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Planning and Transport Research Centre

# Working Paper Series

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***September 2006***

Planning and Transport Research Centre Working Paper No 5

This paper was originally presented at the
Economics Society of Australia Conference 25th September 2006.

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# Competition in Rail: A likely proposition?

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**Abstract:** The separation of many Australian railways into their ‘above rail’ (train and terminal) and ‘below rail’ (track and signalling infrastructure) components occurred in part as a response to Australia’s National Competition Policy (NCP) of the early 1990s. The first to feel the impact of this policy was the National Rail Corporation Ltd, whose government shareholders decided in 1995 not to transfer control of infrastructure assets to this new company but rather to vest them in a separate below rail entity, the Australian Rail Track Corporation (ARTC). NSW and Victoria adopted similar policies in 1996 and Western Australia and Queensland formed separate ‘ring-fenced’ operational units for above and below rail under common ownership. The rationale for these structural changes was similar to that in the electricity and gas industries: vertical separation would expose above-rail segments to competitive entry and thus provide strong incentives for improvements in technical efficiency. However, the assumption that competition would be likely to eventuate was not tested. This paper assesses two Australian railways at the time of separation and performs such a test by examining the subadditivity of the above-rail component of these integrated entities.

## INTRODUCTION

In the early 1990s, Australia embarked on an ambitious programme of micro-economic reform, based largely on the recommendations of the *Hilmer Report* (Commonwealth of Australia, 1993). Part of this reform package was targeted at Australia’s infrastructure industries, especially electricity and gas. Although rail was not mentioned specifically by Hilmer, subsequent government policy decisions applied the same policy of vertical separation to rail that his report had recommended for electricity and gas. A rail consultants’ report (see below) reinforced the Commonwealth Government’s desire to apply vertical separation to the rail industry. Underlying this policy was the assumption was that if vertical separation were applied in rail, competition would eventuate in the above-rail sector of the industry and that this would improve efficiency. This paper, using railway data from the 25 years up to the separation decision tests the validity of this assumption via a test of the additivity of the above-rail sector. The question of whether vertical separation is a desirable policy option is a matter of ongoing research.

Section Two of this paper provides a brief overview of the history of vertical separation in Australian railways, and the report which reinforced the Commonwealth Government’s desire to adopt this policy, as well as discussing the different characteristics of railways, electricity and gas as economic entities which may suggest caution in accepting the presumption of vigorous above-rail competition, and the experience of competition in railways post-reform. Section Three describes the model of additivity to be tested. Section Four summarises the results of the modelling and Section Five provides some conclusions.

## RAILWAY SEPARATION IN AUSTRALIA

From the early 1970s until the mid-1980s Australia's railways were an industry widely believed to be in decline. The monopoly power which they had enjoyed over land transport had long ago disappeared in many vital markets with the rise of trucking from the 1920s (which became a much greater threat from the 1950s), and this had resulted in the inevitable negative financial consequences which commonly attend the loss of monopoly power. This in turn aggravated political interference in critical areas of business decision-making, including pricing. Obsolescence further threatened survival, as investment in infrastructure lagged levels required for industry sustainability, retarded by an immense burden of annual deficits, which peaked at around $3.7 billion (BTCE 1995) in 1984/85.[1] Operating deficits grew alarmingly from the 1960s, as rail rates and fares were rarely increased, in an attempt by governments to defy the high rates of inflation in the 1970s. As a consequence, output prices fell well behind rates of growth in input prices. For example, in Westrail's 1977 Annual Report, it was estimated that the government's decision to hold gazetted rates at their July 1975 level for another year, despite cost increases in the intervening two years of 30 percent, cost the railway around $11 million in lost revenues (some eight percent of gross income).

Westrail began a serious program of reform and greatly reduced its operating deficits during the 1970s. During the 1980s and early 1990s, some other railways also initiated major reforms. A reform leader was the Commonwealth-owned Australian National Railways Commission (AN), formed in 1975, which was given the freedom to price as it saw fit and from common carriage obligations. AN also accepted a mandate to pursue commercial objectives, as well as gaining greater freedom to seek labour productivity improvements and divest non-performing assets. Other railways, notably Queensland Rail (QR) and Westrail, followed suit. All railways were also exposed to more competition from road, as State-based legislation enacted in the 1930s reserving many commodities for rail was repealed and freight markets deregulated. The combined effect of these two kinds of deregulation was to drive the railways towards more cost-efficient operations, as they exited clearly unviable markets to focus on their speciality market niches, such as haulage of bulk and long-distance containerised freight, where they enjoyed cost advantages. At the advent of NCP, in the early 1990s, some Australian railways' freight operations were on the way to becoming sustainably profitable.[2] Those not benefiting from deregulation, notable New South Wales and Victoria were languishing.

The reforms carried out in the late 1980s and early 1990s were referred to by the Industry Commission (IC, 1991) as "Phase One Reforms" and they were relatively simple. To induce further efficiency into railway systems would required more significant structural reforms, including changes in ownership, and these "Phase Two Reforms" began in the early Nineties. It is through these Phase Two structural reforms that vertical separation was born.

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[1] In real 2005 dollars. The nominal figure in dollars of the day was $1.6 billion. These figures are annual deficits, not the cumulative railway debt. The BTCE defines the deficit as annual revenues minus the sum of annual operating expenses, depreciation charges, interest costs and government subsidies for non-commercial services.

[2] At least in the sense of covering their operating costs. Few railways covered their capital costs.

Prior to the 1990s, ownership of railways was vested in State governments, which controlled all interconnected rail infrastructure in their jurisdictions through one organisation in each State.[3] Although AN was Commonwealth-owned, it too was effectively imprisoned in a State-based structure inherited from the railways acquired by the Commonwealth in 1975.[4] This fragmented ownership structure – aggravated by breaks of gauge at some State borders – hindered the ability of rail to capture an adequate share of some markets, particularly inter-state freight, and prevented development of economies of scale through agglomeration of key operations across State borders. The establishment of the National Rail Corporation Ltd (NR) in 1991 by agreement between the Commonwealth and all mainland States, began the attack on these impediments to success by creating a new business spanning State borders and with the freedom to adopt commercial business practices and modernise workplace relations. In 1996 the New South Wales Government established FreightCorp with commercial and governance arrangements mimicking the private sector. Queensland Railways (QR) has also adopted a similar corporatisation model.

A major development out of this reform process was to suggest more effective ownership structures for the disparate assets of the industry. Across most of the rail freight industry, and parts of the rail passenger industry, this led directly in the late 1990s to divestment of rail assets to the private sector. As with some other publicly owned infrastructure-intensive assets in some States, it became governments' view that these assets could be operated more productively as private companies, adopting the risk profile, economies of scope, and industrial relations practices of the private sector. Pacific National (PN), which comprised the assets of both the former NR and NSW-government-owned FreightCorp, is the largest example of this. Victoria's sale and lease of rail assets to Freight Australia is another. In other cases the reform process meant arms-length ownership by government. This model was applied to the Australian Rail Track Corporation Limited (ARTC), to maintain public ownership of strategic assets and facilitate future direct investment, and to benefit from the governance disciplines of the Corporations Law.

The second important aspect of structural reform was to unpack the disparate businesses within rail entities. The railways had been large vertically integrated conglomerates often among the largest businesses in their respective States. Loss-making business segments were cross-subsidised in a manner inimical to transparency, making it difficult to identify options for efficiency improvement. This changed when governments and their railways began to unpack these businesses.

It was obvious even before this process began that the urban and non-urban passenger businesses were very different from the freight business. Apart from tourist-oriented services such as the Indian Pacific and The Ghan, it was clear that passenger railways were unlikely ever to be viable without substantial government financial support and that such support could be most effectively realised if the costs of passenger transport were made more transparent. It was apparent however, that many freight business segments – e.g. bulk minerals – were profitable, and that other freight segments – e.g.

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[3] A number of special purpose private railways, mainly in the remote Pilbara region of Western Australia, were privately owned.

[4] AN was the legacy of Prime Minister Whitlam's only partially successful bid for radical rail reform by taking all of the States' railways into Commonwealth ownership; in 1975 the seriously unviable railways of South Australia and Tasmania were combined with the CR to form AN.

intermodal freight – could also be profitable if they could be disencumbered of redundant and obsolete assets, modernise their work practices and (for cross-border 'national' services) break out of their inherited state-based structures. This led to separation of the potentially profitable business segments from the unprofitable. In most cases this occurred first on balance sheets and later through corporatisation and ultimately by sale of assets to the private sector.

AN – which reported its first profit in 1988 – became a model used by the Commonwealth Government to demonstrate what could be achieved. Beginning in 1993 AN's interstate freight business, potentially the most profitable, and that of the other State-owned railways, was transferred to newly formed National Rail Corporation Limited (NR)(Affleck, 2002). NR was mandated to eliminate the persistent deficits from these interstate rail businesses (estimated at more than $300 million per annum); the Commonwealth, NSW and Victorian Governments contributed around $400 million in equity, as well as assets, to NR to achieve that aim. Profitability was achieved just before the sale of NR (and NSW FreightCorp) to newly formed PN in 2002.

