Open Access for Heavy Haul Railroads:
A Questionable Strategy for Social Welfare Gains

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Abstract

Heavy haul freight railroads carrying bulk materials such as coal or iron ore are characterized by several unique challenges relating to investment in construction and maintenance as well as achievement of optimal operating efficiency. This paper examines heavy haul railroads around the world in a comparative context that highlights differences relative to operating parameters, degree of integration with upstream and downstream nodes in the supply chain and regulatory regimes. Emphasis is placed on analysis of the extent and impact of mandated access on heavy haul railroads. The authors find that successful heavy haul railroading requires an intense focus on asset productivity and effective coordination of the supply chain. This leads to a bias for bundled above and below rail operations as well as integration with mine and port operators; where this is not possible, multiple railroad operators must have well-aligned incentives. On the other hand, mandated access appears to yield few benefits beyond lower rates, which are primarily a wealth transfer rather than a social welfare gain. In addition, the costs of coordinating access are material, leading to a neutral result at best, or more likely a loss of social welfare. This suggests that regulation of heavy haul railroads should incentivize coordination and integration, and that mandated access to generate competition does not produce an increase in social welfare.

OBJECTIVES AND METHODOLOGY

Policy makers have long grappled with introducing competition into natural monopoly industries such as transportation, telecommunications and electricity in order to eliminate excess profits and assure efficient provision of service. Freight railroads presented a particular challenge because far from earning monopoly rents, the industry in North America, Europe and Australia struggled to remain financially viable in the face of competition from other modes, especially trucks. Policy makers in the US were the first to tackle the problem of freight railroad viability. The solution adopted was total economic deregulation. The rationale for the change was that regulation was inhibiting the rail industry from responding to competitive pressures from the trucking industry. With the Staggers Act of 1980, US railroads were free to enter and exit markets, introduce new service offerings, enter into private contracts with shippers, set rates and abandon track. Over the next 25 years, the railroads reduced costs, rationalized capacity, increased productivity and improved financial performance. Billions of dollars of welfare gains have resulted from rail deregulation (Winston et al. 1990).

Governments in Europe and in Australia have taken a different approach to freight railroad regulation and revitalization. Their solution centered on increasing competition among railroads by requiring open access to rail lines (also known as mandated access). This would allow multiple operators to offer rail services to shippers over the same infrastructure, which in turn was expected to spur innovation, increase productivity, and lower costs leading to market share gains for the rail industry. Europe and Australia required railroads to vertically unbundle their operations into above and below rail businesses. In some jurisdictions, the below rail assets have been transferred to a separate infrastructure company; in others, the railroad has remained a single corporate entity, but "ring fenced" the management of the infrastructure functions to provide arms- length and unbiased service to its own above rail operating unit and any other operator that wants to use the line. An extensive test of the open access model has been in Australia, where mandated access was introduced in 1995. There, although there is evidence of rail rate reductions, these appear to be wealth transfers from railroads to shippers, not social welfare gains (Fagan 2007).

Open access for the heavy haul segment of the industry has been particularly controversial. A legal battle has raged in Australia since 2004 as to whether privately owned and operated mine railroads have an obligation to provide rail access to other mine companies. One of the core rationales for the open access law is to achieve social welfare gains. The objective of this paper is to examine whether open access in the heavy haul rail segment is likely to lead to increased social welfare.

The methodology for making this determination centers on comparing the benefits of competition resulting from open access with the costs of coordinating the open access regime. One benefit would be increased competition through new entrants joining the market or existing providers expanding their service offerings. Greater competition would be expected to result in lower rates and greater rail share. Competition resulting from access could also yield improved efficiency and service quality. Finally, mandated access could increase investment in infrastructure and rolling stock (although the opposite is also possible if regulatory risk and commercial uncertainty could reduce or delay investment).

There are also possible costs of coordinating a vertically unbundled, mandated access regime. First, the division of responsibility between infrastructure provider and above rail operators could lead to suboptimal tradeoffs, as in performance of track maintenance. There is also the potential for a "maintenance externality" since the lack of track maintenance could impose a cost on above rail operators. The reverse could be true for operators that fail to maintain their rolling stock. Second, the vertical unbundling requirement of access increases the number and size of rail organizations. Third, there is also the potential for regulatory compliance costs and even expenses for litigation. Finally, the regime could introduce time delays in offering new services since there is an elaborate process for regulatory review.

Statistical tests of changes in freight rates, service reliability, investment levels and coordination costs pre- and post- access and across geographies would provide the strongest evidence of the mandated access policy's success or limitations; however, lack of detailed data make such quantitative analyses impossible. Consequently, the present analysis relies on piecing together evidence from industry and government reports, supplemented by interviews with key players in the heavy haul rail industry to determine the net impact of mandated access.

