Regulation in a 'Deregulated' Industry: Railroads in the Post-Staggers Era

by

John W. Mayo* and David E. M. Sappington**

Abstract

The Staggers Rail Act of 1980 is widely perceived to have deregulated the U.S. freight rail industry. Yet substantial rail traffic remains potentially subject to regulatory rate intervention, and in the Post-Staggers era regulators have developed a detailed and expanding regulatory framework for rail shipments. This regulatory framework embodies elements of traditional public utility regulation, including fully distributed costing and, prospectively, earnings regulation. We document the development of the current regulatory framework and provide a cautionary appraisal of potential future industry regulation.

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* Georgetown University.

** University of Florida.

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1 Introduction

Thirty-five years have passed since the Staggers Rail Act of 1980 was enacted.[1] During this time, many scholars have examined the economic consequences of the deregulatory measures embedded in the Act.[2] This focus is natural because since the day of its signing, the Staggers Act has been characterized as "The Railroad Deregulation Act."[3]

The Staggers Act, however, did not completely eliminate regulatory oversight of the rail industry. The legislation retained a variety of regulatory controls and a regulatory body to oversee enforcement of the controls. The set of regulatory controls has evolved and expanded over time. To illustrate, in assessing whether the prices set by rail carriers are reasonable, regulators initially focused principally on whether the price of a shipment was below the stand-alone cost of providing the shipment.[4] More recently, though, the prospect for a substantial expansion of regulatory intervention in the rail industry has emerged.[5] Originally embedded in the pre-Staggers Railroad Revitalization and Regulatory Reform Act of 1976 and carried forward into the Staggers Act is a call for regulators to ensure that rail revenues are "adequate."[6] Based on a review of the legislative history of this language, it has been argued that this revenue adequacy language reflected a Congressional concern that the regulatory framework not *restrain* railroads from earning adequate revenues.[7] Nonetheless, in 1985 regulators began to interpret this language as a potential basis for a regulatory con-

[1]Staggers Rail Act of 1980, Public Law 96-448, 94 Stat. 1895, codified as amended at 49 U.S.C. §10101.

[2]For a list of the principal articles on the economic consequences of dergulation, see http://cbpp.georgetown.edu/railroads/regulation-deregulation.

[3]See, for instance, President Carter's speech when signing the bill into law (https://www.google.com/search?q=president+carter+signing+the+staggers+rail+act&ie=utf-8&oe=utf-8#q=president+carter+signing +the+staggers+rail+act&tbm=vid).

[4]The stand-alone cost of a shipment (or group of shipments) is the cost of providing only the shipment in question, without supplying any other shipments. See United States. Interstate Commerce Commission. Section of Energy and Environment. (1985). *Ex Parte No. 347 (Sub-No.1) Coal Rate Guidelines, Nationwide.* Washington, D.C.: Interstate Commerce Commission. [Hereafter Coal Rate Guidelines (1985)].

[5]Coal Rate Guidelines (1985).

[6]Railroad Revitalization and Regulatory Reform Act of 1976, Public Law 94-210, 90 Stat. 31, codified as amended at 45 U.S.C. §801.

[7]Macher et al. (2015).

straint on earnings. In particular, after defining "adequate revenues" for a railroad to be those that would reflect the industry's cost of capital, the ICC stated that "[o]ur revenue adequacy standard represents a reasonable level of profitability for a healthy carrier ... Carriers do not need any greater revenues than this standard permits, and we believe that, in a regulated setting, they are not entitled to any higher revenues."[8] This belief creates the potential for additional "revenue adequacy regulation" to reduce the rates that rail carriers are permitted to charge below levels that reflect stand-alone costs.

Against this backdrop, important questions arise regarding the economic consequences of the evolution of post-Staggers rail regulation. For instance, has the evolution of regulatory oversight been consistent with lessons from economic principles? How might the prospective application of regulatory controls that are more squarely centered on "revenue adequacy" affect resource allocation in the industry? And, how might such regulation act to enhance or diminish incentives for innovation, cost reduction, and investment? This paper seeks to address these questions.

Section 2 describes the pricing constraints that have been imposed in the rail industry since the passage of the Staggers Act, in the absence of explicit revenue adequacy regulation.[9] The discussion in Section 2 emphasizes the fact that only a portion of the rates a rail carrier sets are subject to regulatory oversight. Section 3 reviews the key conclusions drawn in two related strands of the literature on regulatory economics: the literature that analyzes the partial regulation of multiproduct firms and the literature that assesses the merits and effects of earnings regulation. Section 4 develops a stylized framework for assessing the economic implications of the introduction of explicit revenue adequacy regulation. Although this simple framework does not capture all relevant impacts of such regulation, the framework allows us to analyze several potentially concerning manifestations of the regulation. Section 5 discusses the implications of our analysis and identifies important questions that remain

[8]Coal Rate Guidelines (1985, p. 12).

[9]We review key pricing regulation. Beard et al. (2015) and Boyer (2015) discuss access regulation in the rail industry.

to be addressed.

The ensuing discussion emphasizes that although the Staggers Act relegates much of the determination of price and freight rail service quality to market forces, regulators in the ensuing years have developed a detailed and expanding regulatory framework for rail shipments. This regulatory framework embodies elements of traditional public utility regulation, including fully distributed costing and, prospectively, earnings regulation. Neither economic theory nor empirical analysis of these regulatory regimes suggests that such regulation will foster economic efficiency. Consequently, it is important to be sure that the likely benefits of any contemplated expansion of the regulatory constraints outweigh the associated costs before any expansion is undertaken. The well-documented successes achieved in the post-Staggers era freight rail industry suggest that it may be exceedingly difficult, if not impossible, to design expanded regulation that will deliver benefits in excess of the corresponding costs.

2 Rail Regulation in the Post-Staggers Era

2.1 Cost Allocation and Price Ceilings

Regulation of the U.S. freight rail industry began in 1887 with the passage of the Interstate Commerce Act.[10] For nearly the next one hundred years, rail rates were comprehensively regulated.[11] However, in response to substantially deteriorating economic and physical conditions in the rail industry in the 1970s and a sense that overly-intrusive regulation was a principal cause of this deterioration, policymakers enacted the Staggers Rail Act in 1980.[12]

The Staggers Act fundamentally altered the governance structure of the rail industry,

[10] Interstate Commerce Act of 1887, Ch. 104, 24 Stat. 379. Gilligan et al. (1989) discuss the economic and political origins of the Interstate Commerce Act.

[11] See Gallamore and Meyer (2014) for a detailed discussion.

[12] When signing the Act, President Carter observed "By stripping away needless and costly regulation in favor of marketplace forces wherever possible, this act will help assure a strong and healthy future for our Nation's railroads and the men and women who work for them. It will benefit shippers throughout the country by encouraging railroads to improve their equipment and better tailor their service to shipper needs. America's consumers will benefit, for rather than face the prospect of continuing deterioration of rail freight service, consumers can be assured of improved railroads delivering their goods with dispatch." Available at http://www.presidency.ucsb.edu/ws/?pid=45284.

shifting from a highly granular model of regulation to one in which market participants, rather than regulators and rate bureaus, assumed much of the responsibility for establishing industry prices and investments. Instead of ubiquitous rate-setting by regulators, shippers were authorized to challenge rates set by railroads under specified circumstances.

The Staggers Act led to substantial improvements on many fronts in the rail industry.[13] Rail carriers introduced new services and new pricing structures.[14] The implementation of new technologies and new production methods also was accelerated.[15] Substantial cost reductions and productivity gains were realized in the industry.[16]

The Staggers Act exempts from regulation rates that are established in privately negotiated contracts between railroads and shippers.[17,18] The Act also exempts rail traffic whose revenues (R) are less than 180 percent of the variable cost (VC) associated with that traffic ($R/VC < 180\%$). However, rail traffic traveling at rates above this level ($R/VC > 180\%$) is considered to be "potentially captive" and under the jurisdiction of regulators, who are obliged to ensure that these rates are reasonable.[19] Figure 1 reports the rail traffic that has traveled at prices above and below the 180% R/VC threshold in recent years. Between 2002 and 2013, thirty to forty percent of all U.S. freight rail traffic fell into the ($R/VC >$

[13]The U.S. Senate Committee report on the legislation sunsetting the ICC in 1995 (and replacing it with the Surface Transportation Board) notes that "The Staggers Act is considered the most successful rail transportation legislation ever produced, resulting in the restoration of financial health to the rail industry" U.S. Senate (1995). See also Winston (2005) and Gallamore and Meyer (2014).