The creation of NR had created a new issue in Australian rail, as NR had to negotiate access to the track of other railways in order to carry out its business. In North America railways had negotiated 'running rights' over infrastructure owned by others for more than a century. In Australia however, no such system of mutual running rights had developed. Even the operation of trains carrying interstate freight and passengers was transferred from one state-based railway to another (locomotives, crews and train control) when they cross from one State to another; until the 1960s this practice was reinforced by breaks of gauge. Initially, cross-border operations by NR were facilitated by negotiated access; prices generally combined 'flagfall' and variable tonne-kilometre charges. In the long-term, the significance of the early NR access arrangements was that it demonstrated that access regimes could operate in Australia and that a railway could operate successfully even if its above- and below-rail components were separately managed. This became important in the light of unfolding government policy with respect to the railways in the mid-1990s.

It had been intended that NR become a vertically integrated railway, like all others then operating in Australia; to this end it was agreed that ownership or control of both above- and below-rail assets would be transferred to the new company. However, in June 1995 the Commonwealth and State Government shareholders of National Rail decided not to transfer control of infrastructure to the company, and to initiate formal separation of above- and below-rail components of the national rail business. This decision was motivated by NCP and reinforced by the example of vertical separation policies implemented in Sweden and the UK, and well-articulated by the European Union since 1991. It was further encouraged by an Australian consultant's report suggesting that vertical separation would yield tangible economic benefits in the case of National Rail (see below). Subsequently the Commonwealth and State governments formally agreed to designate a national interstate rail network at the Rail Summit and intergovernmental agreement of September 1997. The Commonwealth then established ARTC as the owner and operator of the below-rail assets formerly controlled by AN and its management control was soon after this extended to include all interstate track in Victoria soon afterwards.

In 1996 NSW and Victoria began a complex and multi-staged restructuring and vertically separation of their State-owned railways; this followed a number of years in which business segmentation had occurred in their respective accounts. In NSW, initially four new organisations were created: FreightCorp (the freight business), the State Rail Authority (the passenger business), Rail Access Corporation (the infrastructure owner and access provider) and Rail Services Australia (a maintenance provider). Separate rail safety and rail access pricing regulators were also created at this time. Victoria established V/Line Freight as a freight service provider and the Rail Track Corporation to manage the track and provide third party access. NSW subsequently reformed again, joining the RSA and RAC to form the Rail Infrastructure Corporation (RIC) in 2001 and selling FreightCorp (along with NR) to privately-owned Pacific National in 2002. In 2003, SRA became RailCorp and assumed control of the metropolitan below-rail assets of Sydney, becoming vertically integrated once again and in 2005 the non-metropolitan below-rail assets were transferred to ARTC. In Victoria, the non-metropolitan freight businesses and track were sold to Freight Australia in 1998,[5] and the metropolitan passenger businesses were franchised to National Express and Connex in 1999. Freight Australia sold its business to PN in 2004, and the metropolitan passenger services were re-franchised to Connex in 2005, after National Express handed back its franchise in 2002.

Queensland and WA did not separate their above and below-rail businesses. However, the below-rail business of Queensland Rail (QR) was ring-fenced from 1996. Queensland retained public ownership of QR, whilst WA sold its rail business to a consortium of Wesfarmers Ltd and Genesee-Wyoming Corporation in 2000, keeping the passenger business in public ownership. The below-rail assets remain in State ownership, and are leased for 60 years to Australian Railroad Group Ltd subsidiary WestNet Rail. Similar lease arrangements apply in other states except Queensland (where vertical integration remains) and South Australia (where ownership of the track formerly owned by AN was transferred to the ARTC).

A picture of the major players in Australia’s mainstream railway industry in 2006, [6] roughly a decade after the ‘Phase Two’ reforms began, is summarised in Table One. It is a complex but incomplete picture. It does not include urban passenger rail networks. In New South Wales, Queensland and Western Australia urban and non-urban passenger rail services are operated by RailCorp, QR and the Public Transport Authority respectively. All are exposed to competition by third party access, though no requests for access are known to have been made. In Adelaide urban passenger rail services are provided by TransAdelaide, and in Melbourne are franchised to Connex. Table One also does not include private mining railways in Western Australia and South Australia,[7] which have remained largely outside the reform

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[5] The track was leased, rather than being sold, but control of the track passed to Freight Australia.

[6] During 2006, the industry has consolidated further, particularly with other links in the logistics chains. At the time of writing, the final ownership of PN is not clear, following the takeover by Toll Holdings Limited of the half interest in PN formerly owned by the Patrick Corporation.

[7] In Western Australia there are major railways integrated with the mining and operations of Rio Tinto Iron Ore and BHP-Billiton. The Whyalla (South Australia) OneSteel works are integrated with iron-ore haulage rail operations contracted to ARG on track owned by OneSteel. An extensive network of vertically integrated railways is owned and operated by sugar mills in Queensland.

program of the 1990s.[8] There is also a number of smaller railway operators, discussed below under the heading of emerging competition.

**Table One: Major Entities in the Australian Railway Industry, 2006**

| **Name** | **Areas of operation** | **Above/Below rail** |
|---|---|---|
| Pacific National Pty Ltd (PN)[9] | New South Wales, Victoria, Tasmania, Queensland, Western Australia; interstate network | Vertically integrated in Victoria and Tasmania and operates above rail elsewhere |
| Australian Rail Track Corporation Ltd (ARTC) | Interstate network; NSW non-metro | Below rail |
| Australian Railroad Group Ltd[10] (ARG) | WA (ARG); South Australia (Australia Southern Railroad) | Above rail in WA; vertically integrated in SA |
| WestNet Rail Ltd | WA (owned by ARG) | Below-rail (west of Kalgoorlie, WA) |
| QR | Queensland, Victoria, NSW, Western Australia | Vertically integrated in Qld; above-rail elsewhere (where it operates as 'QR National'). |
| Asia Pacific Transport Pty Ltd Freight Link Pty Ltd | Adelaide-Darwin railway, SA, Victoria | FreightLink is the above-rail operator and APT manages the Tarcoola-Darwin track under a 50-year BOOT concession. FreightLink also operates Adelaide-Melbourne above-rail services |
| Great Southern Railway | Interstate passenger services (The Ghan, Overland and Indian Pacific) | Above rail operator. |

With the advent of vertical separation and of third party access rights has come economic regulation of the railway industry. The original intent was for all railways to be regulated, if not by the same regulator, then under a similar set of principles, as occurs in electricity and gas. As different States were reforming their industries at different speeds this was difficult. WA, NSW and Queensland put forward their proposed access arrangements in the late 1990s for the NCC to deem them 'effective'. However, that did not eventuate. Although the ACCC model was to be the standard, at the time the States put forward their proposed regimes, the ACCC model was not yet complete, and the states were not prepared to sign up to a standard which they could not yet see. Whilst the NSW regime was temporarily made 'effective' from 1999-2000, this has since lapsed and now none of the states have this status. This has meant that State-based rail access regimes have developed in all States and remain in force, despite the best efforts of both governments and industry lobby groups to achieve greater consistency. The various access regimes are shown in Table Two.[11]

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[8] In principle, private rail infrastructure is subject to Part IIIA of the Trade Practices Act 1975, which prescribes a regime of third party access, but to date this has not been made a practical reality. In May 2006, the Treasurer did not accept a recommendation by the National Competition Council (NCC) that the BHP-Billiton Mt Newman Railroad be declared open to third-party access; subsequently, the WA Government has initiated a process apparently aimed at placing the railway under a State-based regime. The Rio Tinto Iron Ore Railway has successfully argued in the Federal Court that its railway is fully integrated into its production process and therefore is precluded from the third-party access regime.

[9] Formerly 50% owned by Toll Holdings. At the time of writing, Toll was acquiring the remaining 50% from Patrick Corporation, subject to conditions by the Australian Competition and Consumer Commission.

[10] In March 2006 it was announced that ARG and WestNet Rail would be sold to QR (above-rail assets and operations) and Babcock and Brown (below-rail assets) respectively. Genesee and Wyoming Corporation (50% owner of ARG) will retain ownership of ASR.

[11] Not including the NCC.

## Table Two: Australian Rail Access Regulators

| **Regulator** | **Jurisdiction** |
|---|---|
| ACCC | National track and NSW non-urban track |
| Queensland Competition Authority | Queensland |
| WA Economic Regulation Authority | WA south west (WestNet Rail and PTA track), with possibility of regulating Pilbara railways |
| Independent Pricing and Regulatory Tribunal (IPART) | NSW (metropolitan area only) |
| Victorian Essential Services Commission | Victoria |
| South Australian Essential Services Commission | South Australian track and Tarcoola-Darwin railway |

There are differences between the regulators, but in general they operate in much the same way. Each may determine ‘floor’ and ‘ceiling’ revenue levels for the infrastructure under its jurisdiction, and these are based on a cost-based ‘building-block’ model. The exact form of this model is different in each jurisdiction, but the differences are not significant. The most important difference is the way in which asset values are calculated; all adopt the DORC methodology, except the WA ERA which uses the GRV method. All have adopted a ‘negotiate-arbitrate’ regulatory model, though each has its own process to trigger regulatory intervention, with some acting prior to an access request and setting general principles of access, and some acting ex-post, only when access negotiations have failed. Some (the ACCC and QCA) have reference tariffs to guide negotiations. The important point is not the relatively minor differences between regulators in how they undertake regulation, but that there are so many of them. This has the potential to create obstacles (especially delay) for above-rail operators seeking to operate cross-border interstate services.