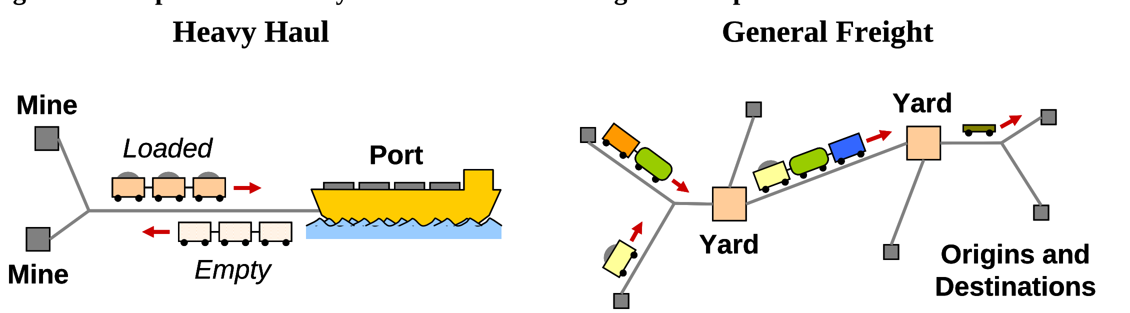
This primarily qualitative assessment is supplemented with a comparison of several key operating statistics such as axle loadings and tons per track across heavy haul railroads with and without access. While it is difficult to ensure an apples-to-apples comparison, the results provide a supplementary indication of performance.

The section below provides an overview of the heavy haul segment of the freight rail industry and details the unique challenges faced by these operations. The access regulatory framework under which different heavy haul railroads operate is described in the following section. The final section provides an assessment of the cost and benefits of open access for heavy haul lines, along with conclusions and lessons for policy makers.

THE HEAVY HAUL SEGMENT OF THE FREIGHT RAILROAD INDUSTRY

The majority of rail shipments move as "general freight" across networks of rail carriers. General freight is characterized by multiple commodities and car (wagon) types moving in a train from multiple origins to multiple destinations. In contrast to general freight, heavy haul shipments move in "unit trains" (i.e. an entire train with a single car type) carrying a single commodity moving generally uninterrupted from a single origin (e.g. a mine loadout) to a single destination (e.g. a port). Trains are typically loaded in only one direction, and return empty. Many heavy haul rail lines are operated in continuous loops where the train consist (locomotives and cars) operate as a single unit through the load-transport-unload-reposition-load cycle. An illustrative schematic of a heavy haul loop operation, in contrast to general freight, is provided in Figure 1.

Figure 1: Comparison of Heavy Haul and General Freight Rail Operations



Some railroads are almost exclusively heavy haul operators, such as the Duluth, Missabe and Iron Range Railway (DM&IR), located in Minnesota and Wisconsin in the United

States. Owned by the Canadian National Railway Company, this line moves approximately three quarters of the iron ore mined in the U.S. China's Daqin Railway is another example of a primarily heavy haul railroad, moving coal from the mines in Datong to the port of Qinhuangdao.

Heavy haul operations at other railroads are a subset of their business. For example at Union Pacific (UP), North America's largest freight railroad, heavy haul operations moving coal (including petroleum coke) accounted for 20 percent of freight revenues and approximately 45 percent of revenue ton-miles in 2007 (Union Pacific 2007).[1] UP's dominant heavy haul line is in the Powder River Basin (PRB) where the company originated nearly 190 million metric tons of coal in 2008 (Union Pacific 2008).[2] In this category of railroads, heavy haul is focused at the rail line level rather than company level.

Another important differentiation among heavy haul railroads is the number of origination and destination points served by the rail operator. The majority of large heavy haul railroads serve a small number of mines. However, the number of destination points can vary from one or two as in the case of the Australian iron ore railroads in the Pilbara and Hunter Valley to literally dozens of electric utility customers for coal originating in the Powder River Basin.

While a rail carrier's individual trains might have characteristics similar to those described above, a heavy haul railroad as defined by the International Heavy Haul Association (IHHA) must meet at least two of the following criteria, as cited on the association's website:

- "Regularly operates or is contemplating the operation of unit or combined trains of at least 5,000 [metric tons];
- Hauls or is contemplating the hauling of revenue freight of at least 20 million gross [metric tons] per year over a given line haul segment comprising at least 150 km in length;
- Regularly operates or is contemplating the operation of equipment with axle loadings of 25 [metric tons] or more."

Heavy haul lines have unique operating challenges compared to general freight lines. These issues range from maintaining intensively used infrastructure, to operating high density lines, to avoiding the substantial costs of system delays. The implications of these complexities are that heavy haul railroads must plan more comprehensively, invest more consistently, and operate more carefully than general freight operations. Specific challenges are described below.

