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"Assessing the Costs of a Haulage Regime"

By Nick Wills-Johnson

Centre for Research in Applied Economics,
School of Economics and Finance
Curtin Business School
Curtin University of Technology
GPO Box U1987, Perth WA 6845 AUSTRALIA
Email: michelle.twigger@cbs.curtin.edu.au
Web: http://www.cbs.curtin.edu.au/crae
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Curtin
University of Technology

Assessing the Costs of a Haulage Regime

Nick Wills-Johnson
Centre for Research in Applied Economics
Curtin Business School
Curtin University
GPO Box U1987
Perth, Western Australia 6845
Email: n.wills-johnson@curtin.edu.au

Abstract

The provision of third-party access to rail infrastructure in WA's Pilbara region has been a contentious issue over the past decade. The most recent endeavour proposed by the State Government involves a haulage regime, whereby incumbents would be required to haul the wagons of third parties seeking access to the line. This paper explores the likely costs of such a regime on the host railways, by examining the impacts of voluntary haulage regimes on US Class One Railways, where they are well-established. It finds that haulage regimes are a cost effective means for US railways to reduce their haulage costs, and that they thus might play a role in the Pilbara. However, consideration of whole-of-system costs, congestion and appropriate pricing are key issues. This paper explores these issues, and proposes a simple pricing mechanism which would ensure fair, efficient haulage with only very limited regulatory involvement.

Assessing the Costs of a Haulage Regime

Introduction

Iron Ore mined in WA's Pilbara region is transported to Port Hedland (in the case of BHP) and Cape Lambert and Dampier (in the case of Rio Tinto) using the two largest private rail networks in Australia. When the track infrastructure was created in the 1960s, its governing State Agreement Acts envisaged third party access to the track, under appropriate circumstances but none has thus far emerged. More recently, Hope Downs Ltd and the Fortescue Metals Group (FMG) have sought access to (respectively) Rio Tinto and BHP's track under the aegis of the National Competition Council. The first attempt failed, whilst the latter is ongoing. In an endeavour to break the impasse, the Pilbara Rail Infrastructure Advisory Committee (PRIAC) was formed within State Government in 2006 to consider the merits of a haulage regime. That is, rather than access being provided for the trains of third parties like FMG, the incumbent railway operators would be required to haul the wagons of third parties. Such regimes, voluntary in nature, operate on US railways, and thus they provide a useful tool to explore the likely impacts of a haulage regime in the Pilbara.

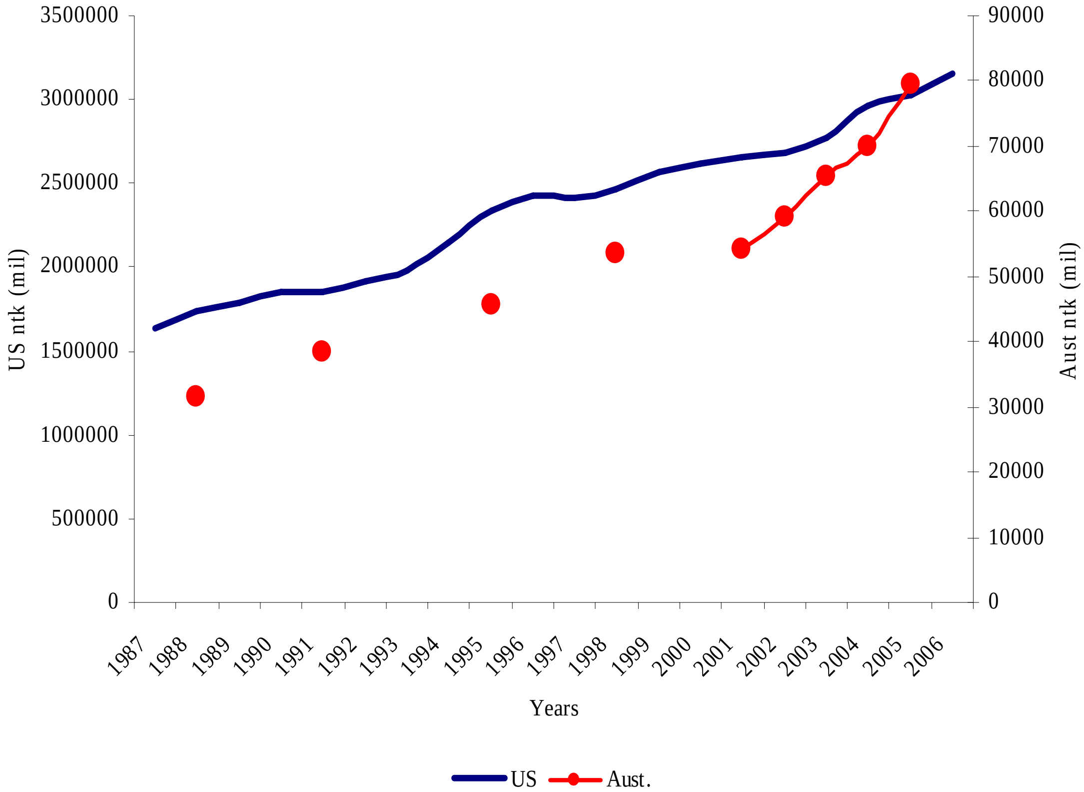
Section One of this paper provides some background to the US rail industry, and the use of voluntary haulage regimes. Section Two introduces the modelling framework, and the data used in the model. Section Three presents the modelling results and associated analysis. Section Four concludes with some policy ramifications with respect to haulage regimes in the Pilbara region.

US Class One Railways

The US rail industry is much larger than its Australian counterpart. In terms of revenue, the US rail industry is roughly six and a half times as large as the Australian rail industry; US$54 billion in 2006 (AAR, 2008a) as compared to A$11 billion in 2005 (ARA, 2006). In terms of the volume of freight, however, Australian railways carry barely three percent of the freight carried by their US peers.[1] However, the Australian rail freight task has grown much faster over the past two decades; 250 percent as compared to 73 percent in the US. This is shown in Figure One.