## The Consultants Report

The decision by the Federal Government to formally separate control of above- and below-rail operations on the national track in 1995 was influenced by a report by Travers Morgan (1995) on the benefits of vertical separation. The report canvassed a number of structural options including a vertically integrated NR offering third party access to the track; State-based financial and track management providing access to all comers in each state; State-based financial management of the track with operational management in the hands of a single entity responsible for ‘retailing’ access services; financial and operational management by NR, WA and Queensland with access regulation by a national body, WA and Queensland; and finally, financial and operational management of the whole below rail network by one body, with access provided to all comers.

The report also examined a number of ownership options – from full public ownership through corporatisation to full private ownership – which were assessed (qualitatively) against criteria of commercial incentives, long-term decision making ability, levels of regulation required, the probability of the ownership structure generating above-rail competition, financial viability and ease of implementation. On this basis, the consultants suggested that government ownership of a corporatised entity would be most appropriate. The report also examined a number of other issues, such as corporate structure, staffing requirements and relationships with regulators.

The report evaluated the options against the goal of providing the greatest amount of competition at the lowest cost, recognising the potential losses in efficiency from separating above and below-rail operations. There was also an assessment of the probability of obtaining necessary infrastructure upgrade funds (some $700 million) under the different structures and of the complexity of each option, in particular the numbers of players involved in each. On this basis, it recommended the ‘corporatised government entity’ option. It envisaged a commercially focused “Track Australia” organisation being the national track manager from Brisbane to Perth (for mainlines and sidings, but not for terminals or other associated infrastructure), subject to only very light-handed price regulation from the ACCC.

Qualitative assessments were supported by scenario modelling. However, the modelling was fairly rudimentary and the results seem to have been driven largely by assumptions concerning the size of market share NR would have under each option, yields, changes in rail traffic,[12] productivity improvements, economies of scale and various aspects of the cost structure. These assumptions seem somewhat arbitrary and there was no sensitivity analysis of assumptions to ascertain the importance of each assumption in driving results. The benefits from reform (suggested surplus of between minus $25 million and plus $12 million to be divided between the States) also does not appear to have been subject to significant sensitivity analysis.

Whilst the qualitative assessments of options suggested in the report appear to have been thorough, the quantitative assessment of the likely effects of change were not as robust. In particular, many assumptions were made about the probability of competition emerging and about its probable effects, which were not modelled or tested in any way. This paper seeks to add to the debate by considering the empirical evidence surrounding the viability of sustainable competition in the above rail sector.

## The Differences between Railways and Electricity and Gas

Economic regulation of the railways is based on the model of electricity and gas, with a building block approach to determining prices within a negotiate-arbitrate model. Underlying this is the presumption that competition might evolve in rail in a similar manner to electricity and gas. There are, however, some conceptual reasons for questioning this implicit assumption. That is, there may be a number of characteristics of railways as economic entities which mean that models of access which provide competition in electricity and gas need not provide the same competition (or indeed, any competition at all) in railways.

Perhaps the most important difference between rail and electricity and gas is the nature of the product. Electricity and gas are homogenous services; the consumer at the end of the pipeline is largely indifferent whose gas or electricity she receives, as the gas and electricity of all producers is the same. The electricity and gas producer is indifferent as to who consumes their electricity or gas, so long as it is consumed. Railways are different because trains are not homogenous. This is because trains, or rather what they carry, are part of a logistics chain. Although consumers might have

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[12] And thus revenue. Only the final option produced an increase in revenue for the rail system as a whole under the set of assumptions made.

some flexibility in when the train carrying their goods arrives, this is limited, and they are not interested in substituting a different train for the one they ordered. Similarly, train operators care very much about to whom their trains are routed.

Related to the heterogeneity of trains compared to electricity and gas is their size. Although no gas retailer seeks access for a single molecule of gas nor an electricity retailer a single electron, the basic unit into which trade can be divided is very small. This means that a wide variety of market opportunities can potentially be serviced by a new gas or electricity retailer. In railways, the basic unit being traded is a train,[13] which is very much larger; a modern intermodal train carries some 1400 tonnes of freight. Essentially, a new operator seeking to enter the above rail industry faces the challenge of finding a market opportunity large enough to justify a single train, which could be quite a challenge. This is not a trivial hurdle for new entrants, particularly on lightly-trafficked lines terminating in small markets.

A second key difference between electricity and gas and rail is the control over the physical things which negotiate the network. Gas molecules and electrons are governed by the laws of physics and it does not matter particularly much if they bump into each other. Trains are driven by drivers, who are less predictable, and it matters a very great deal if trains bump into each other. For this reason, the controls, in terms of signalling and so on, that are required to ensure the safe operation of a railway are much more complex than those required in an electricity or gas network.

A third key difference lies in the interaction between the part of the industry seeking access and the part of the industry providing access. The interaction between the wheels of a train and the track upon which it runs lies at the core of the technically efficient operation of a railway. Vertical separation takes a series of transactions which are governed within the hierarchy of a vertically integrated firm and turns them into market transactions which must be governed by contract. Vertical separation in the electricity and gas industries does the same, but the interaction between the access seeker and the access provider is much simpler in electricity and gas.[14] Provided the gas is of the appropriate quality and pressure, and the electricity of the correct voltage (and the system is not full, which is easier to monitor than in rail, as the physical nature of the products provide instant feedback at all points along the system), there is not much that electricity or gas can do to affect the system as it passes through it. Thus, monitoring needs to be carried out only at the points of entry and exit to the system. Trains are very different. There are many ways in which a train wheel can influence a train track, at all points along the system. Thus trains must be monitored as they traverse all parts of the system, not just at the entry and exit points. Moreover, for electricity and gas, the electricity or gas entering the system is either acceptable, or it is not. Trains are more complex than this, as the effects which trains (most particularly their wheels) can have on tracks are more varied. For example, a train might be allowed to run, but at a slower speed, due to some defect. Finally, whilst

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[13] Access, as defined in the regulation of the rail industry, is defined at the level of a single train. However, freight forwarders may take a risk and purchase access for a single train and then on-sell it in smaller bundles to other market entrants, by charging them for access to their trains. Incumbent operators may well do the same; running larger trains than current demand in a bid to sell portions of them to new entrants. The access regime proposed by BHP in the Pilbara was akin to this; it offered to haul the wagons of Fortescue Mining, rather than provide access at the level of a single train.

[14] Even so, the technical standards governing access to the NEM took many years to perfect.

electricity and gas of the wrong specification might affect the system, the system is less likely to affect the electricity and gas travelling through it. If it does (say a gas pipeline is overloaded and the gas of a third party must be vented in order to maintain system integrity) then compensation is relatively easy. In railways, just as the wheels affect the rail, the rail affects the wheel and it can sometimes be very difficult to apportion liability, particularly in cases where the interaction of a faulty wheel and a faulty track cause both to fail. Moreover, unlike gas and electricity, where only variable costs need to be compensated, if a train is adversely affected by the track over which it operates, then the track owner must compensate the train owner for some portion of his fixed costs (the train) and this portion must be established in the contract prior to access being granted.

None of the above points would necessarily preclude an access regime in rail from succeeding, but they do make the task of access more complex, and suggest, perhaps, that new entry might be muted compared to industries such as electricity and gas and, moreover, that such entry might be of a simpler nature, without, for example, complex auctions of access products. It seems unlikely, for example, that a market analogous to the National Electricity Market could develop for auctioning spare capacity slots on railways. The aim of the empirical assessment of this paper is not to assess how much competition might eventuate, but rather a cruder analysis to ascertain whether any competition might eventuate at all. The question of how much competition might eventuate is difficult to answer as it depends not only on the cost functions of the industry, but also on how both the incumbent and any new entrants might react to each other. This is very difficult to predict empirically. It is possible, however, to examine the competition which has emerged in the above-rail sector post reform.

## Emergence of Competition in Above Rail in Australia

A crucial aspect of structural reform was to create competition in the potentially contestable above-rail sector of the industry in order to realise more efficiencies in the rail industry as a whole. It is thus appropriate to examine the record of the emergence of competition. The historical record is still relatively short, but is thus far not particularly bright. In Australia, immediately following the introduction of open access in the mid Nineties, SCT, Toll and Patrick Rail entered the above rail industry, with Toll and SCT taking up to a quarter of the market on the East West freight rail link. Toll and Patrick Rail subsequently formed Pacific National, and SCT now has a market share on the East West link of less than five percent. Other new entrants include:

- South Spur Rail, in WA, which has a small fleet of locomotives and undertakes hook and pull services for other rail companies.
- CRT, in Victoria and NSW which owns wagons, some terminals and has brought Sprinter trains into Australia. CRT has subsequently been taken over by QR
- Lachlan Valley, which owns wagons and moves container freight in NSW.
- Chicago Freight Car Leasing, which leases wagons and locomotives in Australia, filling a key role for new market entrants.

The market share of these new entrants is negligible. Most of the competition in Australia comes from four of the rail companies formed during the reform process or given concessions as part of it (ARTC, PN, ARG, and QR), as well as the two companies formed with the completion of the Tarcoola-Darwin railway (Asia-Pacific

Transport and Freightlink). These companies are beginning to compete in each other's markets. For example:

- PN has secured freight haulage contracts in north Queensland.
- QR has secured coal haulage contracts in NSW and has recently purchased CRT in Victoria (with its associated terminal) and the above-rail interests of ARG in WA. It also plans to turn its Acacia Ridge terminal into an open access terminal.
- Freightlink has begun offering services between Adelaide and Melbourne.