The first challenge is the intensive use of the rail lines. For example, the Powder River Basin Line handles three to four times the average traffic density of the entire Union Pacific system (Union Pacific 2008). For many heavy haul rail lines, the high volume translates into operating at levels approaching practical capacity. The implication of this high level of activity is that operations must be flawless. Equipment must be ready for loading on time, loaded trains must depart on time, no equipment or infrastructure failures can take place, and trains must be unloaded on schedule at the destination. Small interruptions in any component of the heavy haul supply chain can significantly erode performance. For example, rail ballast fouled by water-logged coal dust in the Powder River Basin caused two derailments in May 2005, leading to significant costs, reduced capacity, and tension between the two rail operators (Frailey 2005). For several months following the accidents, UP was able to load only around 30 trains as opposed to its usual 36, with similar numbers for Burlington Northern Santa Fe (Frailey 2005).

Managing extensively-used heavy haul lines is made more difficult because many of the lines are single track operations. On a line that may be hundreds of kilometers long, meets and passes can only occur at a limited number of passing loops which allow loaded trains moving to the destination to pass empty trains headed back to the mines for reloading. Operating a single track railroad requires precision coordination of train movements since trains may be several kilometers long. The choreography of the loaded and empty trains on a single track requires skillful dispatchers to plan meets and passes and reliable equipment and infrastructure. The rugged terrain that many heavy haul lines must traverse makes the coordination of train movement even more challenging as the topography prohibits placing passing tracks at the optimal locations and where steep grades impose further operating constraints.

A second challenge is that the high tonnage moved on heavy haul lines increases the need for track maintenance. The life of most infrastructure components is a function of volume. Thus track maintenance such as cleaning ballast, replacing ties (sleepers), and grinding rail is required more frequently on heavy haul rail lines than on general freight lines. The challenge of high volume heavy haul lines is that capacity is so extensively used that scheduling time to complete the maintenance is difficult. Heavy haul railroads use two approaches to address the maintenance requirements. They invest in long-life materials such as head-hardened rail which requires less frequent re-profiling, or concrete ties which require less maintenance than wood products. Also, integrated planning between the mines, ports and railroads can ensure that maintenance is completed with the minimum loss of throughput.

The need for equipment reliability is comparable to that of infrastructure. First, railroads have a limited supply of cars and locomotives owing to the high capital cost of the rollingstock. Second, maintenance failures can be costly or even catastrophic. For example a single bad order car can delay an entire train. The inertia of heavy haul trains amplifies a small equipment failure into huge derailment often tearing up kilometers of track. Because of the weight and length of the heavy haul trains these operations benefit from advanced computer-aided train control since stopping distances are so great.

A final complexity is the need for a well-linked supply chain. Heavy haul railroads often connect two high fixed cost businesses – mines and ports/vessels. Moreover, the railroads themselves are capital-intensive. In such businesses, asset utilization is a key enabler for success. Close coordination between mines, ports and railroads prevents the loss of train paths due, for example, to loading delays at the mine or unloading delays at the port. The costs associated with a lack of coordination can be significant. For example, an unused slot in the Powder River Basin forgoes moving up to 13,600 metric tons with a market value of US$217,500 (at spot market prices).[3] Operators of heavy haul railroads suggest that asset utilization is maximized when there is “coordinated flexibly” – the railroad will speed or slow trains to accommodate mine and port operations as well as ship arrivals and sailings. High productivity is essential for profitability, since heavy haul commodities are moved at comparatively lower rates per ton-kilometer. In the U.S. for example, the average rates in 2000 (the latest available data) were 2.2 cents per metric ton-km for coal compared to 4.0 cents per metric ton-km for chemicals and 12.9 cents per metric ton-km for transportation equipment (Christensen 2008, Vol. 2 11-15).[4]

These operating challenges associated with heavy haul railroads lead to a bias for these railroads to (1) bundle infrastructure and train operations under single ownership and management; (2) align incentives with any other train operators; (3) coordinate all aspects of operations across the entire supply chain from mine to railroad to port.

ACCESS ON HEAVY HAUL RAILROADS

The term “access” in the context of rail freight operations is subject to a variety of definitions and interpretations. For the purposes of this assessment access is: the ability of a train operator to use the rail infrastructure of another party. Access can be either voluntary or mandatory. Voluntary access may result from a consensual agreement between the railway operators, and may take the form of track rights, haulage rights, or even joint ownership. Mandatory access can be achieved through regulations that require granting of track rights or haulage rights. In some cases, especially in the European Union, the access may take the form of operations not on the network of another railroad, but on a network managed by an independent infrastructure manager, reflecting an “unbundled” railroad industry structure where separate entities own and/or manage the above and below rail operations.