[14]For example, in the wake of Staggers, rail carriers were able to set rates that significantly accelerated the growth of piggybacking, wherein truck trailers are transported on flatbed rail cars.

[15]A prime example was the rapid post-Staggers replacement of cabooses with more efficient "end-of-train markers." Similarly, mechanized track gangs replaced more labor intensive locally-based track maintenance methods.

[16]Wilson (1997) estimates that costs were "up to 40 percent lower than they would have been under regulation." The productivity gains achieved in the rail industry substantially exceeded the corresponding gains achieved in other transportation industries (including trucking, which also was deregulated in 1980) and in the broader economy. See McFarland (1989) and Eakin and Schoech (2010), for example.

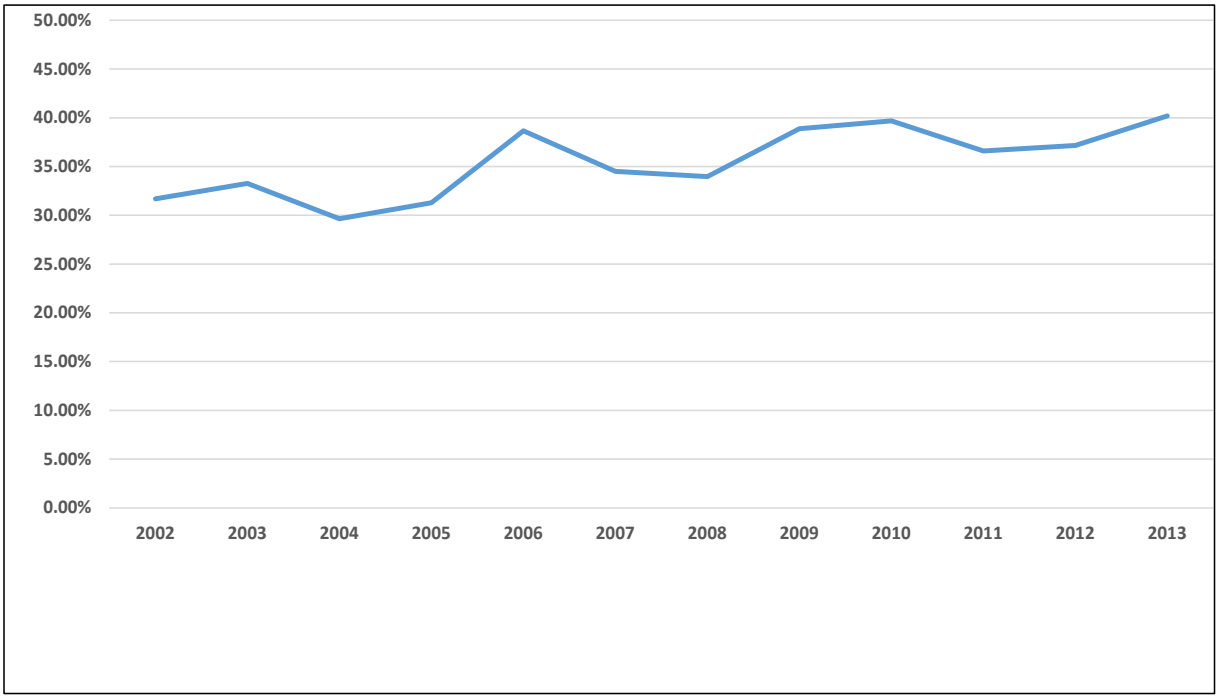
[17]49 U.S.C. §10709(c).

[18]Although the Staggers Act substantially reduced regulatory control, some rail services were exempted from rate regulation even before the Act was passed. To illustrate, in light of significant intermodal competition for their transport, farm products (excluding grain, soybeans, and sunflower seeds) were exempted as early as 1979. The ICC also exempted intermodal shipments and boxcar traffic (which typically admits significant intermodal competition) from regulation in the immediate wake of Staggers.

[19]49 U.S.C. §10707(a).

180%) category. After eliminating traffic in this category that is explicitly exempted because of relevant product or transport mode characteristics, as much as 27 percent of rail traffic remains potentially subject to rate regulation.[20]

Figure 1. Share of Freight Rail Shipments with R/VC > 180%



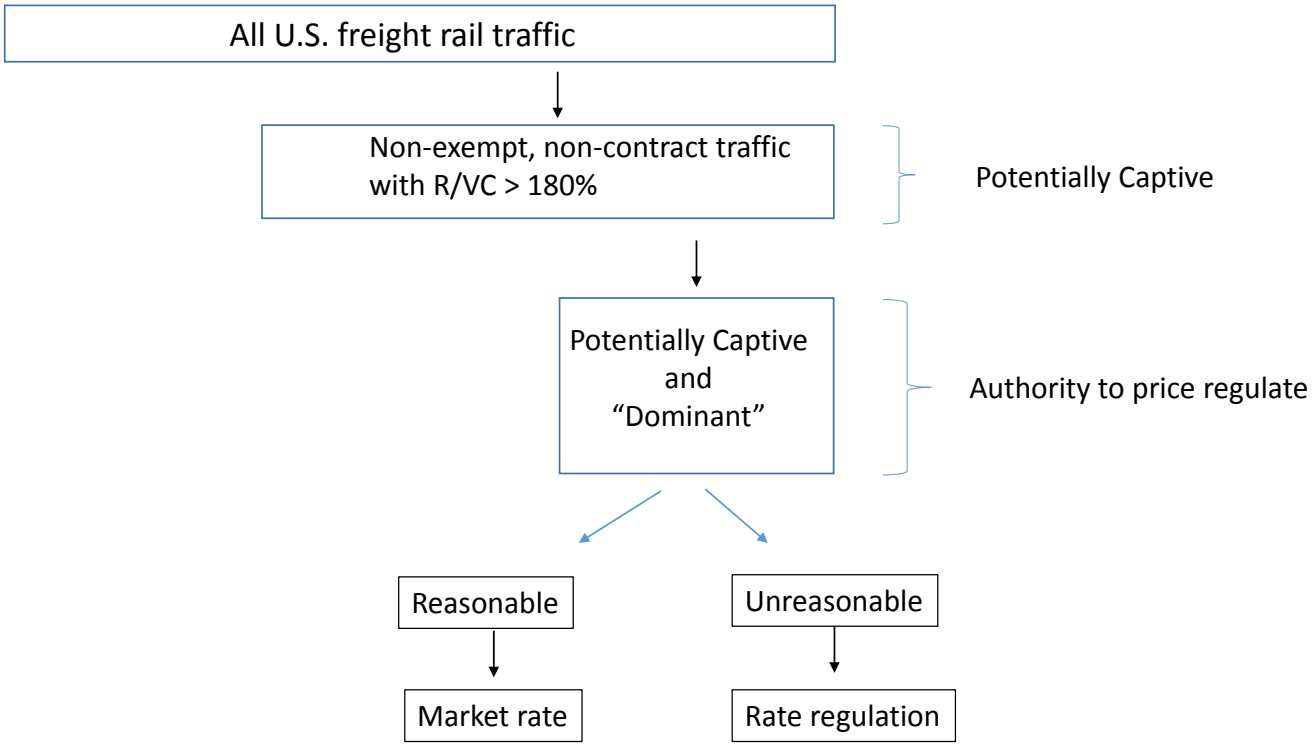
Source. Surface Transportation Board.