There is also evidence of industry consolidation, such as the QR takeover of CRT and part of ARG, the PN takeover of Freight Australia in Victoria and ATN in Tasmania and the wider takeover of Patrick by its PN partner Toll, which will have major ramifications for the industry. Finally, major freight customers, particularly mineral freight customers, place their haulage contracts out to open tender and, even when incumbents win, the pressure of competitive bidding can force down prices.

From a legislative perspective, the EU moved earlier than Australia in vertical separation, establishing a framework which both mandates separation of above and below rail and provides openings for competitors to establish themselves in each market under the aegis of EC Directives 91 and 92. Moreover, Europe has much larger freight markets than Australia. Here too, however, progress has been limited, apart from incumbents in each country obtaining access to neighbouring markets on a reciprocal basis. The best results have been in the UK, where British Rail was completely dissolved and thus all of the current market players are new entrants, Sweden, where half the freight market and a third of the passenger market has been taken by new entrants and Germany, where more than a hundred new rail firms have been created, albeit taking only ten percent of the market (IBM, 2004). In the other EU countries, new entrants have captured less than five percent of the market, and in many cases, none at all (ibid).

## The Economics of Subadditivity and the Railway Model

The major empirical aim of this paper is not to attempt to predict how much competition might have been expected to eventuate in Australian railways following vertical separation, but whether sustainable competition might have been a reasonable expectation at all. The basic economic concept is that of subadditivity; whether the relevant above-rail services can be provided at lower cost by one firm than by two or more firms. There has been a developing literature in the US, examining subadditivity within the context of railway networks. Bitzan (2000) examines three different types of subadditivity, focussing on the desirability of parallel railway mergers, end-to-end railway mergers and third party access to railway networks. Bitzan (2003) focuses just on the latter case. Ivaldi & McCullough (2001) perform a very similar analysis, focussing especially on the separability of above and below rail tasks. Whilst the literature on subadditivity and cost separability in railways is relatively new, there is a growing body of literature from other industries. Telecommunications and the AT&T break-up in the US has been perhaps the most intensively examined industry, with work by Evans & Heckman (1984), Shin & Ying (1992), Wilson & Zhou (2001), Gasmei, Laffont & Sharkey (1997), McKenzie & Small (1997) and Maher (1999) amongst many others. Serafice (1998) and Bloch, Cobel-Neal, Madden & Savage (2001) have examined the Philippine and Australian telecommunications markets respectively. Tsirchart (1995) has examined natural monopoly issues in US energy markets, and Gordon, Ginsch & Pauluk (2003) has examined Similar markets in Canada.

The econometric models of each author exhibit some subtle differences in structure. Indeed, econometric difficulties in the estimation of translog cost functions to test subadditivity play a large role in the literature. Despite these differences, the broad approach is the same; the authors estimate the cost function of the relevant industry using the translog functional form of Christensen, Jorgenson & Lau (1973) and then apply a test for subadditivity to the resultant model. In the case of a firm with a single output, cost subadditivity occurs when average costs are falling,[15] and it is a relatively simple matter to test for the technical condition of natural monopoly by examining average costs. In a multi-product setting, the lack of a suitable denominator complicates matters, requiring the use of ray average costs and some composite good (Baumol, Panzar & Willig, 1988). Even here, economies of scale do not imply cost subadditivity and hence natural monopoly (Sharkey, 1982). Nor do economies of scope (ibid). Only strong cost complementarities imply cost subadditivity, and very few empirical examples of strong cost complementarities exist (Bitzan, 2000). Gordon et al (2003) examine one such empirical example in Canadian gas pipelines, examining the pairwise transray convexity of the cost function. They also perform a direct subadditivity test and compare the results.

A preferred approach in the literature is to test directly whether two firms can produce the output of a single firm at a lower price. The specification of the translog cost function in terms of prices for inputs greatly assists this endeavour. However, the approach does have the shortcoming of an implicit assumption that the cost structure of the hypothetical two firms would be essentially the same as the monopolist, except that they would be smaller. The direct subadditivity approach might best be summarised as it is in Shin & Ying (1992) for a three-output firm as follows:

$$C(q^M) < C(q^A) + C(q^B)$$

Where $$\begin{aligned} q^A &= (\kappa q_1^M, \lambda q_2^M, \gamma q_3^M) \\ q^B &= ((1-\kappa)q_1^M, (1-\lambda)q_2^M, (1-\gamma)q_3^M) \end{aligned}$$

and $\kappa, \lambda, \gamma =$ (0.1, 0.2, … , 0.8, 0.9)

Evans & Heckman (1984) introduced an earlier version of the test which is similar but, as it was performed on only one firm (compared with 58 firms by Shin & Ying), the authors imposed some restrictions on the feasible outputs of the hypothetical two-firm industry such that these outputs were not too far removed from the actual outputs achieved by the monopoly. This localised test of subadditivity was used due to the relatively small amount of data used. Shin and Ying (1992), with a much larger dataset, impose no such restrictions, nor do Bitzan (2000, 2003) or Ivaldi & McCullough (2001). The subadditivity test involves examining every combination possible in the set $\kappa, \lambda, \gamma =$ (0.1, 0.2, … , 0.8, 0.9),[16] applying the cost function with

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[15] As Bitzan (2000) points out, falling average costs are a sufficient but not necessary condition for subadditivity; it is possible for there to be subadditivity and rising average costs.

[16] Bitzan (2000,2003) includes shares of zero and one, giving 365 combinations. He applies these 365 combinations to all 215 observations of output (all US Class One railroads over a 20 year period) to give 78,475 possible cases for each year. In effect, he examines the case if any US railroad, using the cost structure of any given year, were producing the output in a particular year.

most components held constant and only the outputs and relevant technical variables altered,[17] and comparing the sum of the two-firm costs with the actual costs of the monopolist. Evans & Heckman (1984) devise an index of subadditivity degree and test its statistically significant difference from zero in each year, whilst others (including Bitzan) merely examine the proportion of cases where subadditivity holds.

## MODELLING FRAMEWORK AND RESULTS

The model here is based on that of Bitzan (2000, 2003) and Ivaldi & McCullough (2001) and is a simplified version of their models, due to limitations in the data available here. A long run total cost function, which includes below-rail costs, and an above rail short-run quasi-cost function are estimated.

The long run total cost function, which is designed to test the separability of the below rail from the above rail components of the railway, is specified as follows:

$TC=TC(w_{l,}, w_o, w_{br}, NTK, TECHTC, T)$

Where:
$W_{l,}$ = an Laspeyres index of labour costs (above-rail salaries and wages divided by above-rail staff numbers)
$w_o$ = a Laspeyres index of all other above-rail costs including fuel (other above rail operational expenditure, plus a return on and return of above rail capital assets)
$W_{br}$ = a price per GTK for access to the below rail network (total below rail costs divided by GTK of track services provided, based on the same ‘building block’ methodology used by the ACCC.
*NTK* = net tonne kilometres of freight.
*TECHTC* = A Combination index variable incorporating indices for the proportion of passenger in total train kilometres, the length of track operated and the average length of freight haulage .
*T* = a time variable

Ivaldi & McCullough (2001) use indices for input prices, whilst Bitzan (2000, 2003) uses input prices directly. Both specifications were examined in this paper, and the results were broadly similar, in that there were no great differences in the econometric superiority of one approach over another. The most important simplifications here compared with earlier papers are the amalgamation of all outputs into a single output, and of all technical variables into one index. Neither is ideal from the perspective of developing a detailed understanding of the industry and both are done to ensure the model meets the limitations of the dataset. Earlier, more complete model specifications were tested, and were found to be under-specified. This paper is part of a larger project, involving the collection of data from all Australian railways, and it is intended to test a more fully-specified model on this larger panel dataset when it is constructed (see appendices). For this reason, the results summarised in this paper should be taken as being somewhat tentative.

The short run, or quasi-cost above rail function is used to test subadditivity in the above rail sector of the market. It is specified as follows:

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[17] For example, in a railway, if track kilometres are used as a technical variable, these would have to be split between the two hypothetical firms.

$VC=VC(w_L,\ w_o\ NTK,\ TECHVC,\ T)$

The major difference between the *TC* and *VC* models is that the only the above-rail costs are considered as inputs in the *VC* model, which is analogous to treating the below-rail costs as sunk and thus not influencing the behaviour of above rail firms at the margin. The *TECHVC* index of technology variables is the same as the *TECHTC* variable, with the addition of a variable indexing the investment per kilometre of track in below-rail, intended to provide a measure of track quality. Ivaldi and McCullough (2001) use the replacement of sleepers as a measure of track quality, whilst Bitzan (2000, 2003) uses net investment in way and structures per mile of track.