Different forms of access have been adopted around the world reflecting the various objectives that operators and policy makers are seeking to achieve.[5] In Australia, the design of access adopted in the 1995 National Competition Policy was aimed at achieving benefits from curtailing monopolistic behavior and promoting competition in the rail industry (Fagan 2007, 14-15). In the European Union, gradual introduction of greater access in both freight and passenger services, coupled with vertical unbundling of operations and infrastructure was seen as a means to improve declining rail share while decreasing state subsidies (Nash 2006, 26-28). For the European Union, supporting rail was important because it was believed to reduce congestion on the roads and promote an environmentally friendly mode of transportation (European Commission 2001, 27-34). In the United States, access tends to result from other goals. Where access is voluntary, it may reflect aligned interests between private railroad companies. Where it is compelled by the government, such as in the case of trackage rights granted as a condition to merger consent, access is motivated by the desire to protect shippers from monopolistic behavior (Wilner 1997).[6]

The dominant benefit sought through the introduction of access is greater competition in the provision of rail services, although the EU also cites the goal of increasing competition between modes. Ultimately, competition is not an end unto itself but a means to achieve other positive outcomes. The competition-based goals for heavy haul rail lines are the following:

- Efficiency – increasing productivity or reducing costs on a sustained, long term basis.
- Innovation – introducing new equipment, materials, and management processes that facilitate improved performance.
- Investment – bringing capital for equipment and infrastructure to keep pace with demand and where there is a solid return.
- Rates – reducing shippers' costs by lowering rates to reflect achievement of sustainable efficiency gains.

Policy makers understand that there is a price for access-generated competitive gains. First, the transaction costs associated with contracting for access must be considered. The legal and regulatory contracting costs incurred by rail operators, infrastructure owners and government regulators can be sizable. These costs are magnified in cases when a bundled railroad is required to unbundle (i.e. separate operations from infrastructure) replacing relationships within a firm with arms-length relationships between companies. In cases of conflict, litigation costs may be incurred. Furthermore, there may be a need for greater regulatory oversight, introducing significant costs and potential delays in new service offerings pending regulatory review. Uncertainty over regulatory outcomes can also stifle investments.

A second cost category is the expense that arises from incomplete contract costs (Gómez-Ibáñez 2003, 1-17, 84-88). The difficulty in writing a complete contract adds to the costs of access. The contract must not only provide the terms and conditions for access but also define on a practical basis how operations will be coordinated between the multiple service providers and the infrastructure operator. Activities such as signaling, timetabling, operations, maintenance, and investment must be coordinated. Anticipating all of the potential issues and incorporating them into the contract is both costly and extremely difficult. Failure to write a complete contract can also lead to costs associated with misaligned incentives. It may be complex to institute the right incentives for both the operators and the infrastructure provider as well as across operators. For example, there is a potential for a "maintenance externality" since the lack of track maintenance could impose a cost on above rail operators. The reverse could be true for operators that fail to maintain their rolling stock. Another externality can be created if one small operator opts to take actions which have a far greater impact on the dominant operator. For example, if the small operators fail to maintain their locomotives and a unit fails on a single track railroad, the costs of the delay to the large operator will likely be much greater than the small user. The incentives for investment in new infrastructure may also be different for different actors.

A third cost area results from the loss of operating economies of density to the extent that operators' traffic densities are reduced by increased competition. As traffic is spread out over more operators, each individual will be less able to achieve economies in use and maintenance of equipment and infrastructure. On one hand, railroad equipment is often expensive and production capacity is limited, which may create short-term bottlenecks. Shortage of experienced and skilled workers can also be a problem. On the other hand, there may also be duplication of equipment or facilities for multiple operators. Finally, coordination and cooperation between operators may be complicated by incompatibilities between equipment.

Viewed across geographies, policies for access to heavy haul railroads cover the spectrum from comprehensive to none at all. Some heavy haul lines are subjected to mandated open access regimes. This is true in Sweden and in Australia. In these cases, above and below rail operations are unbundled. Another access situation involves voluntary joint access. This applies to the Powder River basin in the U.S., where access by the two joint owner/operators was a result of a combination of aligned interests and regulatory decisions. The Powder River Basin joint rail line is managed as a bundled rail line with one carrier responsible for above and below rail operations. Both companies choose to cooperate in maximizing line capacity though coordinated planning since their financial incentives are well aligned. The largest category encompasses the heavy haul railroads with no access to other operators.

There are also important differences in the maturity of the mandated access regimes across countries. Sweden and Australia initiated open access in the late 1980s and mid 1990s respectively. The Brazilian concession regime was established in 1997. In North America, rulings mandating access are based on regulations that have evolved in content and interpretation over the last several decades. Access is still being designed in South Africa and is not present in China.

ASSESSMENT OF ACCESS ON HEAVY HAUL RAIL LINES

This section considers how well have the objectives of the access regimes have been achieved at heavy haul railroads. The differences in design of the access regimes and their maturity make co complicate an analytical assessment of the impact of access on heavy haul rail performance. In addition, most of the rail lines examined do not publish public performance reports, raising further obstacles to the achievement direct correspondence in comparisons. Consequently, assessment is based on the "weight of the evidence," quantified where possible, and otherwise qualitatively examined.

