Regulation by Benchmarks:

Partial Deregulation of the Railroad Industry

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Preliminary Draft

by

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Abstract

Railroads haul thousands of different commodities between thousands of different origins and destinations. Prior to 1980, all rates were subject to federal regulation. However, financial ruin and bankruptcies in the 1970s led to legislation that placed a greater emphasis on the marketplace in regulating rates. The regulatory agency was mandated to have a costing model in place that allocated costs to specific movements and established thresholds which, if established, gave the regulatory agency jurisdiction over rates. In our previous work, Wilson and Wolak (2016), we provide both theoretical and empirical criticisms of the costing methodology and concluded it should be abandoned. In this paper, we offer a benchmark approach to identifying shipments that may warrant further investigation for whether rates are reasonable or not.

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1. INTRODUCTION

The Railroad Revitalization and Regulatory Reform Act of 1976 (4R Act) and the Staggers Rail Act of 1980 provided for significantly reduced federal regulation of the railroads, which had been subject to federal regulation since passage of the Interstate Commerce Act of 1887. In the 1970s, prior to regulatory reform, the railroad industry was on the brink of financial collapse, and many railroads were bankrupt. It was widely held that regulation impeded the ability of railroads to meet new forms of competition and impeded innovation in the industry.[1] The new legislation introduced new mechanisms for governing the regulation or rates (described in section II), allowed confidential contracts, eased impediments to rail line abandonment and to mergers. The effects on the market have been dramatic with substantial decreases in costs, rates, and the size of the rail network as well as a tremendous consolidation of firms.[2] However, over the last decade, shippers have raised substantial concerns over the level of rate and the changes in rates since the mid-2000s as well as the costs and benefits of seeking rate relief. In this paper, we review the legislative changes with respect to rate regulation, and in particular, the methods used to establish whether the regulatory authority has jurisdiction over rates, and offer a benchmarking approach to regulating rates.

The 4-R Act and the Staggers Rail Act place a greater emphasis on the marketplace to determine rates. The legislation established the notion of market dominance. The regulatory

[1] See, for example, Keeler (1983), Gallamore and Meyer (2014) and many others for the factors leading to regulatory reform.

[2] These are well documented in McFarland (1989), Barnekov and Kliet (1990), Berndt et al. (1993), Vellturo et al. (1992), Burton (1993), Wilson (1994; 1997), MacDonald and Cavalluzzo (1996), Grimm and Winston (2000), Ellig (2002), Bitzan and Keeler (2003), Bitzan and Wilson (2007), Winston et al. (2010), Schmalensee and Wilson (2016).

authority[3] has the jurisdiction to consider the reasonableness of a rate only if there was a finding that the railroad was market dominant over the movement. A finding of market dominance requires that the rate exceeds 180 percent of variable costs, and there is no effective competition present.[4] To determine variable costs, the legislation mandated a costing methodology, and after years of development the Uniform Rail Costing System (URCS) was adopted in 1989, replacing Rail Form A which had been used since 1939. In our previous research we found that both theoretically and empirically this system is inherently flawed and should be replaced.

Our benchmarking approach provides an alternative that does not require a flawed costing methodology. Rather, from observed prices that apply to effectively "competitive" markets, we estimate a benchmark as a function of variables that reflect costs, competitive factors, and unobserved effects time, commodity, and railroad. We then take the estimated model and predict rates for the potentially non-competitive markets. This forms the benchmark, and actual rates are then directly compared to the benchmark rates to identify potentially non-competitive rates. This approach can be applied to all markets, railroads, and commodities and rests on data that are easily obtained and/or collected by the STB.

In the next section, we provide a brief overview of railroad rate regulation and the current practice. We develop the benchmarking model in Section III and describe the data in Section IV. Section V provides the results.

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[3] The regulatory authority was the Interstate Commerce Commission until 1995. In 1995, the Interstate Commerce Commission Termination Act was passed. It created the Surface Transportation Board which now economically regulates the railroad industry.
[4] See Eaton and Center (1986) and Wilson (1996).

II. BACKGROUND

Prior to passage of the Staggers Act, all railroad pricing was subject to regulation. The Staggers Rail Act of 1980 substantially reduced regulatory control over rates by introducing a screening mechanism, "market dominance", for regulatory authority to consider the reasonableness of a rate. A movement is considered not market dominant if the rate was less than 180 percent of variable costs and it was not rebuttable. It is also considered not market dominant if the rate is great than 180 percent but competitive pressures are present ((49 USC §10101(4), Eaton and Center (1986), Wilson (1996)). Notably, until recently, cases had to be initiated by the shipper.[5] That is, rates would be set and the regulatory process would begin with a challenge by a shipper after the rate was set. An aggrieved shipper then must have a rate greater than 180 percent of variable costs and the regulatory authority find a lack of effective competition before the reasonableness of the rate could be considered.