The equations are estimated via the transcendental or translog method of Christensen, Jorgenson & Lau (1973), which gives the following cost functions:

$$\ln TC(y,w,t) = \alpha_0 + \sum_{i=1}^{3}\alpha_i \ln w_i + \beta y + \sum_{j=1}^{2}\varphi_j \ln t_j + \frac{1}{2}\sum_{i=1}^{3}\sum_{l=1}^{3}\gamma_{il}\ln w_i \ln w_l +$$
$$\sum_{i=1}^{3}\alpha_i \ln w_i \ln y + \sum_{i=1}^{3}\sum_{k=1}^{2}\sigma_{ik}\ln w_i \ln t_k + \frac{1}{2}\beta_{yy}(\ln y)^2 + \sum_{j=1}^{2}\ln y \ln t_j + \frac{1}{2}\sum_{j=1}^{2}\sum_{k=1}^{2}\psi_{jk}\ln t_j \ln t_k$$

$$\ln VC(y,w,t) = \alpha_0 + \sum_{i=1}^{2}\alpha_i \ln w_i + \beta y + \sum_{j=1}^{2}\varphi_j \ln t_j + \frac{1}{2}\sum_{i=1}^{2}\sum_{l=1}^{2}\gamma_{il}\ln w_i \ln w_l +$$
$$\sum_{i=1}^{2}\alpha_i \ln w_i \ln y + \sum_{i=1}^{2}\sum_{k=1}^{2}\sigma_{ik}\ln w_i \ln t_k + \frac{1}{2}\beta_{yy}(\ln y)^2 + \sum_{j=1}^{2}\ln y \ln t_j + \frac{1}{2}\sum_{j=1}^{2}\sum_{k=1}^{2}\psi_{jk}\ln t_j \ln t_k$$

The application of Shephard's Lemma to the *TC* equation gives three factor share equations of the form:

$$S_i = \alpha_i + \sum_{l=1}^{3}\gamma_{il}\ln w_l + \delta_i \ln y + \sum_{k=1}^{2}\sigma_{ik}\ln t_k$$

Where $S_i$ refers to the factor shares of the three inputs. The *VC* equation provides very similar results, except that the first summation is from $l=1$ to $l=2$, reflecting the one fewer factor inputs in the *VC* equation.

The system of the translog cost function and two of the three factor share equations is solved using Zellner's (1962) Seemingly Unrelated Regression approach. In so doing, the omission of one share equation resolves the issue of singularity in the error matrix but it means that results are sensitive to which share equation is removed. Testing models with different share equations removed showed that there were not large differences in the resulting coefficients. Homogeneity of degree one between factor prices was imposed and the equations simplified prior to the estimation of the *TC* case. Again, testing for simplification whereby different input prices were removed under the imposition of homogeneity of degree one between factor prices produced similar coefficients in the parameters of interest. In the *VC* case, the smaller model meant that restrictions could be imposed directly in the model, obviating the need to later extract some coefficients and their *t*-scores. The use of this model on two relatively small time-series datasets is not without problems. The estimates are not maximum likelihood estimators. Moreover, there appear to be some issues with heteroscedasticity and autocorrelation in the system and not all of the coefficients had signs the same as those expected by theory.[18] Despite these issues, experimentation with different model specifications produced roughly similar results in the variables of interest in the two railways examined and also in accord with general theory and the results of similar papers in the literature. Thus, whilst the results are tentative, and issued with a number of caveats attached to the econometrics, they do suggest a useful avenue of research, which might improve upon the current situation, where nothing is known, empirically, about these issues in Australian railways.

In estimating the total cost function, the variables of interest for the purposes of this paper are the coefficients of the variables measuring the interaction between the input factors (the $\gamma_{ij}$ terms in the *TC* equation above, where $i \neq j$), as these are the variables which provide an indication of the separability of the above from the below-rail freight task. Table Three summarises these results for Australian National and Westrail. The *t*-ratios are in parentheses.

**Table Three: Total Cost Function, Selected Results**

| **Westrail** | | **Australian National** | |
|---|---|---|---|
| $\gamma_{wowo}$ | 0.138258 (22.873) | $\gamma_{wowo}$ | 0.140478 (20.370) |
| $\gamma_{wowl}$ | -0.063218 (-6.86925) | $\gamma_{wowl}$ | 0.028722 (2.26766) |
| $\gamma_{wowbr}$ | -0.075040 (-9.9698) | $\gamma_{wowbr}$ | -0.16920 (-16.289) |
| $\gamma_{wlwl}$ | 0.191818 (10.19758) | $\gamma_{wlwl}$ | -0.06657 (-1.05448 ) |
| $\gamma_{wlwbr}$ | -0.1286 (-12.14853) | $\gamma_{wlwbr}$ | 0.037848 (1.94882) |
| $\gamma_{wbrwbr}$ | 0.20364 (13.655) | $\gamma_{wbrwbr}$ | 0.131352 (6.5979) |

| *Summary statistics* | | | | *Summary statistics* | | | |
|---|---|---|---|---|---|---|---|
| | SSE | Durbin-Watson | $R^2$ between obs & predict | | SSE | Durbin-Watson | $R^2$ between obs & predict |
| *ln(TC)* | 0.05804 | 0.5648 | 0.9700 | *ln(TC)* | 0.03659 | 2.1474 | 0.9747 |
| $S_o$ | 0.00892 | 0.4918 | 0.9023 | $S_o$ | 0.00161 | 2.2887 | 0.9737 |
| $S_{br}$ | 0.01398 | 0.4405 | 0.0062 | $S_{br}$ | 0.00627 | 2.0347 | 0.8469 |
| *Note – 26 observations* | | | | *Note – 23 observations* | | | |

The magnitudes of the coefficients in Table Three are similar to those found in Bitzan (2000, 2003), although they are smaller than some of those in Ivaldi & McCullough (2001). For Westrail, the own price interaction terms are all positive and the cross-price interaction terms are all negative, which is what economic theory suggests should be the case. AN does not perform quite as well, but in half of the cases, the results accord with theory. Moreover, all of the Westrail results are statistically significant, and of those with the appropriate sign for AN, all are significant. This suggests that splitting a railway into above and below-rail components, at least according to Westrail and AN data would result in inefficiencies.

The key question is how much inefficiency? This was tested by comparing estimations of total cost using the unrestricted cost function with estimations using a total cost function where the coefficients $\gamma_{wowbr}$ and $\gamma_{wlwbr}$ were set to zero (which implies no interaction between the above and below rail components). The AN and Westrail datasets individually, whilst they provided sensible results in regards to the

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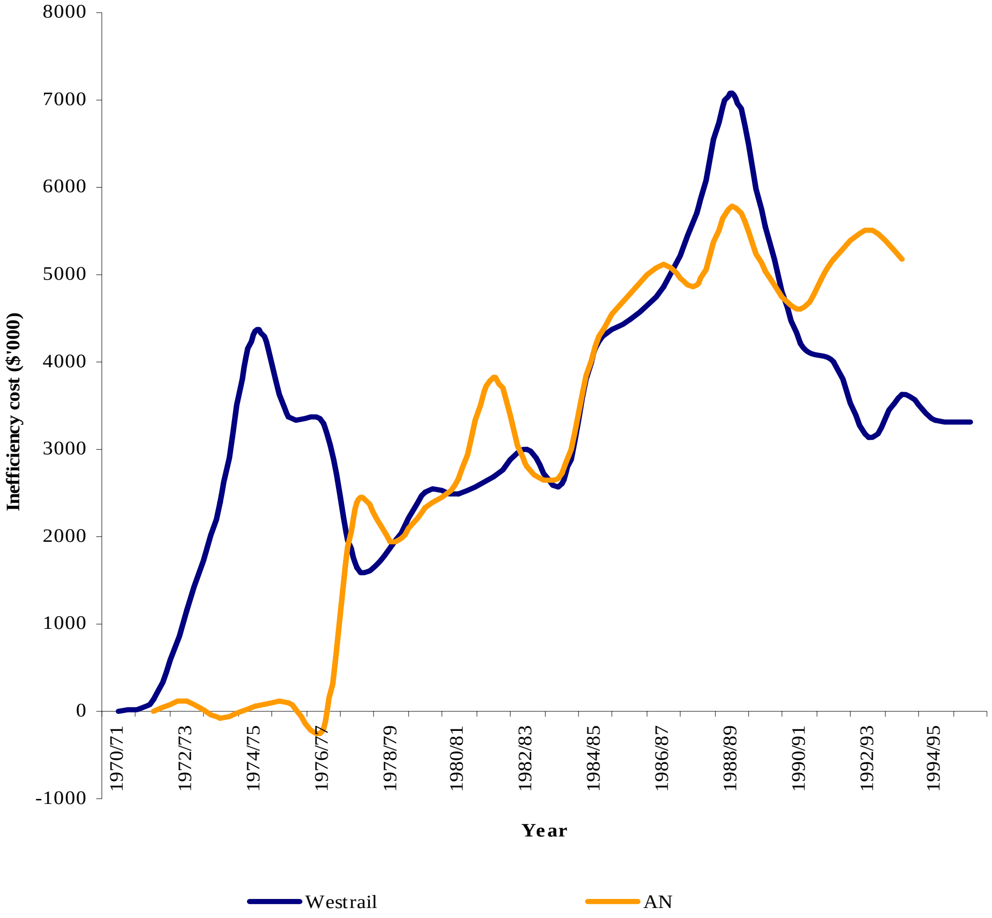
[18] For AN, the Breusch-Pagan test statistic is 21.08, and for Westrail, it is 11.5. Both of these figures suggest heteroscedasticity. The Durbin Watson statistics for AN suggest autocorrelation. Treatment of both of these issues via the methodology of Parks (1967) is a piece of ongoing research.

$\gamma_{ij}$ terms in Table Three, did not provide coefficients for all of the input price and output first order terms that accorded with economic theory. Thus, the data for AN and Westrail were pooled to estimate a new cost function, which did provide more sensible first order coefficients and which gave broadly similar results in respect of the $\gamma_{ij}$ terms. Applying this cost function to the AN and Westrail data, and comparing the restricted with the unrestricted case gave the results summarised in Figure One.

