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An empirical test of modal choice and allocative efficiency: Evidence from US coal transportation

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ABSTRACT

A generalized shipper transportation cost function is estimated to test whether coal shippers achieve allocative efficiency with respect to market prices when facing limited access to the full range of transportation services. Findings indicate that allocative efficiency with respect to market prices is achieved when shippers have access to all major transportation modes. In contrast, the condition for allocative efficiency is not met with respect to market prices when shippers' modal choices are limited to trucking and rail services. Findings for the sample of shippers who face limited shipping choices is interpreted as suggesting an over-use of trucks relative to the use of trains due to price distortions of transportation services.

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1. Introduction

Pro-competitive policies enacted over three decades ago in the transportation industry were passed in part with the intent of creating a more efficient transportation system. Past research presents compelling evidence of non-trivial productivity gains and cost reductions in rail and trucking transportation services.² Shippers have benefited from cost savings associated with enhanced transportation efficiency. For instance, Winston (1998) shows average shipping rates per ton-mile fell from 35% to 75% in trucking and by more than 50% for rail transportation services two decades after the implementation of pro-competitive policies. Coal shippers are a prime example of transportation services users who have benefited from enhanced efficiency and decreasing transportation operating cost. Real average coal transportation rates from 1979 to 1999 fell 29.48% and 33.33%, respectively for rail and trucking services (EIA, 2004).³ While extensive research has examined efficiency gains in the business operations of different sectors of the transportation services industry much less attention has focused on whether

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² See Winston (1998) for a review of some of the more recent studies on pro-competitive policies and transportation efficiency. He reports average real operating cost reductions from 35% to 75% in the trucking industry due partly to the reduction of empty loads per mile. He also reports a 60% reduction in operating cost for rail carriers due partly to the abandonment of one-third of their track miles since the enactment of pro-competitive policies in the mid-1970s and early 1980s. For the most part, research on post-deregulation rates and productivity growth in the trucking and rail transportation sectors are consistent with Winston's findings. For instance, Moore (1986) and Ying and Keeler (1991) find a non-trivial reduction of shipping rates and Ying (1990) finds an appreciable post-deregulation increase in trucking transportation productivity growth. Research on rail rates and performance indicates post-deregulation rate declines and productivity growth increases as Barnekov and Kleit (1990) and MacDonald and Cavalluzzo (1992) report rate declines ranging from 16.5% to 24%. Bitzan and Keeler (2003), Oum et al. (1999), Bereskin (2001), and Wilson (1997) reveal a substantial reduction of rail rates following deregulation.

³ Barge services present another major source of transportation for coal. Their services, however, were never substantially regulated and only provided a 6.23% rate decline for the transportation of coal for the 1979–2001 period of observation.

shippers consider market prices as an appropriate rate to use to attain an allocatively efficient mix of transportation services following the enactment of pro-competitive policies in the transportation services industry. The significance of presenting such an investigation is highlighted by noting that past research reveals that pricing behavior by carriers contributed to a misallocation of transportation services prior to the policy shift promoting inter- and intra-modal competition (Friedlaender, 1969; Martin, 1979).

This study addresses the dearth of research on shipping allocative efficiency during the current competitive business environment in the transportation industry by examining the use of different transportation modes for the delivery of coal in the US. Examining coal shippers' choice of transportation services contributes to our understanding of the costs associated with providing an energy resource that is critical to the operations of US industries. Evidence of this commodity's economic significance is depicted by the large proportion of coal production used to generate the electricity that powers machinery and equipment of many US industries.⁴ This study estimates the coal industry's transportation cost function to test whether shippers consider market prices as viable indicators of transportation costs when making decision on the efficient combination of rail, trucking, and barge services needed to transport coal.⁵ Special consideration is given to the possibility that infrastructure and capacity constraints create a business environment that allows carriers to set prices that do not account for the high opportunity cost associated with relatively poor service quality.