[1] The Australian figure includes roughly $3 billion in various forms of subsidy from government. It also includes revenues from commuter passenger railways, which the US data does not. This accounts for the discrepancy between relative revenues and relative freight haulage tasks.

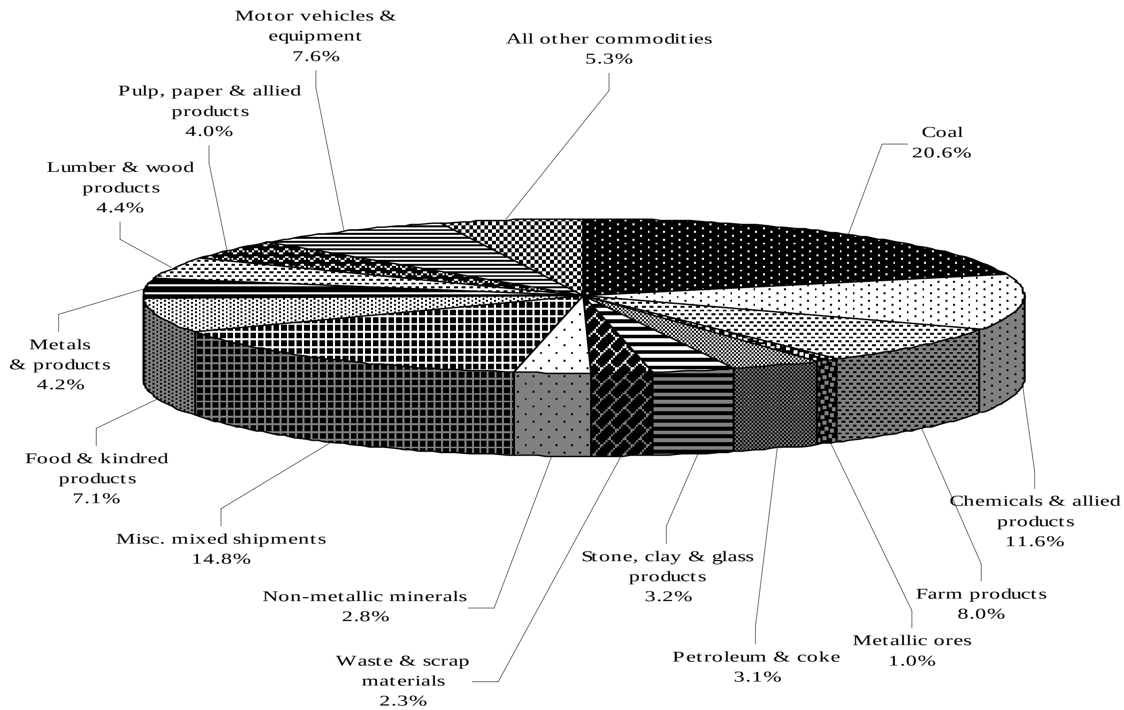
Figure One: US and Australian Freight Task (ntk)



Source: US data: STB R1 Annual Reports, Australian data: ARA, 2007

The US freight task is more diverse than it is in Australia. This is reflective both of a more well-developed rail system serving a larger population and economy, and also of demographic spread. The US has relatively densely populated east and west coasts (with many major cities in between) and Australia does not. This gives scope for more and more varied trans-continental traffic in the US compared to Australia. Moreover, the US is well-served by inland waterways, which compete with railways for haulage of bulk commodities. These reasons combine to result in less reliance on bulk export minerals, and a greater diversity of the traffic base.

Figure Two: US Freight Task, by Revenue (2006) ***check***



Source: AAR, 2008a

Despite the relative diversity of the freight task in the US, coal remains the most important commodity for US railways. However, growth of manufacturing in China has lead to a large increase in intermodal traffic (encompassing several categories in Figure Two), shipped from ports in California to the rest of the US. In 2003, the various categories of intermodal freight surpassed coal for the first time and currently account for around 23 percent of revenues (AAR, 2008a). Intermodal freight has quadrupled over the past 25 years and represents a major source of earnings growth for the industry. In contrast to the situation in Australia, rail freight in the US has kept pace with trucking over the past 25 years; in fact rail has increased its share of the transport task.

The US industry is also much more profitable than Australian railways. Although profits are less than the median for US industry, they have been increasing in recent years, peaking at a return on equity of 14 percent in 2006 (AAR, 2008b). By contrast, the best performing of the Australian railways for which data are available, QR, averaged a return on equity of roughly five percent from 2000 to 2004 (PC, 2004). Despite this, investment in both Australian and US railways has averaged roughly 20 percent of revenues over the past five years (US data from AAR, 2008b, Australian data from Wills-Johnson, 2007).

The difference is that funds for investment in the US are private, including Berkshire Hathaway and other major investment funds (see Machalabar, 2008), whilst Australian railways must rely on government for much of their investment. This is due not only to the much larger size of US railways, allowing them to reap economies of density and scope, but also to the fact that Australian rail data includes commuter and intercity passenger rail tasks, whilst none of the US Class One (see below) railways to which the information in this section pertains have any significant passenger task. Passenger rail requires subsidies, whilst freight is generally profitable and does not.

US railways are divided into three classes for the purposes of economic regulation;[2] Class One railways refer to those with revenues in excess of US$289 million per annum, Class Two refer to railways with revenues between US$20 million and US$289 million, and Class Three railways refer to small railways with revenues of less than US$20 million per annum. The differentiation is made to spare smaller railways of some of the regulatory burden which is necessary for the effective oversight of their larger peers. There are seven Class One railways, accounting for 93 percent of total rail freight carried and 90 percent of total rail employment. Many of the smaller railways either serve localised demand, or act as feeders to the Class One railways. In fact, many are creations of the industry rationalisation process which followed reform of the industry in 1980.