Some of this potentially captive traffic may be subject to effective competition from other rail carriers or other modes of transportation. If the regulator determines that such effective competition prevails, then prices are permitted to move freely, unconstrained by regulation. Alternatively, if such traffic is found to lack effective competition, then regulators must determine whether the proposed prices for the traffic are reasonable.

[20]This 27 percent figure is an upper bound because revenue data on contract traffic, which is exempt by statute, is generally confidential and therefore unpublished.

Figure 2 provides a schematic overview of the Post-Staggers rate rail regulation process. The figure illustrates the fact that rail services are not comprehensively regulated. Rather, a set of non-exempt and non-contract traffic with ($R/VC > 180\%$) are deemed to be "potentially captive." Within this set of potentially captive shipments, the authority to regulate prices is limited to traffic for which there is a lack of effective competition (i.e., for which market dominance prevails) and where the railroad is also determined to be charging unreasonable rates.[21]

Figure 2. U.S. Freight Rate Regulation in the Post-Staggers Era



[21] The inquiry into whether a given set of rail movements is subject to effective competition or, alternatively, is subject to market dominance occurs in two steps. First, it is determined whether the rates of the target traffic exceed the (R/VC > 180) threshold. If not, the traffic is judged to be subject to effective competition. If so, the STB undertakes a "qualitative analysis" of whether there are "feasible transportation alternatives that are sufficient to constrain the railroad's rates to competitive levels." (See, e.g., *M&G Polymers USA, LLC v. CSX Transport, Inc.,* Surface Transportation Board, September 27, 2012, updated - December 7, 2012, p. 2.) For this set of traffic, regulators then determine whether the challenged rates are reasonable or unreasonable. In the latter case (only), regulators have the authority to exert rate regulation.

The presence of substantial joint and common costs in the provision of rail services complicates the regulatory task of assessing the reasonableness of proposed rates.[22] In its first attempt to deal with this challenge post-Staggers, the ICC proposed to ensure the recovery of joint and common costs by allocating them across the various rail services being supplied.[23] The maximum reasonable rate for a service was set equal to the variable costs associated with the service plus a markup determined by the amount of joint and common costs allocated to the service. By 1985, however, the ICC rejected this approach, concluding that "a meaningful maximum rate policy could not be founded on a strictly cost-based approach."[24]

Having rejected (allocated) cost as the sole determinant of reasonable rates, the ICC developed "Constrained Market Pricing," which reflects principles of Ramsey pricing and contestable markets.[25] Ramsey principles justify relatively pronounced increases in rates above marginal cost on those services for which demand is relatively insensitive to price.[26] In relying on Ramsey principles, the ICC recognized that demand considerations can play an important role in determining appropriate rates. Rather than attempting to apply directly the Ramsey inverse elasticity formula (which it deemed impractical), though, the ICC determined that prices below the stand-alone cost of providing a rail movement were reasonable,

[22] Common costs are "those shared by two or more services in variable proportions, such as a terminal" while joint costs are "those shared by two (or more) services in fixed proportions, such as a front haul-back haul arrangement" (United States. Surface Transportation Board. (1996). *Ex Parte 347 (Sub No.2) Rate Guidelines - Non-Coal Proceedings.* Washington, D.C.: Surface Transportation Board. [Hereafter Non-Coal Rate Guidelines (1996)], p. 3). The STB indicates that "inherent in the rail industry cost structure are large amounts of joint and common costs that cannot be directly attributed to particular traffic" (p. 3). While it is difficult to determine the level of these costs precisely, if we assume that the industry secured a normal profit in 2013, STB reports suggest that nearly $25 billion of the industry's roughly $70 billion in costs are joint and common. (See, e.g., 2013 Commodity Stratification Report, Surface Transportation Board.) Kahn (1970) provides a foundational discussion of joint and common costs in regulated industries.

[23] See the discussion in Coal Rate Guidelines (1985, pp. 2-3).

[24] Coal Rate Guidelines (1985, p. 3).

[25] See Baumol et al. (1982) for a comprehensive development of the theory of contestable markets.

[26] See Baumol and Bradford (1970) and Brauetigam (1989) for an introduction to the application of Ramsey principles in a public utility environment. See Braeutigam (1979) and Baumol and Willig (1983) for early discussions of the application of Ramsey principles in the rail industry.

whereas prices in excess of stand-alone costs were not reasonable.[27]

After a decade of employing the stand-alone cost test as the primary measure of whether a proposed rail rate was reasonable, the STB determined that shippers should have access to simpler, less costly means to challenge rail rates.[28] In its 1996 Non-Coal Rate Guidelines, the STB introduced its Three Benchmark method for assessing the reasonableness of rates.[29] The first of these benchmarks is referred to as the Revenue Shortfall Allocation Method (RSAM). The RSAM benchmark is "the uniform markup above variable cost that would be needed from every shipper of potentially captive traffic (the $>$ 180 traffic group) in order for the carrier to recover all its ... fixed costs."[30] The fixed costs in question are the joint and common costs that have not been recovered from revenues generated by "competitive traffic" (i.e., traffic transported at rates with an R/VC ratio below 180%). The Board emphasized that this benchmark was not to be used in isolation to determine if a rate is unreasonable. Nonetheless, the Board concluded that "the RSAM benchmark provides an appropriate framework for assessing the extent of a carrier's revenue needs that can and should be recovered through differential pricing."[31] Observe that the RSAM benchmark effectively re-introduces the cost allocation methods the ICC abandoned in 1985 as a foundation for assessing the reasonableness of rates.

The second benchmark measure in the Three Benchmark test, R/VC_{COMP}, is determined by calculating the markup over variable cost that a railroad secures on "traffic that involves

[27] A price above the stand-alone cost of providing a service forces consumers of the service to pay more than they would pay if a competitive firm produced only the service in question. Conversely, if a price is less than the stand-alone cost of a service, then customers of the service "must not be harmed and may be benefiting from the fact that the supplier is serving other customers in addition to themselves" (Baumol, 1986, p. 121.) Although the stand-alone cost test is grounded in economic theory, the test has engendered criticism (e.g., Pittman 2010).

[28] A stand-alone cost challenge to a set of rates can be expensive because it requires the shipper to demonstrate through the design, modelling, and calculation of an efficient stand-alone rail network that the challenged rates exceed the cost the efficient network would incur to supply the service(s) in question.

[29] Non-Coal Rate Guidelines (1996).

[30] Non-Coal Rate Guidelines (1996, p. 19).

[31] Non-Coal Rate Guidelines (1996, p. 21).

similar commodities moving under similar transportation conditions."[32] This benchmark reflects the idea that, absent precise demand elasticity data, the benchmark can at least indicate whether the target traffic's rates are consistent with other traffic with similar demand characteristics. Challenged rates that exceed the R/VC_{COMP} benchmark are presumed not to be justified by demand elasticity considerations.

The third benchmark, $R/VC_{>180}$, is the measure of the extent to which a carrier is marking up rates for its traffic above the 180 benchmark, on average. The purpose of this benchmark test is to "ensure that the complaining shipper's traffic is not bearing a disproportionate share of the carrier's revenue requirements *vis-à-vis* other relatively demand-inelastic traffic without good cause."[33]

Despite the STB's attempt to streamline the procedures for challenging rates, no shipper challenged proposed rates using these simplified benchmarks in the decade following their introduction.[34] To further afford shippers less costly means to challenge proposed rates, in 2007 the Board altered both the pathways available to challenge rates and the standards for determining the reasonableness of rates. The Board determined that challenges involving shipments of large amounts of rail traffic should continue to employ the stand-alone cost test. The Board established a simplified stand-alone cost test for medium-sized shippers.[35] Finally, for small shippers, the Board retained the use of the Three Benchmark test.[36]

The 2007 standards also clarify the application of the Three Benchmark method. In particular, under the Three Benchmark test, when a party challenges rates for a set of

[32]Non-Coal Rate Guidelines (1996, p. 25).

[33]Non-Coal Rate Guidelines (1996, p. 28).