**Figure One: Comparing Vertical Integration and Separation Costs**



The formation of the pooled data cost function was somewhat ad-hoc, and the data underpinning it are not without problems (discussed previously). However, the $\gamma_{ij}$ coefficients used are similar to those of Bitzan (2000, 2003) and seem likely to be at least in the correct orders of magnitude of effect. Ongoing research will repeat the analysis for a wider selection of Australian railways. These tentative results suggest that separating above from below-rail, at least in the case of AN and Westrail could result in efficiency losses in the order of $5 to $8 million per annum. By comparison, the operating expenses of each of the railways towards the end of the period of analysis were around $250 million, so the efficiency losses do not seem substantial.

The major purpose of this paper is to examine the issue of subadditivity; whether the above-rail sector in Australia can support more than one operator in a sustainable fashion. Again, due to the nature of the data, the results are highly tentative. In particular, estimating the short-run variable cost function for each railway separately gave very poor results; the signs on some coefficients were opposite to that predicted by theory and few of the results were statistically significant. Thus, estimates were obtained for the two railways together, and these proved a little more robust. The results are summarised in Table Four.

**Table Four: Above-Rail Variable Cost Regression, Joint Results**

| **Variable** | **Coefficient** | **t-ratio** |
|---|---|---|
| *intercept* | -45.999 | -2.9690 |
| $lnw_L$ | 0.66105 | 1.2911 |
| $lnw_o$ | 0.33895 | 0.66197 |
| *lnNTK,* | 13.412 | 3.3697 |
| *lnTECHVC,* | 3.7691 | 0.73704 |
| *lnT* | 0.60825 | 0.43992 |
| *lnNTK*lnNTK* | -0.75565 | -2.9483 |
| *lnTECHVC*lnTECHVC* | 1.8434 | 2.0148 |
| *LnT*LnT* | -0.016243 | -0.51236 |
| *lnNTK*lnTECHVC* | -0.66674 | -0.97599 |
| *lnNTK*lnT* | -0.093016 | -0.52367 |
| *lnTECHVC*lnT* | 0.26620 | 0.71705 |
| $lnw_L * lnw_L$ | 0.053468 | 3.7718 |
| $lnw_L * lnw_o$ | -0.10694 | -3.7718 |
| $lnw_o * lnw_o$ | 0.053468 | 3.7718 |
| $lnNTK* lnw_L$ | 0.011153 | 0.17064 |
| $lnNTK* lnw_o$ | 0.10723 | -0.17064 |
| $lnTECHVC* lnw_L$ | -0.011153 | -0.96372 |
| $lnTECHVC* lnw_o$ | -0.14396 | 0.96372 |
| $lnT* lnw_L$ | 0.14396 | -1.3739 |
| $lnT* lnw_o$ | -0.039986 | 1.3739 |

| | *SSE* | *Durbin-Watson* | *$R^2$ between obs & predict* |
|---|---|---|---|
| *ln(TC)* | 1.3391 | 0.4032 | 0.6171 |
| $S_o$ | 0.52669 | 0.3106 | 0.3759 |

*Note – 49 observations*

In this instance, the restrictions of homogeneity of degree one were imposed within the model, rather than being used before-hand to remove variables. The estimated parameters are not maximum likelihood estimators and are sensitive to which share equation is omitted in their estimation, though the differences in the coefficients estimated when each of the two share equations was removed was not substantial.

To estimate subadditivity, the actual output of *NTK* in each year was split between two hypothetical firms in ten percent incremental share increases, giving five unique splits each year.[19] All variables except *NTK* were held at the mean for that year between AN and Westrail, and the actual *NTK* for each firm was split between the two hypothetical firms and put into the cost function.[20] The sum of the costs for the two hypothetical firms was then compared with the cost predicted by the model for producing the monopoly output for that year. In no cases were the costs of joint production smaller than the cost of single production of above-rail outputs. In fact, in most cases, the costs of joint production was substantially higher. As there were no cases where the two-firm case produced a lower cost, the restrictions of Evans & Heckman (1984) were not imposed.

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[19] That is (0.1:0.9, 0.2:0.8, 0.3:0.7, 0.4:0.6, 0.5:0.5)

[20] The same test was performed on the AN data and the Westrail data individually, rather than their average, and the same subadditivity results were found.

This result seems to strongly indicate subadditivity in the above-rail sector in Australian railways and that sustainable competition is unlikely to develop in this natural monopoly. These findings accord with those of Bitzan (2000, 2003) and Ivaldi & McCullough (2001). They are, however, highly tentative in nature. Due to data limitations, the cost functions used were very simplistic, and a more complex cost function (more outputs and a split in the technical variables), may alter results. However, at this stage, it seems unlikely that there is a strong case to be made for the support of sustainable competition in the above-rail sector of Westrail and AN.

The question must be asked about the competition which has emerged over the past decade, particularly on the rail link from Melbourne and Sydney to Perth (which was operated by AN). The market shares are not great, but they have been sustained. The most likely reason for this is the implicit assumption underpinning the direct subadditivity model above; that the two hypothetical firms will have the same cost structure as the incumbent. It may be possible, and it seems to have been the case in Australia, that it is possible for smaller firms with different cost structures to the incumbent, to gain a market share. The rise of short-line railroads in the US following the *Staggers Act* reforms of the early 1980s suggests similar conclusions.

## CONCLUSIONS

The modelling results, although highly tentative, point towards two findings:

- Above and below-rail are not separable.
- The above rail part of Westrail and AN is subadditive.

The first result suggests that inefficiencies will arise if the above and below rail components of the two railways are separated. However, further work undertaken to quantify these inefficiencies suggests that they are not substantial; in the order of a few percent of operating costs for each of the railways.

The second results suggest only weak potential for sustainable competition in the above rail sector, particularly amongst firms similar to the incumbent.[21] However, even a small amount of competition can be beneficial. In the US, when the Staggers Act of 1980 reformed the rail industry, it allowed the emergence of numerous short-line railways; small operators (often with only one locomotive) hauling freight along a track to an adjacent main line. Such business was often unprofitable for the larger, Class One railroads and hence adversely affected their efficiency. Without access regimes of some kind, short-line railroads cannot exist, as they are unable to gain access to the mainlines which they need. Moreover, without short-line railroads, larger railroads might otherwise be forced to operate unprofitable services or, as seems more likely, to close them down. The existence of short-line railroads acts as a kind of safety valve for the industry.

It may be that contestability is more important for efficiency than actual competition. If the incumbent could lose a large portion of its market share through large customers re-tendering their haulage contracts to a new entrant, this may be sufficient to drive efficiency improvements in the industry. Contestability seems most useful in cases

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[21] QR, which is far more like PN than SCT is, is poised to enter the East-West freight market. The analysis of this paper suggests, perhaps, that there will not be room for both on the East-West rail link.

where there are a small number of large customers. For example, in Western Australia, NSW and Queensland, the large minerals haulage contracts are put to tender every few years and, due to the presence of an access regime, railways from around Australia can bid for these contracts and indeed, some NSW contracts have changed hands. The incumbent has an advantage, as is always the case, but it is not an absolute advantage, as was the case formerly when no access regime existed.

For these reasons, judging the amount of competition which emerges solely on the number of competitors or their market share is erroneous. It is still useful, however to examine in a systematic manner the likelihood of competition emerging and its sustainability over the longer term, which is the object of this paper.

## Bibliography

Affleck, F, 2002, *National Rail, 1991-2002: Investing In Policy Reform*, 25th Australasian Transport Research Forum, Canberra 2002

Australasian Railway Association (ARA), 2003, *Australian Rail Industry Report*, available from www.ara.net.au

Baumol, WJ, Panzar, JC & Willig, RD, 1998, *Contestable Markets and the Theory of Industry Structure*, San Diego: Harcourt Brace Jovanovich

Bitzan, JD, 2000, *Railroad Cost Conditions: Implications for Policy*, Paper prepared for the Federal Railroad Administration, US Dept of Transportation, mimeo

Bitzan, JD, 2003, "Railroad Costs and Competition: The Implications of Introducing Competition to Railroad Networks", *Journal of Transport Economics and Policy*, vol 37 no 2 pp 201-25

Bitzhan, J (2000) *Railroad Cost Conditions: Implications for policy* Paper prepared for the Federal Railroad Administration, US Dept of Transportation May 2000.