In 1980, the US rail industry underwent major reform under the *Staggers Act*, which sought to arrest the decline, apparent for many decades but hastening in the 1970s. By 1980, the railways had been regulated federally for nearly 100 years, and the resulting web of regulatory practice had come close to strangling their businesses with more than 21 percent of US rail track accounted for by companies in bankruptcy by the mid 1970s (AAR, 2008c). The *Staggers Act* made a number of key changes:

- It allowed railways more freedom to price discriminate and price commercially (and confidentially) for their services, abolishing most collective rates.
- It provided much more streamlined mechanisms for line abandonment and sale, creating, in effect, the genesis of the short line railway movement in the US.
- It reduced the range of services over which the regulator, then the Interstate Commerce Commission (ICC) but since 1996 the Surface Transportation Board (STB), could apply regulation and shifted the focus of rate investigations to a greater consideration of rate adequacy for the railway.

The response of the railways to these reforms was dramatic. Since 1980, the industry has consolidated, merging 40 railways into seven and reaping the resultant economies of scale.[3] It has also increased labour productivity by some 167 percent, amongst the best performance of any US industry, and certainly better than the 15 percent increase in the 25 years prior to 1980. At the same time, real rates have decreased by 55 percent, resulting in railways increasing their market share of the freight task from roughly 35 percent in the 1970s to more than 40 percent today (AAR, 2008c).

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[2] None of these classes include commuter rail, although the regulator does have a role in overseeing Amtrack, the US intercity passenger railway.

[3] In part this is due to changing definitions of a Class One railway. If the same real revenue cut-off used today were in place in 1980, only 26 railways would have been defined as Class One railways.

Although the *Staggers Act* removed much of the regulation of US railways, it did not deregulate them entirely. The STB retains powers to set rates, approve mergers and pooling arrangements, oversee line abandonment and construction (including an ability to require other railways to allow the new line to cross their own) and regulate the interchange of traffic amongst carriers. It can also compel railways to meet its service obligations, provide an alternative service, or give access to a terminal or switching infrastructure. Finally, the STB also monitors the financial condition of Class One Railways through its R1 Annual Reporting mechanism, discussed further under the discussion on data used in this paper below.

This reporting and monitoring role, which began in the early 20th Century, has proven to be very useful in economic analysis. The annual reports contain detailed data which are consistent across railways and across long periods of time. Moreover, they are public documents. As a result, US railways have been extensively analysed by economic researchers. Bitzan (2000) provides an overview of this literature.

Private Cars and Haulage Regimes

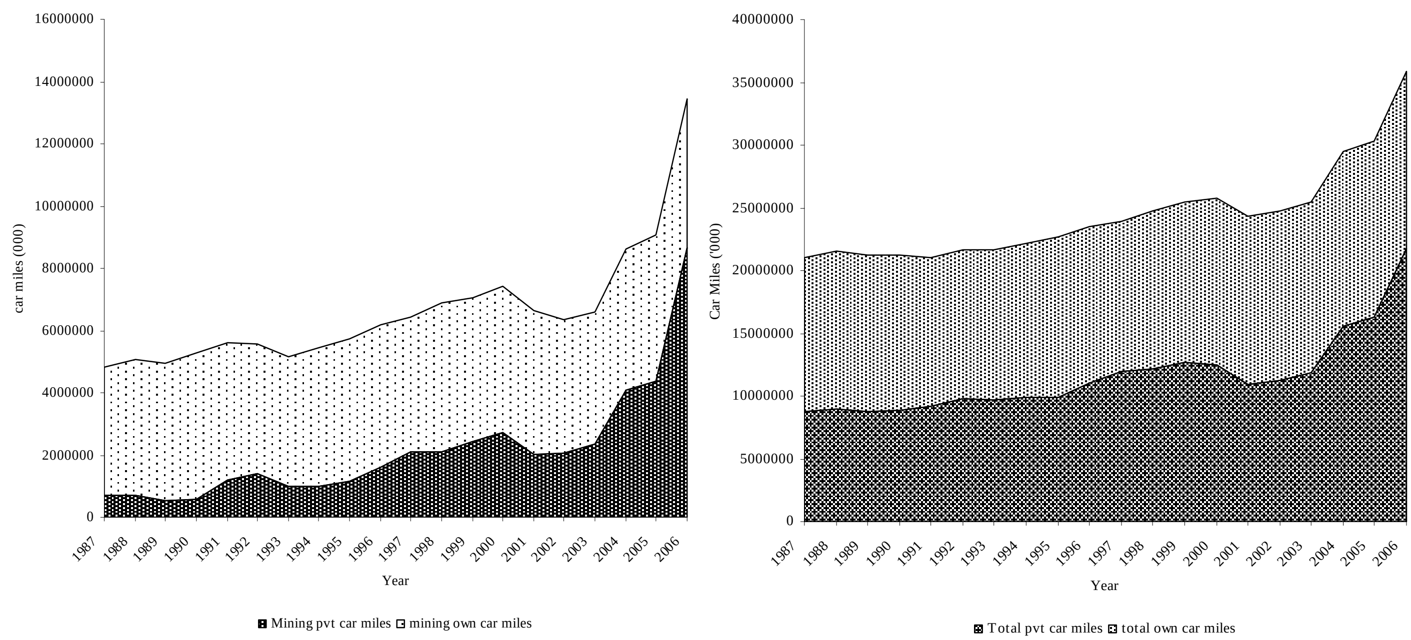
Private cars refer to cars that are hauled by the railways, but which are neither owned nor leased by them. Private cars are hauled under contractual haulage regimes, the voluntary equivalent of what is planned for the Pilbara. Haulage regimes are a popular way in which railways can extend their reach to cities where they do not own any track. They are often also much less burdensome in a contractual, administrative and regulatory sense than other ways of expanding a rail business. In the US, the alternative to a haulage regime is either joint marketing with another railway, or trackage rights. Joint marketing raises the issue of antitrust enforcement (from which the railways are no longer immune following the *Staggers Act* reforms). If trackage rights are granted, they become a matter of public record, kept by the STB, and also expose the railway to compensation claims from employees if the tenant railway takes business from the host. Haulage regimes suffer neither of these disadvantages for the railways concerned, and for shippers, they allow a single point of contact for their freight task, regardless of the number of hauliers.