[34]United States. Surface Transportation Board. (2007). *Ex Parte 646 (Sub-No.1) Simplified Standards for Rail Rate Cases.* Washington, D.C.: Surface Transportation Board. [Hereafter Simplified Standards for Rail Rate Cases (2007)], p. 4.

[35]Principal among the changes embodied in the simplified test is that the assumption that the rail carrier's challenged traffic operates with fully utilized, efficiently deployed assets. This assumption avoids time consuming and contentious debates over managerial and productive efficiencies associated with the challenged traffic. For a complete description, see Simplified Standards for Rail Rate Cases (2007, pp. 13-15).

[36]The Board estimated that with this set of methodologies in place, the Three Benchmark Test would be applicable to approximately 45 percent of the potentially captive traffic that may face shipper complaints. Simplified Standards for Rail Rate Cases (2007, p. 35).

shipments, the Board first selects a comparison group for the R/VC_{COMP} benchmark. Next, rates for the comparison group are scaled up (for revenue inadequate firms) or down (for revenue adequate firms).[37] Once scaled, the Board calculates the mean and the standard deviation for the prices in the comparison group. If the challenged rate falls above the 90 percentile of the distribution of the adjusted comparable rates, the Board will presume the challenged rate to be unreasonable, absent "other relevant factors."[38]

One additional element of the regulatory oversight process arose in 2012. Recall that rates are only subject to regulatory oversight if the traffic at issue is provided under conditions of market dominance. In 2012, the STB introduced the "limit price R/VC ratio" test to determine whether a set of challenged traffic is subject to market dominance.[39] The test proceeds as follows. First, the Board estimates a "limit price," which is the highest price a carrier could charge a shipper without causing a significant amount of the traffic at issue to be diverted to a competitive alternative.[40] Next, the ratio of this limit price to the variable costs associated with the traffic is computed, yielding the "limit price R/VCratio." Finally, this ratio is compared to the firm's RSAM (i.e., the uniform mark-up on all $R/VC > 180$ traffic that would allow the firm to just break even). If the limit price R/VC ratio exceeds the RSAM mark-up, then the Board concludes that the traffic at issue lacks effective competition (i.e., is subject to market dominance).

The comparison of the limit price R/VC ratio to the RSAM figure to reach market dominance conclusions raises at least two concerns. First, recall that RSAM reflects the allocation of residually uncollected fixed costs to the set of $R/VC > 180$ traffic. Consequently, the limit price R/VC test bases conclusions about market dominance on cost allocations, which are unavoidably arbitrary. Second, the issue of market dominance has received consider-

[37]The scaling mechanism is described in Simplified Standards for Rail Rate Cases (2007, pp. 19-22).

[38]The Board does not specify what these other relevant factors may be, but indicates that they should be sufficiently precise as to quantify their effects on the presumed maximum lawful rate.

[39]See *M&G Polymers USA, LLC v. CSX Transportation, Inc.,* Surface Transportation Board, Updated Decision - Public Version, December 7, 2012.

[40]The mechanism for calculating this price is described in *M&G Polymers USA, LLC v. CSX Transportation, Inc.,* Surface Transportation Board, Updated Decision - Public Version, December 7, 2012, pp. 13-14.

able attention in the industrial organization literature.[41] No single formulaic approach for determining market dominance has emerged from this literature because numerous factors (including market structure, entry barriers, mobility conditions, and firm conduct) can interact in complex ways to determine the presence or absence of effective competition. This caveat notwithstanding, the STB's limit price R/VC formula seeks to determine whether a set of traffic is subject to market dominance simply by determining whether the estimated limit price exceeds the calculated RSAM.[42]

In sum, after initially abandoning cost allocation methods in the early 1980s as arbitrary and unreliable,[43] the STB appears to be increasingly relying on a fully allocated cost benchmark (*viz.*, RSAM) in assessing both the extent of competition a set of traffic faces and the reasonableness of the rates associated with that traffic. Ironically, the introduction and application of RSAM and the limit price R/VC ratio threatens to bring full-circle the regulatory approach to the rail industry in the post-Staggers era. Specifically, the first attempt to determine the reasonableness of rates in the post-Staggers era emphasized the allocation of all joint and common costs to individual rail services. With the increasing emphasis on simplified procedures for assessing rate reasonableness and the emphasis on RSAM as part of the market dominance determination, the STB has again made cost allocations central to the determination of the reasonableness of rates.

2.2 Revenue Adequacy Regulation

The pricing principles described above have been formulated in the absence of any explicit concern with limiting rail carrier revenues to the level of capital costs. As noted above, the Staggers Act calls for regulators to "*assist* rail carriers in attaining revenues that are 'adequate ... to cover total operating expenses, including depreciation and obsolescence, plus

[41] See Bresnahan (1989) and Kahai et al. (1996), for example.

[42] See *M&G Polymers USA, LLC v. CSX Transportation, Inc.,* Surface Transportation Board, Updated Decision - Public Version, December 7, 2012, pp. 3-4.

[43] Coal Rate Guidelines (1985).

a reasonable and economic profit or return (or both) on capital employed in the business.' "[44] Adequate revenues, in turn, are defined to be those that would provide a rate of return on net investment that was equal to the cost of capital.[45] The ICC has suggested such adequate revenues should serve as both a floor and a ceiling on appropriate revenues. Specifically, as noted above, the ICC has stated that "[o]ur revenue adequacy standard represents a reasonable level of profitability for a healthy carrier ... Carriers do not need any greater revenues than this standard permits, and we believe that, in a regulated setting, they are not entitled to any higher revenues."[46]

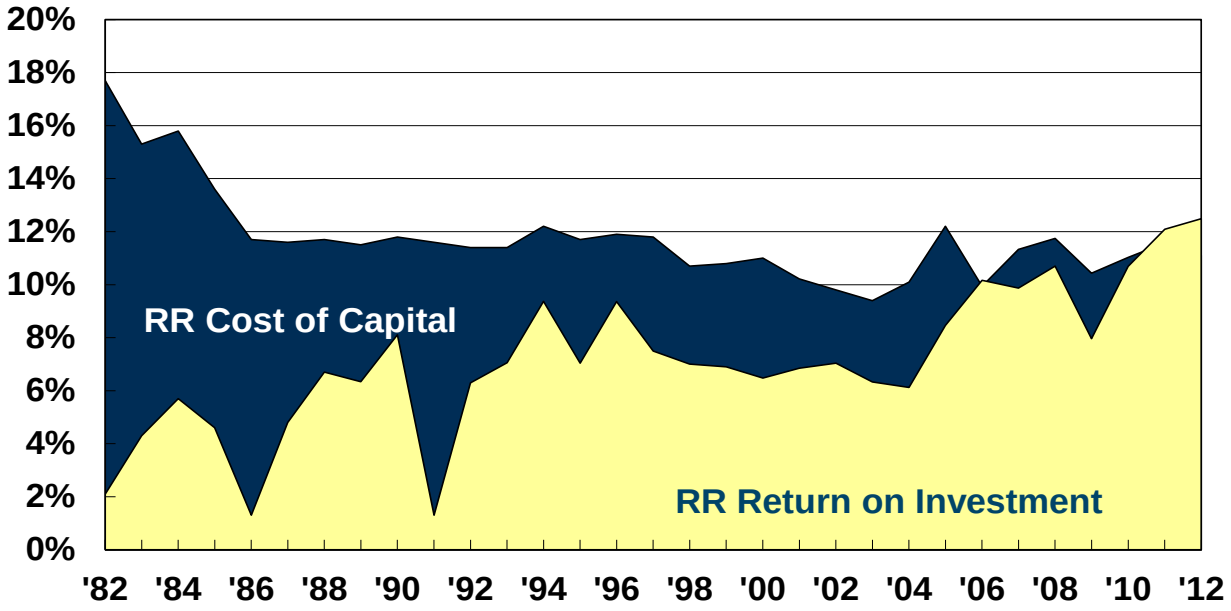
Although this conclusion by the ICC nominally introduced a powerful new regulatory constraint to the rail industry in 1985, the practical impact of this constraint has been limited to date. This is the case because, until recently, the revenues that carriers have secured typically have been below capital costs. More recently, however, an increasing number of railroads are thought to be achieving revenue adequacy. Figure 3 provides a historical comparison of revenues and capital costs in the rail industry.