As discussed above, the core benefits and costs of access considered for assessment of heavy haul railroads are the following, adapted from Fagan 2007:

Table 1: Possible Benefits and Costs of Mandated Access (Fagan 2007; BITRE 2003)

Benefits of Competition	Costs of Coordination
• Efficiency • Innovation • Investment • Competitive Rates	• Contracting and ongoing administration • Incomplete contract resolution • Operating dis-economies

Heavy haul rail lines considered

Analysis centers on over a dozen heavy haul rail lines as summarized in Table 3. In North America, these include the Powder River Basin coal line, the Duluth, Missabe and Iron Range's iron ore lines, and the Monongahela Valley coal line. In addition, Brazil's EFC and EFVM iron ore railroads, Sweden's Malmbanan, South Africa's Transnet heavy haul lines (Orex and COALlink), and China's Daqin coal line are examined. In Australia, the lines analyzed include BHP Billiton's Mount Newman line, and Rio Tinto's iron ore lines (Robe River and Hammersley) in the Pilbara, as well as the Hunter Valley Coal Chain and Queensland Rail's Goonyella Supply Chain rail link in Australia's eastern coal region.

Table 2: Heavy haul rail lines around the world

Country	Railroad	Private or State-owned	Core Commodity	Route Length (km)	Track (as of 2008)	Millions metric ton, yearly (2007)
Australia	BHP Iron Ore Mt. Newman	Private	Iron ore	426	Single	106.3
Australia	Rio Pilbara	Private	Iron ore	1300	Single	220 (2009)
Australia	Hunter Valley	State-owned infrastructure	Coal		From single to triple	89.0
Australia	Goonyella	State-owned	Coal	734	Mostly double	82.0
Brazil	EFVM	Private (concession)	Iron ore	905	2/3 double, rest single	136.6
Brazil	EFC	Private (concession)	Iron ore	892	Single	100.4
China	Daqin	State-owned	Coal		Single	150.0 (2006)
South Africa	COALlink	State-owned	Coal	540	Double	74.1
South Africa	Orex	State-owned	Iron ore	861	Single	32.0
Sweden	Malmbanan	State-owned	Iron ore	536	Single	28.7
USA	Powder River Basin Joint Line (UP/BNSF joint ownership)	Private	Coal	204	Mostly triple, sections quad	326.0
USA	DM&IR (CN ownership)	Private	Iron ore		Single	
USA	Monongahela Line (NS ownership with CSX trackage)	Private	Coal		Double, sections of single	

These lines cover a broad spectrum of heavy haul operations. They include the primary heavy haul railroads in top iron ore producing countries, which include Brazil and Australia (U.S. Geological Survey, 2006). The heavy haul iron ore rail line in Sweden is one of the few unbundled heavy haul lines for which access is available to rail operators, although there is only one iron ore freight train operator. Although the Duluth, Missabe and Iron Range Railway in the U.S. is small in comparison to other ore railroads, it represents a bundled operation serving multiple unrelated mining companies. On the coal side, rail lines in all of the top coal producing countries are examined, including China, Australia, the United States and South Africa (BP Statistical Review of World Energy 2008).

Moreover, these railroads represent a spectrum of regulatory access regimes. As illustrated in Table 3, the Malmbanan line in Sweden and the Hunter Valley coal lines in Australia have mandated access. In these cases, above- and below-rail operations are unbundled with separate managers of above and below rail operations. The Powder River Basin line is managed by a single carrier but supports the above rail operations of two joint owners. The Brazilian EFVM and EFC, and the South African Orex and COALink, as well as the Pilbara railroads have no access. All of these have bundled above- and below-rail operations. However, all but the BHP and Rio Tinto railroads serve multiple customers; the BHP and Rio Tinto railroads only haul freight on behalf of their parent companies.

Table 3: Access conditions for heavy haul rail

	Characteristics	Mandated Open Access	Voluntary Joint Access	No access: single operator	Multiple haulage customers	Bundled	Heavy Haul Unit Trains Dominant	Integrated supply chain
Country	**Railroad**							
Australia	BHP Mount Newman & Goldsworthy			X		X	X	X
	Rio Tinto Pilbara			X		X	X	X
	Hunter Valley	X			X		X	**
	Goonyella (Queensland)			X	X	X	X	
Brazil	EFVM			X	X	X		X
	EFC			X	X	X		X
China	Daqin			X		X	X	
S. Africa	Orex			X	X	X	X	***
	COALlink			X	X	X	X	***
Sweden	Malmbanan	X			X			X
USA	PRB		X		X	X	X	
	Monongahela Line		X*		X	X	X	
	DM&IR			X	X	X	X	

* This case of joint access was government mandated; but access is not open to other parties
** Supply chain components are separately owned, but some degree of coordination occurs
**** Transnet, the operator of the Orex and COALlink lines, operates the terminal ports but not the originating mines

Table 3 also displays supply chain integration and traffic characteristics. Supply chain integration refers to railroads that operate as part of integrated supply chains encompassing mine, rail, and port operations. Integration of the supply chain enables improved coordination and generally leads to greater efficiency. It also may imply different operational priorities – for example, BHP operates its railroad to maximize tonnage through the supply chain, not necessarily based on cost considerations for the railroad alone.