Haulage regimes also represent a way to expand capacity without the expense of purchasing additional capital assets. For this reason, they became a popular approach in the US in the 1970s, when the railways were starved of capital and often unable to invest in wagons themselves. The use of private wagons for risk sharing remains popular today, and not only in the US; in Australia, railways and coal mining companies have engaged in similar risk sharing arrangements in respect to coal wagons. In the US, shippers themselves rarely own cars. Instead, the cars are most often owned by car leasing companies, who therefore bear the long-run risk of car ownership. The railways themselves also make use of leased cars, particularly through TTX, a car-owning company jointly owned by a number of the Class One railways themselves, which owns more than 210,000 railway cars, mostly intermodal, flatbed and car-carrying wagons.

Private wagons and haulage regimes are not a 21st, or even a 20th Century innovation. As the railways expanded in Britain in the 1830s and 1840s, it soon became apparent that the needs of shippers and the geographical limits of each railway were not the same. Hence railways adopted a system of bilateral accounts to allow passenger cars and good wagons to pass from one railway to another. This soon became very complex, and thus, at the suggestion of a London banker (the banks had faced much the same problem with cheques, some 70 years previously), the railways formed a Railway Clearing House, which created an efficient system of swapping cars between railways through a centralised pool. Lardner (1855) provides a detailed account as to how this first railway pool, soon copied around the world as railways faced the same problem, operated.

In the sample period analysed, private cars have become an increasingly large share of overall car miles for US Class One railways. Figure Three shows the growth in both private and own car miles. The left hand side of Figure Three shows the growth of private and own car miles used in minerals related freight tasks, and the right hand side shows the growth of private car miles and owned car miles more generally.

Figure Three:Private and Own Car Miles



Source: STB R1 Annual Reports

As a total proportion of car miles, private car miles now account for roughly 60 percent of the total, up from around 40 percent at the outset of the period. However, when one examines wagons used in minerals traffic, the growth is far more pronounced, from 15 percent of car miles at the outset of the period to more than 60 percent by 2006.

Modelling Framework

The cost function for US railways used in this analysis was estimated using the transcendental (translog) cost function of Christensen, Jorgenson and Lau (1973), expressed thus:

$$\ln VC(y,w,t) = \alpha_0 + \sum_{i=1}^{3}\alpha_i \ln w_i + \sum_{j=1}^{n}\beta_j y_j + \sum_{k=1}^{3}\gamma_i \ln t_k + \sum_{d=1}^{15}\delta_k D_k + \frac{1}{2}\sum_{i=1}^{3}\sum_{l=1}^{3}\alpha_{il} \ln w_i \ln w_l +$$
$$\sum_{i=1}^{3}\sum_{j=1}^{n}\alpha_i\beta_j \ln w_i \ln y_j + \sum_{i=1}^{3}\sum_{k=1}^{3}\alpha_i\gamma_k \ln w_i \ln t + \frac{1}{2}\sum_{j=1}^{n}\sum_{p=1}^{n}\beta_{jp} \ln y_j \ln y_p + \sum_{j=1}^{n}\sum_{k=1}^{3}\beta_j\gamma_k \ln y_j \ln t_k + \frac{1}{2}\sum_{k=1}^{3}\sum_{q=1}^{3}\alpha_{kq} \ln t_k \ln t_q \quad (1)$$

Applying Shephard's Lemma to the cost equations gives n factor share equations of the form:

$$S_i = \alpha_i + \sum_{l=1}^{3}\alpha_{il} \ln w_i + \sum_{j=1}^{n}\alpha_i\beta_j \ln y_j + \sum_{k=1}^{3}\alpha_i\gamma_k \ln t_k \quad (2)$$

In both equations, w denotes input prices, y output prices and t the technical variables. In the first model, with two outputs, n=2, whilst in the second model, where rail output is split in three, n=3.

Estimating the translog functional form as a system results in a singular covariance matrix, since factor shares add to one and hence have zero errors. Following usual practice, the systems were estimated with one factor share equation removed. Price homogeneity implies that the α_i terms sum to one, thus:

$$\sum_{j=1}^{3}\alpha_i\beta_j = 0 \text{ and } \sum_{k=1}^{3}\alpha_i\gamma_k = 0 \text{ for each input } w_i \quad (3)$$

Symmetry implies $\alpha_{ij} = \alpha_{ji}$. Price homogeneity and symmetry were imposed to add degrees of freedom to the regression. Missing parameters were retrieved manually.

The models were estimated using Zellner's (1962) Seemingly Unrelated Regression (SURE) utilising maximum likelihood estimators for each equation in the system. Modelling was undertaken using SHAZAM (2004).[4] Given the short timeframe for each railway in the panel (a maximum of 20 observations per railway), it was not reasonable to undertake a formal test of stationarity, as the critical values for such tests are justified by their asymptotic properties. However, the diagonal elements of the autocorrelation coefficient matrix are close to one, suggesting the data may be non-stationary. Moreover, the correlation between the output variables in levels form was in excess of 90 percent and such high multicollinearity clouded results for the model in levels form. Estimating the model in first differences addresses both of these issues and, since the underlying model is linear, the coefficients can still be interpreted as they would be in a linear model.

[4] SHAZAM does not allow for GLS within its linear systems command. It does, however, allow a non-linear regression with an option (called ACROSS, see SHAZAM, 2004, p249) which estimates a SURE model with vector autoregressive errors. This allows for maximum likelihood estimation of the regression parameters, provided the model converges, and provides efficient and consistent estimates of the coefficients. The model estimated is a linear model, but due to the nature of SHAZAM, it was estimated using a non-linear approach. Thus, some diagnostic test statistics are not available.