[44]Coal Rate Guidelines (1985, p. 11). Emphasis added.

[45]See Burton and Sims (2015) for a modern assessment of this process.

[46]Coal Rate Guidelines (1985, p. 12).

Figure 3. Class I Railroads' Cost of Capital vs. Return on Investment.



blue = industry cost of capital. yellow = return on investment.

Source. Surface Transportation Board.

The Surface Transportation Board changed the method by which it calculates the rail industry cost of capital in 2006.

The recent increase in the ratio of revenue to capital cost depicted in Figure 3, coupled with the ICC's comments in 1985, raise the possibility that regulators might consider explicit revenue adequacy regulation that attempts to restrict revenues to the level of capital costs in the rail industry.

3 Related Literature

In light of the historic and the potential future regulatory policy in the US rail industry, it is instructive to review key conclusions from the economic literatures that analyze cost allocation procedures and earnings restrictions.

Fully distributed cost (FDC) allocation methodologies have been employed for many years in several regulated industries. However, serious economic study of these methodologies only

began in the late 1970s. In an assessment of the merits of fully distributed costs in the rail industry, Owen and Braeutigam (1978) observe that fully distributed cost pricing "bears no direct relationship to economically efficient pricing since it attempts to set prices based on costs alone, with no considerations for demand schedules for the service."[47] In a more formal analysis, Braeutigam (1980) analyzes the economic consequences of three popular FDC allocation methods (*viz.*, the relative output method, the attributable cost method, and the gross revenues method), finding in each case that the resulting set of prices is inefficient and generally inconsistent with Ramsey prices.

Baumol and Willig (1983) offer a more pointed critique. They demonstrate that the application of fully allocated costs for establishing rate ceilings can fundamentally undermine not only the ability to achieve efficient pricing but also the financial viability of the regulated enterprise.[48] They also observe that the imposition of price ceilings that reflect FDC allocations can impair incentives for mutually beneficial contracts between shippers and railroads. In particular, in the presence of FDC-based price ceilings, such contracts must not only recover the costs directly attributable to the contracted services but also must compensate for the consequent reduction in the regulated ceiling rates. The reduction arises because any recovery of fixed costs from contract traffic reduces prices for non-contract traffic (because fewer fixed costs are allocated to such traffic). The authors conclude that "rate ceilings derived from fully distributed costs are inimical to the public interest" (p. 40).

Sweeney (1982) examines the performance of FDC methods in settings where only a portion of the firm's products are subject to regulation. He demonstrates that when the fraction of fixed costs allocated to a service increases with the output of the service, a partially regulated firm may implement prices that are strictly dominated.[49] That is, there

[47] Owens and Braeutigam (1978).

[48] The authors show that the regulated firm reduces output of the service for which FDC pricing does not constrain pricing in order to allocate more cost to the FDC-constrained activities (thereby securing higher prices for the latter services). The allocations may improve the financial performance of the firm relative to the initial constrained situation, but fail to permit the firm to fully recover its costs. Incentives for this inefficient output shifting persist even when the firm is financially viable under FDC pricing.

[49] Rogerson (1992) develops a related model of a partially regulated defense firm that sells its outputs to

are alternative prices that would secure both higher profit for the firm and lower prices for consumers. This outcome arises in the presence of earnings regulation because the firm has an incentive to shift costs to the regulated sector by reducing output in the unregulated sector (by charging higher prices for unregulated services). The resulting increased costs allocated to the regulated sector produce higher prices in that sector also.[50]

Brennan (1990) identifies related distortions arising from earnings regulation and FDC allocations of overhead costs. Specifically, he finds incentives for cross-subsidization in the presence of the combination of earnings regulation and FDC. He notes that these incentives "all rely critically on the premise that the allowed revenues from sales of the regulated product will be permitted to rise if the apparent 'costs' of providing the regulated product rise." He concludes that "if the regulator wants to strip the regulated firm of the incentive to engage in these tactics, it could set prices independently of future costs" (p. 47). Braeutigam and Panzar (1989) demonstrate that earnings regulation and FDC pricing can distort the incentives of a partially regulated firm to diversify into unregulated markets. In sum, the economic literature concludes that FDC allocation methods can induce inefficient pricing, distort market outputs, and alter incentives for efficient diversification.

The literature's assessment of earnings regulation is no more encouraging than its assessment of FDC allocation methods. Specifically, a large literature has identified many drawbacks to earnings regulation, primarily in the context of rate-of-return regulation. A survey of this literature concludes that these drawbacks include: "(1) limited incentives for innovation and cost reduction; (2) over-capitalisation; (3) high costs of regulation; (4) excessive risks imposed on customers; (5) cost shifting; (6) inappropriate levels of diversification and innovation; (7) inefficient choice of operating technology; and (8) insufficient pricing

commercial customers and to the military. The military imposes cost allocation rules that determine the price of services sold to the military. Rogerson shows that a FDC allocation tied to direct labor costs will induce the firm to both engage in pure waste and to adopt inefficient combinations of inputs. This is the case because the labor-based allocation of costs create an incentive for the firm to employ too much labor and to recover the associated costs in nominally "cost-based" contracts with the Department of Defense.

[50] Cavalluzzo et al. (1998) present empirical evidence that mandated FDC pricing of financial services promotes the allocation of overhead costs to less competitive services.

flexibility in the presence of competitive pressures."[51]

4 A Stylized Model of Rail Regulation

To further assess the earnings regulation that may be under consideration in the U.S. rail industry, we analyze a simple formal model that includes the following features. A single rail carrier (R) produces one service in a regulated sector (sector 1) and another service in an unregulated sector (sector 2). The demand for R's service in the regulated sector is perfectly inelastic at X_1. c_i will denote R's product-specific unit cost of production in sector $i \in \{1, 2\}$. F is R's fixed cost of production. Therefore, R's total cost of producing outputs X_1 and X_2 is $C(X_1, X_2) = F + c_1 X_1 + c_2 X_2$.

Provision of the unregulated service is characterized by Bertrand price competition, where R is the least-cost supplier of the unregulated service. p_2 will denote the unit cost of production for the second-most efficient producer of this service. Consequently, in equilibrium, R will supply the entire demand for the unregulated service at price p_2.

R chooses three types of cost-reducing effort: effort ($e_1 \geq 0$) that reduces its unit cost of production in the regulated sector, effort ($e_2 \geq 0$) that reduces its unit cost of production in the unregulated sector, and effort ($e_F \geq 0$) that reduces its fixed cost of production, F. These efforts are costly for R to deliver and difficult for the regulator to measure accurately because they reflect, for example, the diligence with which the firm pursues all possible means of cost reduction. For simplicity, we assume the regulator cannot monitor R's innovative effort at all, and so cannot compensate R directly for the cost of this effort.[52] $E_i(e_i)$ will denote the (unmeasured) expense that R incurs in delivering cost-reducing effort e_i, $i \in \{1, 2, F\}$. The relevant expense increases at a non-decreasing rate with the level of R's cost-reducing effort,[53] and increased effort reduces production costs at a non-increasing rate.[54]

[51] Sappington (2002, p. 240).

[52] The qualitative conclusions drawn below are unchanged if the regulator can observe some, but not all, of R's efforts to reduce its production costs.

[53] Formally, $E_i(0) = 0$, $E_i'(e_i) > 0$, and $E_i''(e_i) \geq 0$ for all $e_i > 0$.