On some lines, the vast majority of traffic consists of heavy haul unit trains and there is negligible general freight or passenger traffic. Combination of different types of traffic introduces scheduling challenges and operating constraints and generally reduces overall efficiency. The BHP and Rio Tinto railroads in Australia are the only railroads in the sample which are bundled, only have heavy haul unit train traffic, and are part of integrated supply chains. This implies the highest possible level of coordination.

Assessment of benefits

The adoption of access for the heavy haul railroads studied has led to a limited set of benefits. As described in greater detail below, efficiency improvements on heavy haul railroads appear similar on those with and without access. The same is generally true for innovation and investment. The one benefit that has been achieved as a result of access is lower rates. However, there is little evidence that the reductions are sustainable through improved efficiency/productivity. Rather the rates declines appear to be a bid to buy market share and thus only a wealth transfer between companies.

Efficiency: Improvements in heavy haul rail efficiency have taken place on rail lines with and without access as railroads have added infrastructure and upgraded equipment. For example, in the Powder River Basin between 1985 and 2005, originated tonnage grew from 17.24 million metric tons to 295 million metric tons (Union Pacific 2006).[7] This growth was largely a result of capacity expansion. This was also a period of productivity improvement in American railroading, with freight revenue ton-miles per employee-hour on all U.S. Class I's increasing from 1,196 in 1985 to 4,182 in 2007 (AAR 2008, 41).

It should be noted that some of the most impressive achievements in operating efficiency have been achieved on lines with no access. This is the case of the highly integrated iron ore rail lines in the northwestern Australian region of the Pilbara where mining companies BHP Billiton and Rio Tinto operate their own rail networks. For example, the Pilbara railroads have trains with the highest axle loads, demonstrating excellent equipment utilization as well as the high underlying quality of the track infrastructure.[8] In addition, these railroads report high volumes of annual tons moved per railroad track.[9] These Pilbara railroads efficiently employ locomotive power by using a low number of locomotives per million tons.[10] Finally, they run their trains, which are often over three kilometers long, with only one driver, achieving considerable labor savings. These metrics, where publicly available, are displayed in Table 4, above. Although many other factors affect these metrics, and lines with access such as the Malmbanan perform very well in some categories, these numbers suggest that efficiency may not increase in cases of access, and that stronger incentives may exist in cases of integration.

Table 4: Heavy haul railroad performance metrics

Country	Rail line	Axle load, metric tons	Million metric tons per track, yearly	Locomotives per million metric tons, yearly
Australia	BHP Iron Ore Mt. Newman	37.5	89	1.07
Australia	Rio Pilbara	32.5	81.5	0.61
Australia	Hunter Valley	30	N/A	1.35
Australia	Goonyella	26	N/A	1.66
Brazil	EFVM	25	79	2.54
Brazil	EFC	31.5	84	1.82
China	Daqin	25	75	N/A
South Africa	COALlink	26	24	4.18
South Africa	Orex	30	27	3.97
Sweden	Malmbanan	30	23	0.63
USA	PRB Joint Line	32	105	N/A

Innovation: The degree of innovation introduced on heavy haul operations bears little relationship with whether the rail line has access or not. For example, BHP has installed Positive Train Control (PTC), a system designed to override engineer control of trains in order to prevent overspeeds and movement through stop signals. In the Powder River Basin, PTC will be implemented by 2015 as a result of legislation enacted by the United States Congress. In general, access does not seem to generate use of innovative technologies, whose implementation is instead based on other factors.

Capital investment: The amount of capital investment follows the same pattern as innovation: both heavy haul rail lines with and without access have strong patterns of investment based on the need to upgrade capacity and increase efficiency. Among lines with access, a large capital investment program is underway on the Malmbanan in Sweden as part of an approximately US$700m investment upgrade of mining operations (LKAB Annual Report 2007).[11] The Powder River Basin, with joint access, has seen heavy capital investment amounting to approximately US$340m between 2000 and 2008 as additional track has been built (Van Hattem 2008). In Brazil, EFC and EFVM invested hundreds of millions of dollars between 2007 and 2010 in order to expand capacity and upgrade equipment (Gevert 2008). In the Pilbara in Australia, mining companies have invested heavily in their rail infrastructure.[12] For example, Rio Tinto has stated an investment of $8.6 billion between 2000 and 2008 (Mineprocessing 2009). Thus, the degree of access has little or no bearing on investment in improving rail infrastructure and operations, which is instead more directly related to capacity needs.