Bloch, H, Cobel-Neal, G, Madden, G & Savage, S, 2001, "The Cost Structure of Australian Telecommunications", *Economic Record*, vol77 no 239 pp338-50

Bureau of Transport and Communication Economics (BTCE), 1995, *Analysis of the Rail Deficit*, BTCE Information Paper 40, AGPS, Canberra

Christensen, LR, Jorgenson, DW & Lau, LJ, 1973, "Transcendental Logarithmic Production Functions", *The Review of Economics and Statistics*, vol 55 no 1 pp28-45

Commonwealth of Australia, 1993, *National Competition Policy*, Report by the Independent Committee of Inquiry (Hilmer Report), AGPS, Canberra

Evans, DS & Heckman, JJ, 1984, "A Test for Subadditivity with an Application to the Bell System", *American Economic Review*, vol74 no 4 pp615-23

Gasmei, F, Laffont, JJ & Sharkey, WW, 1997, "Incentive Regulation and the Cost Structure of the Local Telephone Exchange Network", *Journal of Regulatory Economics*, vol 12 pp5-25

Gordon, DV, Gunsch, k & Pawluk, CV, 2003, "A Natural Monopoly in Natural Gas Transmission" *Energy Economics* vol25 pp 473-85

Hensher, DA, Daniels R and DeMellow, I, 1992, *A comparative Assessment of the Productivity of Australia's Rail Systems 1971/72-1990/91,* ITS Working Paper 92-7, U of Sydney

Hensher, DA, Daniels R and DeMellow, I, 1994, *Revision and Update: Productivity of Australian Railways 1971/72 to 1991/92,* Institute of Transport Studies Working Paper 94-14, U of Sydney

IBM Consulting Services (2004) *Rail Liberalisation Index 2004: Comparison of the market opening in the rail markets of the Member States of the European Union, Switzerland and Norway* Available from www.bahn.de/presse

Industry Commission (IC), 1991, *Rail Transport*, Industry Commission Report no 13, AGPS, Canberra

Ivaldi, M &McCullough, CJ, 2001, "Density and Integration Effects on Class 1 US Freight Railroads", *Journal of Regulatory Economics*, vol 19 no 2 pp 161-82

Maher, ME, 1999, "Access Costs and Entry in the Local Telecommunications Network: A case for de-averaged rates", *International Journal of Industrial Organization*, vol 17 pp593-609

McKenzie, DJ & Small, JP, 1997, "Econometric Cost Structure Estimates for Cellular Telephony in the United States", *Journal of Regulatory Economics,* vol12 pp147-57

Parks, R, 1967, "Efficient Estimation of a System of Regression Equations When Disturbances Are Both Serially and Contemporaneously Correlated", *Journal of the American Statistical Association*, vol 62 pp500-09

Serafice, R, 1998, "Was PLDT a Natural Monopoly?", *Telecommunications Policy*, vol 22 no4/5 pp 359-70

Sharkey, WW, 1982, *The Theory of Natural Monopoly,* Cambridge: Cambridge University Press

Shin, RT & Ying, JS, 1992, "Unnatural Monopolies in Local Telephone", *RAND Journal of Economics*, vol 23 no 2 pp 171-83

SWATS (Southern Western Australia Transport Study), 1978, *Main Report of the Study Team*, mimeo

Travers Morgan, 1995, *Consultants Report to the Federal Department of Transport on the Reform of the National Rail Network,* mimeo

Tsichart, J, 1995, "Monopsony Power and the Existence of Natural Monopoly in Energy Utilities", *Resource and Energy Economics*, vol 17 pp327-40

Wilson, W & Zhou, Z, 2001, "Telecommunication Deregulation and Subadditive Cost" Are local telephone monopolies unnatural?" *International Journal of Industrial Organization*, vol 19 pp909-30

Zellner, A, 1962, "An Efficient Method of Estimating Seemingly Unrelated Regressions and Tests of Aggregation Bias", *Journal of the American Statistical Association*, vol 57 pp500-09

## APPENDICES

### Description of the Datasets

Perhaps the greatest difficulty associated with analysing the Australian railway industry, particularly compared to its North American counterparts, is inadequate data. Access to corporate data is very limited in Australia's rail industry due to loss of 'corporate memory' (and corporate records) following the numerous restructures and asset sales, and to the trend to reveal less information in annual reports.

The ABS collected consistent data on the railways from the late Sixties until the mid Eighties. This dataset covers most of the data necessary for constructing economic models of the industry, except for data on capital expenditure in the industry, but it does not contain any recent data. Daniels, DeMellow & Hensher (1992, 1994) have constructed a consistent dataset for all Australian railways from 1971 to 1991 which includes capital expenditure. However, this dataset does not distinguish between above and below rail expenditure and also ceases at 1991. The only other source of the relevant data are the annual reports of the various rail companies. As noted by Daniels et al (ibid), extracting data from the annual reports of the railway companies can be a very difficult process. The definitions of variables change through time, often without a clear indication of how, variables reported in one year may or may not be there the next, accounting standards change and numbers are sometimes revised from year to year as estimates change. Moreover, one of the consequences of the movement in the industry towards a more commercial focus is that less and less information useful for economic analysis is included, due in no small part to the fact that the railways now face the same pressure as every commercial business; that their competitive advantages might be understood and emulated by rivals.

Inconsistencies between railways in how variables are defined and what is reported mean that it is not possible to collect exactly the same data from every railway. However, the general forms of the data are the same in each case, and are as follows:

- Capital expenditure, divided into an above and below rail component.
- Operational expenditure, divided into an above and below rail component and also into a component representing the operation of services, the maintenance of services and administration.
- Depreciation, divided into above and below rail components.
- The cost of capital, labour (plus labour on-costs), fuel and equipment.
- Total route km and train km.
- Passenger journeys – urban and non-urban.
- Freight tonnages hauled, divided into grain, minerals and general freight.[22]
- Net tonne kilometres of freight divided into grain, minerals and general freight.
- Gross tonne kilometres of track.
- Freight revenue.
- Staff numbers.

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[22] Grain is rather loosely defined to cover those freight tasks which have a single source and multiple destinations (like fertiliser) and which have multiple sources and a single destination (like grain and most other agricultural produce). Minerals traffic covers freight with single (or few) sources and single (or few) destinations and usually carried in unit trains. General freight covers everything else, including container freight. Due to patchy reporting in annual reports, the categories are a little ad-hoc.

### *Australian National*

The time series for the Australian National Railway Commission runs from 1970/71 (reported by the Commonwealth Railways, one element of AN's eventual scope following its formation in 1975) through to 1993/94, the last year of its full operation before interstate freight was transferred in NR. It covers both the formation of AN in 1975 and subsequent transfer to Commonwealth ownership of the railway assets of Tasmania and South Australia (excluding Adelaide urban passenger services), which was completed in 1977/78.

For Australian National, a consistent series of capital accounts existed for the whole period of study (except for the first few years, which were estimated based upon proportional relationships between capital and operational expenditure from later years, multiplied by the actual operational expenditure in these first few years) and differentiated between different above and below-rail asset classes. For part of the period, the operational expenditure and cashflow statements showed either total depreciation, total capital expenditure or one or both of these line item by line item. Unfortunately, the cashflow and operational expenditure figures rarely tallied with those in the capital account. Thus, where available, the actual numbers from the operational expenditure and cashflow statements were used, line item by line item. Where total capital expenditure and/or depreciation were available in the cashflow and operational expenditure accounts but individual line items were not, the proportionate shares from the capital accounts were applied to the actual total capital expenditure and depreciation numbers from the operational accounts. Asset values were consistently reported for the period in the capital account and were thus used.

Fuel and equipment expenditure was available for much of the period, from Daniels et al (1994). For fuel in the final few years, figures for Tasmania were available and used to proxy mainland figures, based upon proportional relationships between the two in earlier years. Equipment expenditure was reported in AN annual reports for some of the period concurrent with the Daniels et al figures, but the numbers were different, suggesting different definitions. These differences were consistent, however, and thus used to augment the Daniels et al (1994) figures.

ABS figures report both tonnages of freight and NTK up until 1982. From these figures, it is possible to calculate how many kilometres the freight has been hauled each year. For AN, this figure remains remarkably steady over the period to 1982, reflecting the fact that many of the major freight tasks did not change significantly over the period. For the period after 1982, the number of kilometres in each year was deduced from the preceding years and multiplied by actual tonnages (from annual reports) to obtain a proxy NTK figure.[23] Total NTK figures were reported throughout the period, and were typically higher (by around 1000 million NTK) than the sum of the figures thus proxied. Thus, the share of grain, minerals and general freight in the proxied NTK series was applied to actual total NTK to obtain final NTK figures.

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[23] In some cases, this was averaged for the period from 1971 and in some cases, where the freight task was a new one from the absorption of South Australian and Tasmanian assets in 1977/78, the average was from 1977/78. The basis for this decision was the clear break in the kilometres hauled series evident in the latter case.

The final adjustments were to the GTK series. Actual GTK were available from 1973/74 to 1986/87. Over this period, the proportion of NTK to GTK rose from 29 percent to around 44 percent. The rough yardstick for the industry is slightly less that 50 percent, and hence GTK were estimated as being 208 percent of NTK in the years following 1986/87. For the years prior to 1973/74, the average from 1973/74 until the absorption of the South Australian and Tasmanian assets in 1977/78 (29 percent) was used as the proportional relationship, making GTK estimates 345 percent of reported NTK figures.

### *Westrail*

Westrail provides figures for the whole period, except that in 1993/94, it ceased to provide any information in its annual reports on freight breakdowns. As with AN, many data points had to be estimated. Wherever possible, this was done on a similar basis to AN.

The Westrail capital accounts provide good, consistent information which can be used to differentiate between above and below rail capital expenditure and asset values. Thus, only a few data points needed to be estimated for these series, where certain pieces of information were not available.[24] Depreciation figures are available in the operational expenditures from 1985/86. Prior to this date, total depreciation was available in the operational expenditure accounts and was combined with proportional estimates in the capital accounts (the capital accounts contain asset values and capital expenditure, but not depreciation) of the depreciation line items to obtain line item estimates.