[54] Formally, $F'(e_F) < 0$, $F''(e_F) \geq 0$, $c_i'(e_i) < 0$, and $c_i''(e_i) \geq 0$ for $i = 1, 2$. We also assume that small levels of effort are very effective and reducing costs and are not very onerous for R. Formally, $\lim_{e_F \to 0} E_F'(e_F) = 0$,

The total resource costs – including effort costs – that R incurs in delivering outputs X_1 and X_2 are:

$$F(e_F) + c_1(e_1)\,X_1 + c_2(e_2)\,X_2 + E_F(e_F) + E_1(e_1) + E_2(e_2)\,. \tag{1}$$

(e_1^*, e_2^*, e_F^*) will denote the efficient levels of (e_1, e_2, e_F), i.e., the levels that minimize the total resource costs identified in expression (1). Formally, e_1^*, e_2^*, and e_F^* are determined by:

$$-\,F'(e_F^*) \;=\; E_F'(e_F^*) \quad \text{and} \quad -\,c_i'(e_i^*)\,X_i \;=\; E_i'(e_i^*) \;\; \text{for } i \;=\; 1,\,2\,. \tag{2}$$

Expression (2) indicates that the efficient level of cost-reducing effort is the level that equates the marginal reduction in production costs with the marginal increase in effort cost.

We explore some of the impacts of two forms of "revenue adequacy regulation" in this simple setting. Under "comprehensive earnings regulation," the price in the regulated sector (p_1) is set to eliminate R's aggregate measured profit in both sectors, given the price (p_2) that R sets in the unregulated sector. Under "focused earnings regulation," p_1 is set to eliminate R's measured profit (only) in the regulated sector.

4.1 Comprehensive Earnings Regulation (CER)

Formally, comprehensive earnings regulation (CER) requires:

$$[\,p_1 - c_1(e_1)\,]\,X_1 + [\,p_2 - c_2(e_2)\,]\,X_2 \;-F \;=\; 0\,. \tag{3}$$

Equation (3) implies that under CER, R secures exactly zero profit from all of its operations combined. This is the case regardless of the level of production costs that R secures. Under such a policy, if R were to undertake any cost-reducing effort, R would incur the associated expenditures but experience no corresponding financial benefit. Consequently, R will refrain from delivering any unmeasured cost-reducing effort under CER, as Conclusion 1 reports.

Conclusion 1. *When it operates under CER, R will set* $e_1 = 0$, $e_2 = 0$, *and* $e_F = 0$.

Proof. When R operates under CER, its objective is to:

$$\underset{e_1,\,e_2,\,e_F}{Maximize} \quad [\,p_1 - c_1(e_1)\,]\,X_1 + [\,p_2 - c_2(e_2)\,]\,X_2 \;-F - E_1(e_1) - E_2(e_2) - E_F(e_F) \tag{4}$$

subject to equation (3). Expressions (3) and (4) imply that R's objective under CER is to:

$\lim_{e_i \to 0} E_i'(e_i) = 0$, $\lim_{e_F \to 0} F'(e_F) = -\infty$, and $\lim_{e_i \to 0} c_i'(e_i) = -\infty$ for $i = 1, 2$.

$$\underset{e_1, e_2, e_F}{Maximize} \quad -E_1(e_1) - E_2(e_2) - E_F(e_F)\,.$$

Because R's objective function is strictly decreasing in e_1, e_2, and e_F, R will set each of these variables at its minimum feasible level (0). ■

Conclusion 1 has two important implications for the application of CER to the rail industry. First, to the extent that shippers can observe rail carriers' earnings and can quickly contest established rates at low personal cost, a rail carrier will be precluded from earning more than its cost of capital. As soon as a carrier proposes rates that generate positive (extranormal) earnings, shippers will challenge the proposed rates for the regulated services, and thereby secure rate reductions that eliminate the carrier's earnings. Indeed, CER may introduce a race among shippers to be the first to challenge "excessive" rates (before other shippers secure rate reductions that eliminate the rail carrier's profit.)

Second, like rate of return regulation (RORR), CER will limit incentives for innovation and cost reduction. In particular, cost reductions in either the regulated sector or the unregulated sector that result in earnings above the allowed threshold will generate offsetting reductions in regulated rates to ensure the rail carrier earns no extranormal profit. Consequently, CER will only provide incentives for innovation if there is a lag in translating observed cost reductions into offsetting price reductions.[55]

The distortions identified in Conclusion 1 are not the only distortions that CER can introduce. Potential additional distortions include the following three. First, CER regulation can curtail incentives for quality-enhancing innovation, just as it can limit incentives for cost-reducing innovation. CER limits the ability of a rail carrier to benefit financially from quality-enhancing innovation regardless of whether the innovation arises in the regulated or the unregulated sector. Consequently, CER is likely to stifle quality-enhancing innovation in both sectors, just as it can be expected to inhibit cost-reducing innovation in both sectors.

[55] Ironically, economic welfare may be enhanced in this situation by regulatory bureaucracy that introduces delays and/or by regulatory rules that limit the ability of shippers to rapidly secure rate reductions. Even with regulatory lag, though, RORR (and CER) are likely to diminish the pace of industry innovation (Sweeney 1981).

Second, cost reductions in the unregulated sector can reduce welfare in the rail industry by increasing the scope of regulation. This is the case because a reduction in the cost of supplying a service can increase the ratio of revenue to variable cost above the 180% threshold that triggers regulatory oversight. The rail carrier may not be harmed directly by the associated increased scope of regulation because CER limits the carrier's overall profit to zero, regardless of the number of regulated and unregulated services it offers. However, the carrier, the shippers, and the regulator alike may all incur higher costs due to the expanded scope of regulation. The expanded scope of regulation resulting from cost-reducing innovation can thereby reduce industry welfare.[56]

Third, CER can support, if not encourage, a rail carrier's efforts to maximize revenue or output, rather than earnings. The associated costs of inefficient output expansion (and potentially below-cost pricing) would be borne by "captive" shippers under CER, as regulated rates are adjusted to ensure zero profit for the rail carrier across all of its operations. Thus, CER can encourage a rail carrier to act particularly aggressively in the provision of "unregulated" services, conceivably displacing more efficient competitors.[57]

4.2 Focused Earnings Regulation (FER)

Under focused earnings regulation (FER), the revenue adequacy constraint is applied to the rail carrier's earnings in the regulated sector rather than to its earnings in all sectors combined. Specifically, the firm's measured (extranormal) profit in the regulated sector is held to zero under FER. To calculate measured earnings in the regulated sector, one must allocate a portion of the firm's fixed costs (F) to the regulated sector. Let $f_1 \in [\,0, 1\,]$ denote this fraction. Then FER can be represented formally as:

$$[\,p_1 - c_1(e_1)\,]\,X_1 - f_1\,F \;=\; 0\,. \tag{5}$$

[56] CER is likely to entail considerable regulatory costs in part because the regulator may have to determine whether costs (in all sectors) have been incurred prudently. The prospect of such regulatory oversight introduces the possibility of "regulatory moral hazard," i.e., a regulator may declare a prudent expense to have been incurred imprudently in order to increase the carrier's measured earnings and to thereby authorize lower prices for shippers.

[57] Sappington and Sidak (2003) analyze the potential for corresponding behavior by state-owned enterprises.

Conclusion 2 characterizes the cost-reducing effort the rail carrier (R) will deliver under FER.

Conclusion 2. *When it operates under FER, R will set* $e_2 = e_2^*$ *and* $e_1 = 0$. *R will also set* $e_F < e_F^*$ *if* $f_1 > 0$.

