies*, 24:1 11-32
- Levin, RC, 1978, "Allocation in Surface Freight Transportation: Does Rate Regulation Matter?" *Bell Journal of Economics*, 9:1 18-45
- Littlechild, SC, & Owen, G, 1973, "A Simple Expression for the Shapley Value in a Special Case", *Management Science*, 20 99-107
- Locklin, DP, 1933, "The Literature on Railway Rate Theory", *Quarterly Journal of Economics*, 47:2 167-230
- Mavor, J, 1894, "The English Railway Rate Question", *Quarterly Journal of Economics*, 8:3 280-318
- McLean, SJ, 1905, "The English Railway and Canal Commission of 1888", *Quarterly Journal of Economics*, 20:1 1-58
- McWilliams, 1923, "The Future of Railway Control", *Quarterly Journal of Economics*, 38:1 31-53
- Mertens, JF & Sorin, S, 1994, *Game Theory Methods in General Equilibrium Analysis*, Dordrecht, Kluwer
- Myerson, RB, 1977, "Graphs and Cooperation in Games", *Mathematics of Operations Research*, 2 225-74
- Myerson, RB, 1991, *Game Theory: Analysis of Conflict*, Cambridge Mass, Harvard University Press
- Peltzman, S, 1976, "Toward a More General Theory of Regulation", *Journal of Law and Economics*, 19:3 211-40.
- Pigou, AC, 1920, "The Theory of Value Before Adam Smith (book review)", *The Economic Journal*, 12:47 374-5
- Posner, R, 2003, *Economic analysis of law*, 5th edition, New York: Aspen Publishers
- Rubin, PH, 2003. "Why Was the Common Law Efficient?" *Emory School of Law, Law and Economics Research Paper Series*
- Schumpeter, JA, 1954, *History of Economic Analysis*, New York, Oxford University Press

- Shapley, LS, 1953, "A Value for n-Person Games" in H. W. Kuhn and A. W. Tucker, (eds.), *Contributions to the Theory of Games, Volume II*, Princeton: Princeton University Press
- Shapley, LS, 1969, "Utility Comparisons and the Theory of Games" *La Decision*, Ed. du CNRS, Paris, 251-263.
- Shields, DJ, Towinsk, B & Kent, BM, 1999, "Models for Conflict Resolution in Ecosystem Management", *Socio-Economic Plannign Sciences*, 33 61-84
- Shitovitz, B, 1973, "Oligopoly in a Market with a Continuum of Traders", *Econometrica*, 41 467-501
- Stevenson, G, 1987, "Rail Transport and Australian Federalism", *ANU Centre for Research on Federal Financial Relations Monograph # 44*
- Stigler, G, 1971, "The Theory of Economic Regulation", *Bell Journal of Economic and Management Science*, 2:1 3-21
- Turvey, R, 1971, *Economic Analysis and Public Enterprises*, London, Allen & Unwin
- Virtue, GO, 1909, "The Minnesota Railway Valuation", *Quarterly Journal of Economics*, 23:3 542-7
- Watson, P, 2005, *Ideas: A History of Thought and Invention, from Fire to Freud*, New York, Harper Collins
- Webb, MG, 1976, *Pricing Policies for Public Enterprises*, London, Macmillan