Net tonne kilometre figures post 1982 were estimated in a similar fashion to those for AN, on the basis of kilometres. Westrail's kilometre figures were not, however, as consistent as those for AN, particularly for minerals traffic, where shorter-haul alumina and bauxite haulage came to dominate over longer haul iron ore during the period. However, from 1986/87, Westrail provided graphical representation of its freight task in NTKs for the three categories of agriculture, minerals and general freight. It also provided graphical representations of total tonnages. Thus, it was possible to estimate the number of kilometres the freight travelled. Such estimates were necessarily rough, due to the poor precision of the graphs. For the intervening years (1982/83 to 1985/86), the actual tonnages of freight items were combined with kilometres set on a glide path to move from the km figures deduced via the ABS figures to the km figure deduced from the later Westrail annual report graphs to provide NTK figures.

Westrail does not report GTK figures in its annual reports. However, a review of Westrail (SWATS, 1978) from the 1970s does contain some estimates. These are roughly comparable to the figures of AN, and change in a roughly comparable way. Thus, from 1976, Westrail's GTK to NTK ratio is set on a glide path to match the industry benchmark (208 percent) by the same year that AN does (1988/89) and at 208 percent thereafter. These numbers are then applied to reported NTK figures to give estimates of GTK.

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[24] In such cases, the data which are available are combined with estimates, usually proportions based, of those data which are not available. There are only two years in the asset value series and one in the capital expenditure series where this occurs.

## *Model Particulars of the Combined AN & Westrail TC Model*

A brief summary from the model outputs of the total cost model where the data for AN and Westrail were pooled.

### *Overall Results*

```
Breusch-Pagan LM test for diagonal covariance matrix =   10.828
 chi-square with    3 d.f.     P-value= 0.01269
Likelihood ratio test of diagonal covariance matrix =   37.102
 chi-square with    3 d.f.     P-value= 0.00000
 VARIABLE       COEFFICIENT    ST.ERROR       T-RATIO
 ONE          6.6515         2.0361         3.2668
 F           0.46645        0.96765E-01     4.8204
 G           0.45824        0.13895         3.2980
 H           0.38458        0.35347         1.0880
 I           0.77709        0.46594         1.6678
 J           0.73549        0.52190         1.4092
 K           0.28420E-01    0.12297E-01     2.3111
 L          -0.13976        0.89072E-01    -1.5691
 M           0.59535E-01    0.39146E-01     1.5208
 N          -0.10493E-01    0.77497E-02    -1.3540
 O           0.34013E-02    0.11372E-01    0.29910
 P           0.89502E-01    0.16302E-01     5.4902
 Q          -0.24301E-01    0.94732E-02    -2.5652
 R           0.11394E-01    0.12738E-01    0.89452
 S           0.14751E-01    0.88141E-02     1.6736
 U           0.74934E-01    0.75432E-02     9.9340
 V          -0.80436E-02    0.94063E-02   -0.85513
 W          -0.41570E-01    0.12471E-01    -3.3333
 X          -0.12673        0.74351E-01    -1.7044
 Y           0.45000E-01    0.19940E-01     2.2568
 Z          -0.25562        0.16909        -1.5117
 ONE         0.46645        0.96765E-01     4.8204
```

### *Equation-by-Equation Results*

```
EQUATION  1 OF  3 EQUATIONS
 Dependent variable = lntc                49 observations
 R-square =   0.9064
 Variance of the estimate-sigma**2 =  0.78930e-02
 Standard error of the estimate-sigma =  0.88842e-01
 Sum of squared errors-sse=  0.31572
 Mean of dependent variable =   12.802
 Log of the likelihood function =  299.802
 Raw moment r-square =   1.0000
 VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL STANDARDIZED ELASTICITY
   NAME    COEFFICIENT   ERROR      40 DF   P-VALUE CORR. COEFFICIENT  AT MEANS
 ONE        6.6515      2.036       3.267     0.002 0.459     0.0000     0.5196
 F         0.46645     0.9676E-01   4.820     0.000 0.606     0.6495    -0.0187
 G         0.45824     0.1389       3.298     0.002 0.462     4.7052     0.1974
 H         0.38458     0.3535       1.088     0.283 0.170     6.2748     0.1202
 I         0.77709     0.4659       1.668     0.103 0.255     1.9635     0.0482
 J         0.73549     0.5219       1.409     0.166 0.217     2.4628     0.1695
 K         0.28420E-01 0.1230E-01   2.311     0.026 0.343     3.9938     0.0762
 L        -0.13976     0.8907E-01  -1.569     0.125-0.241    -0.7063    -0.0117
 M         0.59535E-01 0.3915E-01   1.521     0.136 0.234     0.9634     0.0441
 N        -0.10493E-01 0.7750E-02  -1.354     0.183-0.209    -0.1226     0.0015
 O         0.34013E-02 0.1137E-01  0.2991     0.766 0.047     0.1489     0.0028
 P         0.89502E-01 0.1630E-01   5.490     0.000 0.656     0.2119    -0.0036
 Q        -0.24301E-01 0.9473E-02  -2.565     0.014-0.376    -0.5370    -0.0109
 R         0.11394E-01 0.1274E-01  0.8945     0.376 0.140     0.0566    -0.0015
 S         0.14751E-01 0.8814E-02   1.674     0.102 0.256     0.6495     0.0207
 U         0.74934E-01 0.7543E-02   9.934     0.000 0.844     0.1319     0.0023
 V        -0.80436E-02 0.9406E-02 -0.8551     0.398-0.134    -0.8828    -0.0237
 W        -0.41570E-01 0.1247E-01  -3.333     0.002-0.466    -0.4265     0.0095
 X        -0.12673     0.7435E-01  -1.704     0.096-0.260    -5.3511    -0.0905
 Y         0.45000E-01 0.1994E-01   2.257     0.030 0.336     0.2059     0.0035
 Z        -0.25562     0.1691      -1.512     0.138-0.232    -2.5537    -0.0553
Durbin-Watson = 0.6055    Von-Neumann ratio = 0.6181    Rho =  0.72300
Residual sum =  0.13348      Residual variance =  0.78930e-02
Sum of absolute errors=   3.0631
R-square between observed and predicted = 0.9145
Runs test:   11 runs,   25 pos,    0 zero,   24 neg  normal statistic = -4.1855
```

```
EQUATION  2 OF  3 EQUATIONS
  Dependent variable = somtc               49 observations
  R-square =   0.5371
 Variance of the estimate-sigma**2 =  0.15101e-02
 Standard error of the estimate-sigma =  0.38860e-01
 Sum of squared errors-sse=  0.83057e-01
 Mean of dependent variable =  0.22148
 Log of the likelihood function =  299.802
 Raw moment r-square =   0.9678
 VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL STANDARDIZED ELASTICITY
   NAME    COEFFICIENT   ERROR      55 DF   P-VALUE CORR. COEFFICIENT  AT MEANS
 ONE       0.46645     0.9676E-01   4.820     0.000 0.545     0.0000     2.1060
 F         0.14987     0.1509E-01   9.934     0.000 0.801     0.9050    -0.3468
 G        -0.41570E-01 0.1247E-01  -3.333     0.002-0.410    -1.8509    -1.0353
 H        -0.10493E-01 0.7750E-02  -1.354     0.181-0.180    -0.7424    -0.1896
 I         0.89502E-01 0.1630E-01   5.490     0.000 0.595     0.9807     0.3212
 J         0.11394E-01 0.1274E-01  0.8945     0.375 0.120     0.1654     0.1518
Durbin-Watson = 0.3311    Von-Neumann ratio = 0.3380    rho =  0.89471
Residual sum = -0.78759e-01  residual variance =  0.15101e-02
Sum of absolute errors=   1.6236
R-square between observed and predicted = 0.5437
Runs test:    7 runs,   24 pos,    0 zero,   25 neg  normal statistic = -5.3410
```

```
EQUATION  3 OF  3 EQUATIONS
  Dependent variable = swstc               49 observations
  R-square =   0.8873
  Variance of the estimate-sigma**2 =  0.44055e-03
  Standard error of the estimate-sigma =  0.20989e-01
  Sum of squared errors-sse=  0.24230e-01
  Mean of dependent variable =  0.42863
  Log of the likelihood function =  299.802
  Raw moment r-square =   0.9974

 VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL STANDARDIZED ELASTICITY
   NAME    COEFFICIENT   ERROR      55 DF   P-VALUE CORR. COEFFICIENT  AT MEANS
 ONE       0.45824     0.1389       3.298     0.002 0.406     0.0000     1.0691
 F        -0.41570E-01 0.1247E-01  -3.333     0.002-0.410    -0.2294     0.0497
 G        -0.16087E-01 0.1881E-01 -0.8551     0.396-0.115    -0.6545    -0.2070
 H         0.34013E-02 0.1137E-01  0.2991     0.766 0.040     0.2199     0.0317
 I        -0.24301E-01 0.9473E-02  -2.565     0.013-0.327    -0.2433    -0.0451
 J         0.14751E-01 0.8814E-02   1.674     0.100 0.220     0.1957     0.1015
Durbin-Watson = 0.7144    Von-Neumann ratio = 0.7293    Rho =  0.61565
Residual sum =  0.42600e-03  Residual variance =  0.44055e-03
Sum of absolute errors=  0.88412
R-square between observed and predicted = 0.8873
Runs test:   11 runs,   25 pos,    0 zero,   24 neg  normal statistic = -4.1855
```