Proof. When it operates under FER, R seeks to maximize expression (4), subject to expression (5). Substituting expression (5) into expression (4) implies that R seeks to:

$$\underset{e_1, e_2, e_F}{Maximize} \;\; f_1 F + [\, p_2 - c_2(e_2) \,] X_2 \; - F - E_1(e_1) - E_2(e_2) - E_F(e_F)$$

which can be rewritten as:

$$\underset{e_1, e_2, e_F}{Maximize} \;\; [\, p_2 - c_2(e_2) \,] X_2 \; - [\, 1 - f_1 \,] F(e_F) - E_1(e_1) - E_2(e_2) - E_F(e_F) \,.$$

The necessary conditions for an interior solution to this problem are given by:

$$e_1 : \;\; - \; E_1'(e_1) \; \leq \; 0 \,; \qquad\qquad [\, - E_1'(e_1) \,] \, e_1 \; = \; 0 \,; \tag{6}$$

$$e_2 : \;\; - \; c_2'(e_2) \, X_2 - E_2'(e_2) \; \leq \; 0 \,; \qquad\qquad [\, - c_2'(e_2) \, X_2 - E_2'(e_2) \,] \, e_2 \; = \; 0 \,; \tag{7}$$

$$e_F : \;\; - \; [\, 1 - f_1 \,] \, F'(e_F) - E_F'(e_F) \; \leq \; 0 \,; \qquad [\, - \, (\, 1 - f_1 \,) \, F'(e_F) - E_F'(e_F) \,] \, e_F \; = \; 0 \,. \tag{8}$$

Expression (6) implies $e_1 = 0$. Expression (7) implies $e_2 = e_2^*$. Expression (8) implies $E_F'(e_F) = - F'(e_F) + f_1 F'(e_F)$. Consequently, if $f_1 > 0$, then $E_F'(e_F) < - F'(e_F) \;\Rightarrow$ $e_F < e_F^*$. ■

Conclusion 2 reports that R will deliver the efficient level of effort to reduce variable costs in the unregulated sector under FER. This is the case because R's earnings are not regulated in this sector. Consequently, R receives the full benefit of its cost-reducing effort directed toward its unregulated activities, and so will undertake the efficient level of cost-reducing effort in this sector.

In contrast, R will not pursue any cost-reducing effort in the regulated sector. This is the case because this effort is personally costly for R, and yet R receives no financial benefit from any cost reduction it secures in the regulated sector. R's measured profit is held to zero in this sector, regardless of the extent of the cost-reducing innovation that R implements.

Thus, while FER can encourage cost-reducing effort in the unregulated sector, it stifles such effort in the regulated sector, just as CER does.

Conclusion 2 also reports that FER typically will induce R to deliver less than the efficient level of effort to reduce fixed costs. This is the case because R bears the full burden of the reducing fixed production costs but receives only a fraction $(1 - f_1)$ of the associated benefit under FER.[58]

Conclusions 1 and 2 together indicate that while the distortions created by CER can be particularly onerous and pervasive, FER is not without its flaws. Before considering alternatives to CER and FER, we briefly consider one additional distortion that can arise under FER. The foregoing analysis does not account for the fact that higher levels of fixed costs often can reduce variable production costs in practice.[59] We now consider whether FER will induce R to adopt the cost-minimizing mix of fixed and variable production costs.

To do so most simply, we abstract from any cost-reducing effort that R might provide. Suppose instead that R's only decision under FER is the choice of its fixed cost, F. Higher levels of F reduce R's variable unit cost of production in both the regulated and the unregulated sector. Formally, $c_i'(F) < 0$ for $i = 1, 2$, where $c_i(F)$ is R's variable unit cost of production in sector i when R installs fixed cost F.[60]

R's total cost of production when it implements fixed cost F in this setting is $c_1(F)\,X_1 + c_2(F)\,X_2 + F$. Therefore, F^*, the efficient (cost-minimizing) level of F, is determined by:

$$c_1'(F^*)\,X_1 + c_2'(F^*)\,X_2 + 1 \;=\; 0\,. \tag{9}$$

Conclusion 3 considers the special case in which R's unit variable cost declines at precisely the same rate in the regulated and unregulated sectors as F increases.

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[58] R is permitted to recover through higher regulated rates the fraction f_1 of any realized increase in F. Therefore, R effectively secures a financial benefit of only $\$(1 - f_1)$ for each dollar by which it reduces F.

[59] For example, investments in railroad signal equipment (which is largely invariant to the volume of rail traffic) can significantly reduce the variable costs that a railroad incurs by enabling the railroad to move traffic more expediently across its network.

[60] We assume $c_i''(F) > 0$ for all $F \geq 0$, $\lim_{F \to 0} |c_i'(F)| = \infty$, and $\lim_{F \to \infty} |c_i'(F)| = 0$.

Conclusion 3. *Suppose R operates under FER and* $c_1'(F) = c_2'(F)$ *for all* F. *Then R will set* $F \gtreqless F^*$ *as* $f_1 \gtreqless \frac{X_1}{X_1+X_2}$.[61]

Proof. When R operates under FER, its objective in the present setting is to:

$$\underset{F}{Maximize} \quad [\,p_1 - c_1(F)\,]\,X_1 + [\,p_2 - c_2(F)\,]\,X_2 \;-\; F \tag{10}$$

subject to:

$$[\,p_1 - c_1(F)\,]\,X_1 - f_1\,F \;=\; 0\,. \tag{11}$$

Substituting expression (11) into expression (10) implies that R seeks to:

$$\underset{F}{Maximize} \quad f_1\,F + [\,p_2 - c_2(F)\,]\,X_2 \;- F$$

which can be rewritten as:

$$\underset{F}{Maximize} \quad [\,p_2 - c_2(F)\,]\,X_2 - [\,1 - f_1\,]\,F\,.$$

The necessary condition for an interior solution to this problem is:

$$-\,c_2'(F)\,X_2 - (1 - f_1) \;=\; 0 \qquad \Rightarrow \qquad c_2'(F)\,X_2 + 1 - f_1 \;=\; 0\,. \tag{12}$$

Observe that $1 - f_1 \lesseqgtr \frac{X_2}{X_1+X_2}$ as $f_1 \gtreqless \frac{X_1}{X_1+X_2}$. Therefore, from expression (12):

$$\begin{aligned} 0 \;=\; c_2'(F)\,X_2 + 1 - f_1 \;&\lesseqgtr\; c_2'(F)\,X_2 + \frac{X_2}{X_1+X_2} \;\overset{s}{=}\; c_2'(F)\,[\,X_1 + X_2\,] + 1 \\ &=\; c_1'(F)\,X_1 + c_2'(F)\,X_2 + 1 \quad \text{as} \quad f_1 \;\gtreqless\; \frac{X_1}{X_1+X_2}\,. \end{aligned} \tag{13}$$

The last equality in expression (13) reflects the maintained assumption that $c_1'(F) = c_2'(F)$ for all F. The Conclusion follows from expression (13) because expression (9) implies:

$$F \;\gtreqless\; F^* \;\text{ as }\; c_1'(F)\,X_1 + c_2'(F)\,X_2 + 1 \;\gtreqless\; 0\,. \quad \blacksquare \tag{14}$$

Conclusion 3 identifies a particular cost allocation rule (the "relative output rule," $f_1 = \frac{X_1}{X_1+X_2}$) and a special technology ($c_1'(F) = c_2'(F)$) under which R will choose the cost-minimizing production technology under FER. To understand Conclusion 3, observe that R effectively pays $1 - f_1$ for each additional unit of F it implements under FER. (R recovers the fraction f_1 of any increase in F through higher rates in the regulated sector.) The only value R derives from this investment in F is the associated reduction in its cost of producing

[61] We assume f_1, the fraction of F allocated to the regulated sector, is not affected by R's choice of F.

X_2, which accounts for the fraction $\frac{X_2}{X_1+X_2}$ of its total output. If increases in F reduce $c_1(\cdot)$ and $c_2(\cdot)$ at precisely the same rate, then R will implement the level of F that minimizes total production costs when $f_1 = \frac{X_1}{X_1+X_2}$ and so $1 - f_1 = \frac{X_2}{X_1+X_2}$ because in this case, the marginal return R anticipates from increasing F is scaled down by the same amount that the cost it effectively incurs from increasing F is scaled down.

More generally, FER typically will not induce R to implement the cost-minimizing level of F. Conclusion 3 illustrates this point when the fraction of common costs allocated to the regulated sector differs from $\frac{X_1}{X_1+X_2}$. Conclusion 4 further illustrates this point in the setting where, as is likely in practice, increases in R's fixed cost of production do not reduce variable costs symmetrically in all sectors. In this case, distortions arise even in the presence of the cost allocation rule ($f_1 = \frac{X_1}{X_1+X_2}$) that induces R to implement the efficient level of F in the setting of Conclusion 3.