Data

Data used in this analysis come from the *R1 Annual Reports* filed by each of the Class One railways in the US.[5] These reports are divided into a number of different schedules, and each schedule into a number of different line items. The line items are consistent across all railways, and across all years in the sample. Data from 1996 to 2006 are available on the website of the STB and data prior to 1996 were sourced from the Association of American Railroads, which compiles data from the Reports into its *Analysis of Class One Railroads*. The generous assistance of the AAR in sourcing data prior to 1996 is gratefully acknowledged by the author.

Data are annual, from 1987 to 2006 inclusive, although not every railway exists in every year, due to mergers. Thus, the dataset forms an unbalanced panel. The following describes the data used for each railway in the panel:

- Atchison-Topeka and Santa Fe Railway: 1987-1995 (merged with Burlington National in 1995 to form Burlington National Santa Fe).
- Burlington National: 1987-1995.
- Burlington National Santa Fe: 1996-2006.
- Canadian National: 2002-2006 (began reporting in 2002. Prior to that, reporting is in respect to its two US railways, Illinois Central and Grand Trunk Western).
- Chicago & North Western Railway: 1987-1994 (merged with Union Pacific in 1995).
- Consolidated Rail: 1987-1999 (purchased in 1998 by CSX and Norfolk Southern, who divided the railway between them).
- CSX Corporation: 1987-2006.
- Denver and Rio Grand Western: 1987-1993 (part of Southern Pacific from 1988).
- Grand Trunk Western: 1987-2001 (owned by Canadian National since the 1920s, but reports separately until 2001).
- Illinois Central: 1987-2001 (purchased by Canadian National in 1998, but reports separately until 2001).
- Kansas City Southern: 1987-2006.
- Norfolk Southern: 1987-2006.
- Soo Line: 1987-2006 (a subsidiary of Canadian Pacific Railway).
- Southern Pacific: 1987-1996 (acquired by Union Pacific in 1996).
- Union Pacific: 1987-2006.

Table One summarises the data used. In the first column, the Roman lettering represents the variable, and the Greek lettering in parentheses represents the coefficient used for the relevant variable, to assist in interpreting the table of results, Table Two. Note that both OCM and OMCM have a coefficient denoted with β_2 and that PCM and PMCM both have a coefficient denoted β_3. This is because two models are estimated; the first containing PCM and OCM, and the second containing NMOCM, OMCM and PMCM.

[5] See http://www.stb.dot.gov/stb/industry/econ_reports.html for details. Far more detail can be found in the regulations covering reporting requirements, available from http://tiny.cc/5F.

Table One: Variable Costs Model Regression Data

Variable	Description
VC	Variable costs: Total Operating Costs (Schedule 410, line 620) minus way and structures operating costs (Schedule 410, line 151).
PL (α_1)	Price of Labour: Total salaries and wages (Schedule 410, line 620, column b) divided by numbers of staff (sourced from the AAR).
PM (α_2)	Price of Materials: variable costs minus total salaries and wage for above rail operations, divided by gross ton miles hauled (Schedule 755 line 104).
PE (α_3)	Price of Equipment: net investment per loaded train (see below).
OCM (β_2)	Own Car Miles: miles travelled by cars owned or leased by a railway (Schedule 755, lines 30 for loaded cars and 46 for empty cars).
PCM (β_3)	Private Car Miles: miles travelled by cars owned by third parties (Schedule 755, lines 64 for loaded cars and 82 for empty cars).
NMOCM (β_1)	Non Mineral Own Car Miles: car miles for wagon types not generally used for minerals haulage and owned or leased by the railway (see below).
OMCM (β_2)	Own Mineral Car Miles: car miles for wagon types generally used for minerals haulage and owned or leased by the railway (see below).
PMCM (β_3)	Private Mineral Car Miles: car miles for wagon types generally used for minerals haulage and owned by third parties (see below).
RM (γ_1)	Route Miles: miles of road operated (Schedule 755, line 1).
ALH (γ_2)	Average Length of Haul: revenue ton miles (Schedule 755, line 110) divided by revenue tons (Schedule 755, line 105).
RK (γ_3)	Return on below rail capital per mile of road operated (see below).

Two models are estimated, one comparing private car miles with own car miles and a second using non-mineral own car miles, own mineral car miles and private mineral car miles as three separate outputs. In terms of variable costs, inputs (PE, PM and PL) and technical variables (RM, ALH and RK), both models are of the same form. Each of the price variables are, in fact, proxies of price indices, which are a more proper input in the derivation of cost functions. However, whilst such price indices are available for the industry as a whole, they are not available for individual railways. The practice followed above is reasonably consistent with the literature in this regard.

The model used in this paper conforms very closely to similar analyses undertaken by Bitzan (2000, 2003) and Ivaldi & McCullough (2001, 2006), which are themselves closely related to a history of the development of cost functions using Class One railway data (see Bitzan, 2000). There are differences between this model and those in the literature. In particular, this study uses car miles as the output of each railway (like Ivaldi & McCullough but unlike Bitzan) but it divides them in a unique fashion to explore the impacts of private car miles. From a methodological perspective, Ivaldi & McCullough (2006) use a Generalised McFadden (1978) cost function rather than the translog function which has been used more widely in the past. Their paper summarises the reasons for this choice of functional form.

Most of the variables above are reasonably self-explanatory, but the output variables, and the variables related to capital expenditure require some further explanation. The *R1 Annual Reports* do not identify how much of a given commodity is carried. However, they do divide car miles travelled into the different types of wagons. Box cars, flat cars and refrigerated cars are generally used for intermodal and general freight, covered hopper cars are generally used for grain traffic, tankers are used for bulk liquids and gondolas and open hopper cars are generally used for bulk minerals traffic. This, of course, is a very rough categorisation, but it does allow one to partition the haulage task into different commodities. In particular, it allows one to examine minerals haulage tasks, by examining gondola cars and open hopper car miles. Ivaldi & McCullough (2001, 2006) use car miles in a similar fashion, but split output differently, as the focus of their work is different to that of this paper.