Rates: The one area where access has generated benefits is in lowering rates. Rate reductions generate welfare gains if they are accompanied by efficiency generated cost reductions; otherwise the rate reductions are merely a wealth transfer from the railroad to the shipper. In eastern Australia, reports indicate that coal shippers experienced rate reductions of up to 20 percent as a result of competition upon introduction of mandated access (Productivity Commission 2005). Mining company Xstrata recently introduced further competition by contracting with British carrier Freightliner to operate a new service on its behalf; this may push rates even lower (Chambers 2009). However to date there is no evidence that rate reductions resulting from increased competition have been accompanied by complementary cost reductions. In the United States, rail rates for coal originating in the Powder River Basin declined for many years as the railroads shared their efficiency gains with the mine companies. However, since 2004 coal rates have been increasing (Christensen 2008, Vol. 2 12-3). The rate increases have taken place despite the railroads actually improving their productivity. The fall and subsequent rise in Powder River Basin coal rates appear to be a function of demand and supply for coal rather than access since the access regime has been constant throughout this period.

Assessment of costs

Contracting process: Examination of heavy haul lines around the world reveals strong evidence that there are significant costs of coordination. First, there is the contracting process itself. In Australia, Pacific National (PN) intermodal service over Queensland Rail (QR)-owned track from Cairns to Brisbane took over 18 months to negotiate (Fagan 2007, 17). In this case, a PN representative indicated that the only reason the customer waited for the service was that the shipper was an affiliate of PN; otherwise the drawn-out contracting process would have discouraged the shipper from using this service. The difficulty of achieving a contract between QR and PN reflects the challenge in aligning contrasting interests.

Incomplete contract resolution: A second set of coordination costs are associated with the difficulty of writing a compete contract. While the contract is agreed by the participating parties, it is often challenging to specify terms that align incentives and that maintain appropriate behavior in the future as circumstantiates change. Gómez-Ibáñez describes the consequences of incomplete contracts in Argentine rail concessions in the 1990s (Gómez-Ibáñez 2003, 84-108). When traffic conditions did not meet projections, pressures mounted for renegotiation of contracts. This led to greater transaction costs and regulatory uncertainty, which in turn affected operators' ability to efficiently provide train services.

Operating dis-economies: Finally, there are costs because access reduces the operating efficiency of the line. In the Powder River Basin, the presence of two operators necessitated construction of multiple staging yards. For example, Burlington Northern Santa Fe (BNSF) lacked room to store trains, meaning that it had to stage trains from long distances and risk losing slots to the Union Pacific if no BNSF trains were ready to load. BSNF therefore built a staging yard at Donkey Creek in 2006 in order to gain operating flexibility.[13] Similarly, the introduction of access in the Monongahela Valley with Norfolk Southern and CSX required additional staging capacity. Until this capacity was completed and operations were operations were coordinated, loadings dropped from approximately 24 trains per day to approximately 15 trains per day.[14] In general, an operator who is a new entrant on a particular line lacks staging yards, inspection facilities, locomotive maintenance facilities, storage capacity, and experience in network coordination.

CONCLUSIONS

Lack of consistent and comprehensive data for the heavy haul railroads prevents an analytical weighing of the benefits and costs of access. However, the evidence presented suggests that under the most favorable light, access benefits and coordination costs offset each other. It is not unreasonable to expect that the costs of coordination likely exceed that benefits that have realized from access on the heavy haul rail lines. Indeed, the highly integrated Australian Pilbara railroads exhibit industry leading performance in several key measures. Eastern Australian railroads with mandated access have instead experienced significant challenges from conflict between actors with differing interests. The Powder River Basin Joint Line in the United States, owned and operated in tandem by two railroads, also demonstrates the importance of closely aligned incentives. Because the unique challenges of heavy haul railroading lead to a bias for bundled above and below rail operations as well as integrated supply chains, further regulatory action towards mandated access should be approached with caution.

REFERENCES

Association of American Railroads. 2008. *Railroad Facts*. AAR Policy and Economics Department. Washington D.C.

Australian Department of Infrastructure, Transport, Regional Development and Local Government: Bureau of Infrastructure, Transport and Regional Economics (BITRE). 2003. *Rail Infrastructure Pricing: Principles and Practice*, http://www.bitre.gov.au/publications/61/Files/btre_r109.pdf

Chambers, Matt. 2009. Xstrata trains shunt Asciano. *The Australian*, September 25, Business News.

European Commission. 2001. *European Transport Policy for 2010: Time to Decide. White Paper*, http://ec.europa.eu/transport/white_paper/documents/doc/lb_texte_complet_en.pdf.

Fagan, Mark. 2007. Introducing Competition into Natural Monopoly Industries: An Evaluation of Mandated Access to Australian Freight Railroads. *Mossavar-Rahmani Center for Business and Government Regulatory Policy Program Working Paper*, RPP-2007-05.