Conclusion 4. *Suppose R operates under FER and* $f_1 = \frac{X_1}{X_1+X_2}$. *Then R will set* $F \gtreqless F^*$ *as* $|\,c_2'(F)\,| \gtreqless |\,c_1'(F)\,|$ *for all* F.

Proof. From expression (12), R's choice of F is determined by:

$$c_2'(F)\,X_1 + c_2'(F)\,X_2 + 1 = 0$$

$$\Rightarrow \quad c_1'(F)\,X_1 + c_2'(F)\,X_2 + 1 \gtreqless 0 \quad \text{when} \quad |\,c_2'(F)\,| \gtreqless |\,c_1'(F)\,| \text{ for all } F. \qquad (15)$$

The conclusion follows from expressions (14) and (15). ■

To interpret Conclusion 4, consider the setting where increases in F reduce R's variable unit cost in the unregulated sector more rapidly than they reduce R's unit variable cost in the regulated sector. Then, given the proportionate charge for F that R effectively faces under the presumed form of FER, the marginal return R anticipates from increasing F (i.e., the corresponding reduction in variable costs in the unregulated sector) is high relative to the associated effective cost. Consequently, R implements more than the cost-minimizing level of F.[62]

[62] A corresponding argument explains why R implements less than the cost-minimizing level of F when

Taken together, Conclusions 3 and 4 indicate that attempts to allocate common costs across sectors in order to implement FER typically will induce R to adopt other than the cost-minimizing production technology. Of course, R has no strict incentive to adopt the cost-minimizing technology under CER either. Indeed, for the reasons explained above, R has no strict incentive to minimize any component of production costs under CER. Therefore, earnings regulation in any form has the potential to introduce serious distortions. These distortions can be particularly widespread if earnings regulation is imposed ubiquitously.

4.3 Price Cap Regulation (PCR)

The preceding analysis demonstrates that comprehensive earnings regulation (CER) and focused earnings regulation (FER) both typically limit the incentives of a regulated enterprise to operate efficiently. Before concluding, we briefly consider an alternative to CER and FER. Many forms of "incentive regulation" have gained popularity in other industries in recent years.[63] Incentive regulation seeks to limit the detrimental effects of rate of return regulation by allowing firms that deliver exceptional performance to secure more than merely "adequate" earnings. Pure price cap regulation (PCR) is one relatively straightforward form of incentive regulation. In the context of the formal model analyzed in section 4.1, PCR replaces explicit earnings regulation with a ceiling ($\overline{p}_1$) on the price that R can set in the regulated sector. The distinguishing feature of this price ceiling is that its level is not linked to R's aggregate realized earnings or to R's realized earnings in the regulated sector.

Under PCR, R will choose the price in the regulated sector and its cost reducing efforts to maximize its profit. Formally, the firm's problem is:

$$\underset{p_1 \leq \overline{p}_1,\, e_1,\, e_2,\, e_F}{Maximize} \quad [\,p_1 - c_1(e_1)\,]\,X_1 + [\,p_2 - c_2(e_2)\,]\,X_2 - F(e_F) - E_1(e_1) - E_2(e_2) - E_F(e_F)\,. \quad (16)$$

increases in F reduce R's variable unit cost in the unregulated sector less rapidly than they reduce R's unit variable cost in the regulated sector.

[63] For analyses of incentive regulation and additional references to the relevant literature, see, *inter alia,* Joskow and Schmalensee (1986), Laffont and Tirole (1993), Blackmon (1994), Lyon (1994), Crew and Kleindorfer (1996, 2002), Sappington (2002), and Sappington and Weisman (2010).

Conclusion 5. *When it operates under PCR, R will set* $p_1 = \overline{p}_1$, $e_1 = e_1^*$, $e_2 = e_2^*$, *and* $e_F = e_F^*$.

Proof. Let λ denote the Lagrange multiplier associated with the $p_1 \leq \overline{p}_1$ constraint. Then the necessary conditions for an interior solution to R's problem in expression (16) are:

$$-c_i'(e_1) - E_i'(e_1) = 0 \text{ for } i = 1, 2; \quad -F'(e_F) - E_F'(e_F) = 0; \quad \text{and} \quad X_1 - \lambda = 0. \quad (17)$$

The first two equations in expression (17) imply that $e_1 = e_1^*$, $e_2 = e_2^*$, and $e_F = e_F^*$. The last equation in expression (17) implies that $\lambda > 0$ and so $p_1 = \overline{p}_1$. ■

Conclusion 5 indicates that, in principle, price-based regulation can provide strong incentives for innovation and cost minimization. However, the implications of this theoretical conclusion for the rail industry must be tempered by the actual practice of price cap regulation. Regulators in the electricity and telecommunications sectors, for instance, typically have been unable to successfully commit to pure price regulation, instead implementing various hybrid forms of regulation that link authorized prices to the firm's realized earnings.[64] This has led to the general critique that the theory underlying the standard analysis of price cap regulation and other forms of incentive regulation "proceeds by ignoring an immutable institutional constraint, namely that neither commitment nor its associated information rents are reasonable assumptions."[65] This critique certainly applies to the simple model of price cap regulation that underlies Conclusion 5, which abstracts from both the information asymmetries and the commitment difficulties that regulators face in practice.

[64] Sappington and Weisman (2010, p. 228) observe that, in practice, price cap regulation "can resemble ROR, affording little pricing discretion to the regulated firm and providing limited incentives for innovation and cost reduction." Armstrong et al. (1994, p. 172) note that, in practice, the distinction between price cap regulation and rate of return regulation "is one of degree rather than kind." Blank and Mayo (2009) provide a political economy model of regulation in which hybrid regulatory regimes arise in equilibrium despite the superior efficacy of pure price cap regulation.

[65] Crew and Kleindorfer (2000, p. 13). Vickers and Yarrow (1988, pp. 427-428) note "it is difficult for governments to commit their successors to allow the regulated firm its fair share of the gains from successful investment and innovation, and hence dynamic efficiency may suffer. These concerns are greatest in industries with long asset lives and sunk costs."

5 Conclusions

The Staggers Act of 1980 is widely ascribed to have deregulated the U.S. freight rail industry. Indeed, the majority of traffic in the post-Staggers era has traveled at prices and qualities determined by the free interaction of the supply and demand for rail services. The consequent economic benefits of this governance mechanism have been widely documented. However, a detailed regulatory framework has emerged for overseeing rates in the post-Staggers era. This regulatory structure has reintroduced to the industry elements of older-era regulation, including cost allocation and even the prospect of earnings regulation.

We have detailed this evolution and drawn upon the cost allocation and earnings regulation literatures to highlight relevant economic lessons. We have also developed a stylized formal analysis of potential regulation of rail shipments that are deemed to warrant direct regulatory intervention. In particular, we examined selective implications of comprehensive earnings regulation, focused earnings regulation, and price cap regulation. We found that earnings regulation in either a comprehensive or focused form introduces distortions that limit economic efficiency. In principle, price regulation could conceivably eliminate these distortions. However, even under what is nominally introduced as price regulation, regulated prices typically are linked to realized earnings in practice, and the associated distortions arise.

"Pay for performance" is a central element of modern incentive regulation. Incentive regulation explicitly provides the potential for more than "adequate" earnings in order to motivate the regulated enterprise to deliver superior performance. Earnings above merely adequate levels is not necessarily a sign of regulatory failure. To the contrary, higher earnings can reflect regulatory success and corresponding benefits for consumers. These observations call into question the merits of the ICC's interpretation of Congress's "revenue adequacy" language, even if Congress intended the "constraint" to limit "excessive" earnings.

In closing, we note that any potential gains an additional layer of regulation might engender in the rail industry should be weighed carefully against the associated costs. The

relatively light-touch approach to regulation in the post-Staggers era produced substantial gains in the rail industry. These gains suggest it may well be difficult, if not impossible, to design expanded regulation that will deliver benefits in excess of the corresponding costs.

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