The variables related to the price of equipment and the return on below-rail capital also require further explanation. The *R1 Annual Reports* divide total investment (Schedule 352B) into above (line 40) and below rail (line 31). The reports also show accumulated depreciation (Schedule 335), again divided into above (line 40) and below (line 30) rail components. The return on capital represents the opportunity cost of total above or below rail investment, net of accumulated depreciation, in each year. The opportunity cost of capital is calculated by the STB each year (see http://tiny.cc/4krXE).[6]

The return on below rail capital is normalised by route length to produce a technical variable which proxies track quality; greater investment in general relates to higher quality track. The return on above rail investment is used to develop a price for above rail equipment (essentially locomotives and wagons). To derive this price, one needs a denominator, much as one might use staff numbers to price labour. I consider the relevant unit to be a loaded train.[7] Thus, the total cost of above rail capital is divided by the number of loaded trains to give a price per train. The number of loaded trains is a composite measure comprising loaded freight cars (Schedule 755 lines 120-122), total car miles (Schedule 755, line 88 minus lines 82 and 46) and total locomotive unit miles (Schedule 755 line 11). Implicitly, it assumes one locomotive per train.

Model Results

Table Two provides a summary of the results of the model. Various different specifications are examined. However, all results (available from the author upon request) are broadly similar to those presented in Table Two. The first two columns of Table Two summarise the results of Model One including two outputs; private car miles and own car miles. The latter two columns summarise the results of Model Two with three outputs; own car non-mineral miles, own car mineral miles and private car mineral miles. The single Greek letters refer to the first order effects of particular variables as summarised in Table One above. The double subscript and double letter combination Greek letters refer to second order effects. Thus α_{11} refers to the second order effect of the price of labour on itself (or the own price elasticity of labour), and $\beta_1\gamma_2$ refers to the second order effects of non- mineral own-car miles on the average length of haul (or the cross elasticity between these two variables).

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[6] For 2006, the STB decided to move from a discounted cash flow to a Capital Asset Pricing Model approach, which has generated great debate in the US rail industry. As a result of this, the STB has yet to publish a 2006 cost of capital figure. The cost of capital used for 2006 (9.5 percent) is based on private discussions with the AAR.

[7] Schedule 755 (lines 120-22) report numbers of loaded cars, not total numbers of cars.

Table Two: Model Results

	PCM - OCM		NMOCM – OMCM - PMCM	
	Coefficient	T-RATIO	Coefficient	T-RATIO
α_0	0.00095097	0.095438	-0.005472	-0.61235
α_1	0.33143	16.592	0.30274	37.909
α_2	0.65092	44.623	0.64354	83.473
α_3	0.01765	101.43	0.05372	1,069.48
β_1	na	na	0.32644	8.2721
β_2	0.3784	10.067	0.098631	4.3173
β_3	0.077223	3.4525	0.010896	2.3308
γ_1	0.23864	4.6918	0.10856	1.7228
γ_2	-0.037794	-0.52706	0.0032645	0.039258
γ_3	0.070574	2.3508	0.014734	0.48327
α_{11}	0.091115	10.331	0.091158	9.662
α_{12}	-0.091845	-10.283	-0.089998	-9.563
α_{22}	0.1034	9.9445	0.10499	9.7127
$\alpha_1\,\beta_1$	na	na	-0.0071289	-0.42347
$\alpha_2\,\beta_1$	na	na	0.011728	0.61495
$\alpha_1\,\beta_2$	0.0026644	0.17722	0.0033149	0.32092
$\alpha_2\,\beta_2$	0.027111	1.5935	0.011847	1.0005
$\alpha_1\,\beta_3$	-0.0065013	-0.74984	-0.0017931	-0.99577
$\alpha_2\,\beta_3$	0.0057052	0.57885	0.0018998	0.93537
$\alpha_1\,\gamma_1$	0.019383	1.0523	0.025075	1.4157
$\alpha_1\,\gamma_2$	-0.017816	-0.61627	-0.0034901	-0.11128
$\alpha_1\,\gamma_3$	-0.0016316	-0.71227	-0.0010081	-0.42654
$\alpha_2\,\gamma_1$	-0.041523	-1.9717	-0.042082	-2.0711
$\alpha_2\,\gamma_2$	0.031619	0.95671	0.023824	0.67594
$\alpha_2\,\gamma_3$	0.18982	3.0999	0.10668	1.7425
β_{11}	na	na	-1.432	-3.4397
β_{12}	na	na	-0.051617	-0.27376
β_{13}	na	na	-0.020181	-0.44121
β_{22}	0.20431	0.55541	0.2496	1.4985
β_{23}	-0.58013	-3.1913	-0.0090458	-0.41003
β_{33}	-0.14412	-1.5588	0.0029698	0.78797
$\beta_1\,\gamma_1$	na	na	1.0614	1.6078
$\beta_1\,\gamma_2$	na	na	3.6982	3.6168
$\beta_1\,\gamma_3$	na	na	0.26708	0.6613
$\beta_2\,\gamma_1$	-0.11794	-0.30667	-0.97866	-2.6454
$\beta_2\,\gamma_2$	1.9029	3.0658	-0.54762	-1.5065
$\beta_2\,\gamma_3$	-0.25344	-0.85782	-0.51538	-2.3966
$\beta_3\,\gamma_1$	-0.27159	-0.98753	0.062207	1.1084
$\beta_3\,\gamma_2$	0.21135	0.40781	-0.082125	-0.93107
$\beta_3\,\gamma_3$	-0.15479	-0.96877	-0.023417	-0.4785
Durbin Watson	1.9864		2.0467	
Rho	0.00336		-0.02551	
Residual Sum	0.079511		-0.0031702	
R^2 between obs. & predict.	0.6148		0.9873	
$G`H^{-1}G$ Statistic	1.267E-12		8.229E-11	

The $G'(H^{-1})G$ result indicates model convergence and hence maximum likelihood estimation. The Durbin-Watson results suggest the modelling process has adequately accounted for serial correlation in the data. In Table Two, the results for dummy variables, and the second order interaction effects between technical variables have been removed to save space. Neither are of particular interest in this analysis, which focuses on effects associated with different output types. Similarly, the coefficients on the second order interaction effects between inputs have not been recovered.