Frailey, Fred W. 2005. Powder River 'blowout' sends BNSF, UP reeling." *Trains,* September.

Gevert, Theodor. 2008. Commodities boom fuels railfreight renaissance. *International Railway Journal.* November.

Gómez-Ibáñez, José A. 2003. *Regulating Infrastructure: Monopoly, Contracts, and Discretion*. Cambridge, MA: Harvard University Press .

Kain, Peter. 2003. "Rail Infrastructure Pricing" Seminar presentation, October 22 2003.

Laurits R. Christensen Associates. 2008. A Study of Competition in the U.S. Freight Railroad Industry and Analysis of Proposals that Might Enhance Competition: Final Report, Vol. 1-3. Prepared for U.S. Surface Transportation Board. http://www.stb.dot.gov/stb/elibrary/CompetitionStudy.html

LKAB. 2007. Annual Report 2007. http://lkab.com/?openform&id=4412

Mineprocessing. 2009. "Foreign investment key to the Pilbara." April 3, http://www.mineprocessing.com/News/detail-a1019-b-c9-d0-e0-f.html

Nash, Chris. 2006. Europe: Alternative Models for restructuring. In *Competition in the Railway Industry*, ed. José Gómez-Ibáñez and Ginés de Rus, 25-47. Cheltenham, UK: Edward Elgar.

Peltier, Robert. 2007. Electric Power 2007: Where the Gencos Meet: PRB Coal Users' Group grapples with supply chain challenges. *Power*, June. http://findarticles.com/p/articles/mi_qa5392/is_/ai_n21290688

Productivity Commission. 2005. *Review of National Competition Policy Reforms*.

Union Pacific Corporation. 2006. News Release: UP, BNSF Announce Southern Powder River Basin Joint Line $100 Million Capacity Expansion Plan. May 8. http://www.uprr.com/newsinfo/releases/capital_investment/2006/0508_sprb.shtml

Union Pacific Corporation. 2007. 10-K Annual Report 2007. http://www.up.com/investors/attachments/annuals/2007/annual_report.pdf

Union Pacific Corporation. 2008. Business Group Overview: Energy. http://www.uprr.com/newsinfo/attachments/media_kit/business_groups/energy.pdf

U.S. Energy Information Administration. 2008. Coal News and Markets report. http://www.eia.doe.gov/cneaf/coal/page/coalnews/coalmar.html

Van Hattem, Matt. 2008. Wyoming coal line expansion. *Trains*. November.

Wilner, Frank N. 1997. *Railroad Mergers: History, Analysis, Insight*. Omaha: Simmons-Boardman.

Winston, C., Corsi, T.M., Grimm, C.M., Evans, C.A.1990. The Economic Effects of Surface Freight Deregulation. Washington, DC: The Brookings Institution.

Notes

[1] UP cites approximately 251 billion coal revenue ton-miles out of 561 billion total.

[2] UP cites 204.6 million short tons for 2008, equivalent to 185.6 million metric tons.

[3] 15,000 tons per train estimate from Peltier 2007; market value based on $14.50 per short ton (spot price) for 8,800 BTU Powder River Basin coal with 0.8 SO2, on Nov. 28, 2008, from U.S. Energy Information Administration 2008.

[4] Figures given in cents per short ton-mile, and then converted to cents per metric ton-kilometer.

[5] See for example BITRE 2003 Chapters 1 and 5 for a description of different policy objectives sought through access and their applicability to the Australian context.

[6] See for example pp. 299-300 for granting of trackage rights in 1996 BN-Santa Fe merger, and pp. 308-309 for trackage rights in 1996 Union Pacific-Southern Pacific merger.

[7] 19 million and 325 million US tons respectively.

[8] Axle load is measured as the weight of a freight car's load divided by the number of axles. High quality track is needed to withstand the stress of heavy axle loads, so railroads with high axle loading have invested heavily in engineering, track materials, and rolling stock.

[9] A high tons per track figure demonstrates an efficient use of existing infrastructure without over-investment. For this calculation, double track is defined as 2.0 tracks. Single track is defined as 1.2 tracks to account for passing loops. A line that was 50 percent single track and 50 percent double track would be defined as 1.6 track, which is the result of (½*1.2)+(½*2).

[10] Calculated as the size of the railroad's locomotive fleet divided by the annual tons railed. Note that this metric may be skewed by the type of locomotives employed if they are of different horsepower, and by power requirements depending on terrain.

[11] SEK 5,858m at 1 SEK = 0.1199 USD.

[12] Mine operators in this region with private rail networks include BHP Billiton, Rio Tinto, and Fortescue Metals Group. Fortescue is involved in a legal dispute with BHP and Rio Tinto over access to their respective rail networks; however it has also built its own rail line for transportation of iron ore.

[13] Interview with former rail industry executive.

[14] Interview with former rail industry executive.