2. Accessibility, capacity constraints, and the choice of transportation modes

Bulk commodity shippers rely heavily on the transportation services of rail, barge, and trucking.⁶ Differences in economies of shipment size and economies of distance influence shippers' choice of transportation mode for hauling bulk commodities such as coal. Rail and barge carriers are able to take advantage of economies of shipment size, in part because of the large hauling capacity of these modes of transportation and the high fixed costs required to purchase large shipping vehicles for these types of operations.⁷ In addition, rail and barge carriers are able to lower per unit costs of hauling large loads because they are able to haul large volumes of freight without proportionately increasing crew sizes. In contrast, trucking carriers have an inherent cost advantage hauling relatively small shipments over short distances due in part to lower fixed costs compared to rail and barge.⁸ Economies of shipment size and distance are more difficult to attain for trucking transportation because of the need to employ at least a proportional number of drivers and motor vehicles for 80,000 lb increases in freight.⁹ Given these attributes rail and barge carriers are generally better suited for providing service for long-haul shipments, whereas trucking contracts are generally better suited for providing short-haul feeder service.

In addition to the attributes inherent to different transportation modes, carrier pricing behavior also influences shippers' use of rail, barge, and trucking services. For instance, past research argues that prior to the enactment of pro-competitive policies rail prices did not reflect the full cost of transportation when rail carriers were the sole long-distance service provider (Friedlaender, 1969; Harbeson, 1969; Moore, 1975; Peck, 1965; Martin, 1979).¹⁰ These authors report that relatively high rail prices did not discount the cost of low quality service. Research on relative service quality across transportation modes suggests that compared to rail, trucking provides faster and more reliable transit times (Winston, 2005).¹¹ Rail pricing that did not take into account inter-modal differences in service quality contributed to a less desirable allocation of transportation resources by bulk shippers because shippers based modal choices on the opportunity cost of the service rather than on the market price. Hence, while the attributes of rail service suggest that it is better suited for hauling bulk commodities over long distances, shippers have an incentive to consider trucks if rail prices do not accurately depict the value of the transportation service. Friedlaender reports that the primary source of the less desirable allocation of transportation services was the shifting of bulk traffic away from rail to trucks.

Pro-competitive policies targeting freight transportation in the late 1970s and early 1980s had the potential to change shippers' usage of transportation services by promoting rate declines for such services. Coal shipping is a prime example of the influence of pro-competitive transportation policies on freight pricing and transportation resource allocation. Shipping rates for coal hauled by rail fell in real 2000 dollars from \$14.45 to \$10.19 per ton from 1979 to 1999.¹² Rates fell slightly more for truck hauling services as the real price declined from \$9.00 to \$6.00 per ton for the same period. Much smaller rate

⁴ Eighty-eight percent of coal production in 1998 was used to produce electricity as compared to only 42% in 1960s (EIA, 2000; Elmes and Harris, 1996).

⁵ The utility industry's total transportation costs are examined in this study to account for the shipping rate in addition to service-induced costs.

⁶ Coal shippers rely much less on the transportation services of collier, pipeline, and conveyer.

⁷ The purchase of track and locomotives depicts substantial fixed cost for rail carriers. The purchase cost of barges contributes to the significant fixed cost for this form of water transportation.

⁸ Resor et al. (2004) observe that relatively high terminal and drayage costs contribute to rail's disadvantage relative to trucking service for short hauls. These authors also find that rail has a competitive advantage at distances of greater than 500 miles.

⁹ The comparatively limited capacity of trucks generally restricts the advantageous utilization of trucks to short-haul deliveries of bulk commodities of typically less than 50 miles (Andersen, 1981). Most states adhere to the 80,000 lb weight limit for trucks. However, tractors with two or more trailers having gross vehicle weight of more than 80,000 lb are limited to certain highways in 21, mostly western states (Association of American Railroads, 2008).

¹⁰ These authors observe that rail carriers' practice of setting rates based in part on "value-of-service" amounted to rates that were set at levels which reflect conditions of demand for services rather than for the cost of providing these services.

¹¹ Winston (2005) also reports that following deregulation, rail greatly improved its service, partly through end-to-end mergers. In a separate study he estimates that the annual benefits to shippers due to service quality improvements amount to \$5 billion annually in 1990 dollars (Winston et al., 1990).

¹² Domestic coal shipping rates are taken from the Energy Information Administration's Coal Transportation Rate Database, 2004.

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