Turning first to the first order effects, all of the input and output coefficients are positive (but not all technical coefficients are), indicating that an increase in inputs or an increase in outputs increase variable costs. This is to be expected. The most important results from the perspective of this paper are the coefficients associated with private car miles. In each case, the coefficients on these variables is smaller, by roughly an order of magnitude, than the corresponding coefficient for own car miles. Moreover, these results are statistically significant, and F-tests on the equality of each coefficient suggests that the differences between them are statistically significant as well. It seems that, for an average US railway, it is much less costly to the railway to haul an additional car-load of freight using a third party wagon than it is to haul it using its own wagons. This is especially the case for wagons which haul bulk minerals. The results are not particularly surprising, given that the railways do not have to pay the capital costs of private wagons.

Few of the second order effects are significant. The own and cross price elasticities of inputs are significant and, moreover, reflect their expected signs; own price elasticities are negative and cross price elasticities are positive. This suggests the cost function is at least reasonably well behaved.

Analysis

The central result, that private car haulage has a much smaller impact on the cost function than haulage with a railway's own wagons, stands in contrast to the findings in the literature concerning access to a third party's trains; most particularly the work of Bitzan (2000,2003) and Ivaldi & McCullough (2005), who analyse third party access using US data. This suggests that, whilst substantial synergies exist between joint ownership of the track and the trains, fewer synergies exist between owning the locomotive and the wagons. These synergies, moreover, are much smaller than the opportunity costs of capital associated with wagon ownership. This is perhaps not surprising. A haulage regime requires no independent train management role, and third parties are forced by the nature of the regime to adhere to the train timetabling set by the host railway. Moreover, a haulage regime creates a physical connection between the host railway and the access seeker, which allows for an opportunity to check that engineering aspects of the third party's wagons (like wheel profile, for example) match those by which the host railway maximises the efficiency of the wheel-rail interface. It is thus not surprising that Class One railways have increased their use of private cars. What is not clear is whether the current (roughly) 60-40 split between private and owned cars represents an industry equilibrium, or whether the railways will divest themselves of more wagons in the future.

However, before the US experience is translated into a recommendation that mandatory haulage regimes are appropriate for the Pilbara, a number of caveats need to be explored.

Firstly, and perhaps most importantly from the perspective of public policy, the costs above refer to the costs of the host railway, not the total costs of operating trains with third party wagons. Since the host railway does not own the third-party wagons, their capital, maintenance and depreciation costs do not appear on its books. It is not possible to add such costs into the above analysis because we do not have the costs of wagons to third parties. From a system-wide perspective, one only saves with a haulage regime where the third parties have lower costs of wagon ownership and operation than the host railway. To the extent that economies of scale and scope exist in the purchase and maintenance of wagons (the widespread use of wagon leasing companies by both US railways and shippers suggests that they do), smaller wagon owners seem likely to face higher costs than larger wagon owners. This is an important consideration in respect to a haulage regime in the Pilbara. One of the important justifications by the NCC and State Government for access is that it will allow competition to develop in what each describes as the “market” for mining tenements (see NCC, 2005). In particular, the WA Government hopes that a haulage regime will allow smaller miners with access to deposits but without the capital to build a railway to begin export operations. However, if the costs of these smaller operators are higher than those of the incumbent and if a haulage regime acts as intended, it seems likely to increase, not decrease system costs.

The second caveat is that the low costs show, in many cases, what has been achieved after more than a century of operation of private wagons on US railways. Over this time, the US rail system has evolved to accommodate private wagons, and the above models thus show what is possible, not what is inevitable. Moreover, since haulage in the US is voluntary and does not occur with any regulatory involvement, third-party wagon owners cannot use the regulator as a strategic tool in negotiating access with the host railway. If a regulator becomes involved, the access seeker may be able to use it to force the host railway to accept compromises in its operational parameters which would advantage the access seeker, but increase the costs of the railway operator.

The above regressions answer the question, “how much, on average, does a private wagon impact upon the operating costs of a host railway compared with a railway-owned wagon?”. It does not address the question, “if a railway is at capacity, how are costs affected by adding another wagon?”. The answer will obviously be very different. The very low coefficients on private wagons above occur because they are not, in general, displacing wagons operated by the railways themselves. Since haulage agreements are based upon bilateral negotiation, a railway only has an incentive to grant access when doing so will not displace its own more highly valued business. In the case where a railway is at capacity, and private wagons can only be accommodated by displacing wagons operated by the railway itself, the relevant cost of the railway regime is the coefficient above plus the opportunity cost of one of the railway’s own wagons. Alternatively, the cost is the coefficient above plus the cost of new infrastructure required to accommodate the additional haulage task.

In the data provided by Class One railways, little information is provided about the type of haulage, beyond what can be inferred by the types of wagons used. However, discussions with industry in the US reveal that there is a trend in the US towards private wagons for point to point coal haulage (particularly by railways in the Western States) whilst railways use their own wagons to haul coal from multiple sources to multiple destinations (more prevalent in the Eastern States). Point to point haulage of bulk minerals is the lowest cost form of rail haulage there is. Thus, part of the explanation for the very low coefficients, particularly when one compares own wagon with private wagon haulage of minerals, may stem from the fact that, on balance, private wagons are being used for lower cost haulage tasks than wagons owned by the railways themselves. To the extent that this is true, the cost differentials between owned and private wagons for a like haulage task are likely to be narrower than suggested in the regression results above. Unfortunately, the same discussions with US industry were unable to shed light on how much point-to-point coal haulage was being done in private wagons, compared to other types of haulage, and thus it is not clear by how much the cost gap would narrow once one takes the mix of haulage tasks into account.

Finally, it is useful to ascertain whether the regression models undertaken in this paper could provide a useful basis for the pricing of a haulage regime in Australia. The price of haulage should properly be based upon the impacts said haulage has on the costs of an efficient railway. From the models, presuming the US railways being examined are efficient, it is possible to ascertain the impacts on variable costs of an increase in private cars and minerals cars. From Model One, a one percent increase in private car miles results in an increase in variable costs of roughly 0.077 percent, and from Model Two, an increase of private minerals car miles of one percent results in an in an increase in variable costs of roughly 0.011 percent. Evaluated at the weighted average of private car miles and private minerals car miles respectively,[8] these elasticity results translate into costs per car mile of 10.9 cents and 8.2 cents respectively.

From a policy perspective, the issue is how to turn these costs into something which might be used in the Australian context, where there are no private car miles which can be put into a regression model and analysed as is done above. A number of perspectives are possible. The first of these could be to endeavour to set access prices based upon some weighted average of variable costs per car mile. Adopting this approach results in costs of roughly 67 cents per car mile, which is clearly much larger than the actual costs incurred by the host railway from hauling private cars. A second might be to proxy costs by examining the costs associated with the haulage of a railway’s own wagons, perhaps modelling these costs via an econometric approach such as that outlined in this paper. However, taking the same approach as outlined above for private car miles and private minerals car miles and applying this to own car miles in Model One gives a cost of 48.8 cents per car mile, again, much larger than the cost of private car miles. Applying the approach in Model Two gives a cost of 30.3 cents per car mile for non-mineral own car

[8] The weighting is based upon the share of (logged) costs of the given railway in a given year as a proportion of the total (logged) costs over the whole time period. Unweighted averages give roughly the same results.

miles, and 36.3 cents for mineral own car miles. Clearly, using this approach would yield prices which are much too high.

A final approach is to examine accounting data. Strictly speaking, the comparison is somewhat dubious, because the various elements of the accounting spreadsheet are not constructed in the same manner as the model inputs, and do not contain the same elements as the regressions used here. However, these accounting data are likely to be the only elements which are common between the US railways and their Australian equivalents; all trains, for example, require drivers, fuel and so on, and these line items are usually reflected in a roughly similar (or at least translatable) fashion across railways. Thus, they may be all Australian policymakers have to try and translate the US experience into an Australian context.

The US Class One railways list five elements in their (freight related) operating costs:[9]

- Salaries & Wages (Schedule 410, Column b).
- Materials Tools, Supplies, Fuels & Lubricants (Schedule 410, Column c).
- Purchased Services (Schedule 410, Column d).
- General (Schedule 410, Column e).
- Total Freight Expense (Schedule 410, Column f), the sum of the previous four.

Taking the share of each of the first four elements as a proportion of the fifth, and applying the same weighting as above,[10] one obtains the following costs per ton-mile:

• Salaries & Wages	21.8 cents.
• Materials Tools, Supplies, Fuels & Lubricants	11.0 cents.
• Purchased Services	15.6 cents.
• General	19.1 cents.

The results are rough, but appear to suggest that if access were priced at the per car mile price of fuel and related consumables, it would probably be about correct. This is not overly surprising, because most of the other costs associated with a haulage regime would in fact be fixed; each train still has one driver, and the railway still needs to maintain the same track and above-rail infrastructure, but its fuel bill will likely increase because hauling additional wagons requires more fuel. It also suggests that complex cost models as used in the building-block method of regulation now widespread amongst Australian regulators might be unnecessary in this case. It may in fact be possible to regulate by requiring that haulage rates on uncongested track are roughly in line with per car mile fuel and consumables costs, perhaps with a margin to reflect the inevitable inexactitudes of econometric models such as those used in this paper.

Conclusions and Policy Ramifications

This paper explores the question of the costs associated with haulage regimes on railways. To the knowledge of the author, no mandatory haulage regime exists in the world at present, but it being proposed for the Pilbara region of Western Australia as a

[9] Note the differences between these four elements and the inputs of each model described in Table One.
[10] Again, unweighted average results are very similar.

less invasive form of third party access than allowing third party trains to access the track. Given the size and importance of this industry to the Australian economy, it is worthwhile to examine what the costs of such a regime might be.

Whilst there are no mandatory haulage regimes, voluntary haulage of wagons other than those owned by the host railway is as old as railways themselves. In particular, US Class One Railways have both a well-developed system of voluntary haulage regimes, and an excellent data-set with which one can examine the impacts of such regimes on the costs of the host railway.

The paper examines two models. The first examines just private car miles and own car miles as outputs, comparing the costs of each. The second divides total car miles a little further, separating out private car miles that are used in the haulage of minerals. This latter model is perhaps closest to the situation which exists in the Pilbara region of WA.

The paper finds that the costs to the host railway of increasing traffic using private cars is much lower than the cost of increasing traffic using its own cars. In a sense, this is not surprising, as the railway does not have to pay for the cars. It implies is that haulage has a relatively small impact on the operations of the host railway, at least in optimal circumstances. This stands in contrast to studies of third party access at the level of a train, which find substantial increases in costs in the US context.

The modelling results further suggest that the balance-sheet costs of fuel and other consumables are probably a reasonable good proxy for the impact on the host railway of a haulage regime, and thus that this could form a reasonable basis for an access price. This avoids much of the complexity of current regulatory models.

Before a model such as this is used in any form of policy formation, however, it is important to outline its limitations. Two, in particular, stand out. Firstly, the model examines only the costs of the host railway. Although it does not have to purchase and maintain the wagons, someone must. Policy is rightly concerned with the system as a whole, not just the host railway. The cost of the system as a whole will only be reduced if the third party which actually owns the wagons is able to purchase and maintain them at a lower cost than the host railway. If this is not the case, then a haulage regime will increase, not decrease, overall system costs.

Secondly, the US railways are not compelled to provide haulage, and so would not do so when they did not have spare capacity in their system for additional wagons. Where a railway operates at full capacity and the railway operator is forced to provide haulage, it would need to be compensated for any lost traffic this causes, as its own wagons are displaced to make way for those of a third party. As such, haulage regimes are best suited for lines which have spare capacity. However, given the relatively low cost to the host railway of hauling private wagons compared to hauling its own, it is unclear why a railway would need to be compelled to offer haulage in such a situation.

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