Shippers can bring rate cases under three different methods including a Stand-Alone Cost (SAC), which was introduced by the ICC in 1985, and two simplified procedures introduced by the STB in 1997, the Simplified SAC and the Three-Benchmark. Wilson and Wolak (2016) provide a review of these procedures. SAC was introduced in 1985 (Coal Rate Guidelines, Nationwide. 1985 [1 ICC.2d 520, 1985 WL 56819 (ICC)). Basically, in a SAC case, the costs of a hypothetical railroad are used to establish an upper bound on the rates that are deemed reasonable. However, the evidence required is substantial and complicated with ample room for disagreement with the result that SAC cases are expensive and time-consuming. The STB (2013) estimate the costs can exceed $5 million.[6] Shippers have noted that the cost and complexity of

[5] The Surface Transportation Board Reauthorization Act of 2015 now authorizes the Board to investigate on its own initiative (S.808, Section 11).
[6] STB Ex Parte No. 715, Rate Regulation Reforms, July 8, 2013, pp. 10–11.

rate cases limit their use GAO (1999). In the ICC Termination Act of 1995, Congress ordered the STB to develop expedited procedures for resolving disputes. In response, in 1997, the STB introduced the Simplified SAC and the Three-Benchmark standards. Each limit the evidence that parties can submit and set a time limit for decisions.[7]

When first passed market dominance was a consideration of intramodal, intermodal, product and geographic competition. Since 1998, however, the STB has prohibited product and geographic competition on the basis that the impeded efficient processing of the proceeds and presented "undue burdens and obstacles" for shippers challenging rates (STB Ex Parte No. 627, December 10, 1998).[8] Since then a number of cases have caused STB to express concern that assessments of market dominance will slow down and potentially deter rate challenges. It has stated that "new cases involving challenges to dozens, if not hundreds, of transportation rates raise complex market dominance issues. Without some more objective means of resolving these issues quickly, the market dominance inquiry will soon dwarf the rate reasonableness inquiry" (STB NOR No. 42123, M&G Polymers USA, LLC, v. CSX Transportation, Inc.). It is also noteworthy that in 2013 the Association of American Railroads petitioned the STB to restore product and geographic competition, citing the changing nature of rate relief complaints and the growing complexities of making market dominance decisions. The STB ruled against the petition, finding that railroads did not offer a practical framework that could be used in proceeding to establish the existence and practical effect of these forms of competition (STB Ex Parte No. 717).

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[7] A complete review is beyond the scope. See Pittman (2010; 2011) and Wilson and Wolak (2016) for more complete discussions.

[8] This decision was in direct response to the demand by Congress for the timely handling of rate challenges, "avoiding delay in the discovery and evidentiary phases" of proceedings (49 USC §10704(d), §10701(d)(3)).

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The legislation requires that when a railroad has "market dominance," its common carrier rates must be "reasonable."(49 USC §10701(d)(1), §10702.). Market dominance is defined as the absence of effective competition from other railroads or modes of transportation (49 USC §10707). A rate is automatically considered reasonable if it does not exceed 180 percent of its "variable cost," as determined by the Surface Transportation Board (STB) (49 USC §10707(d)(1)(A)). If a disputed rate exceeds this percentage and is found to be in a market lacking effective competition, STB can rule on whether the rate is reasonable.[9] If STB finds the rate to be unreasonable, it must order the railroad to compensate the shipper for overpayments, and it may prescribe the maximum rate the railroad can charge for future movements (49 USC §11704(b), §10704(a)(1).)

To implement the standards, the variable costs of a shipment must be calculated, and the legislation mandates that the ICC and now the STB have a costing methodology.[10] The ICC had used Rail Form A, an accounting-based cost allocation systems for costing railroad services and activities, since 1939. Under regulatory reforms, the ICC was charged to develop an updated method to determine "economically accurate railroad costs directly and indirectly associated with particular movements of goods, including the variable costs associated with particular movements."[11] To comply, ICC developed the Uniform Railroad Costing System (URCS), which

[9] When a complaint is filed, STB may investigate the reasonableness of the challenged rate or dismiss the complaint if the complaint does not contain reasonable grounds for investigation and action [49 USC §10704(b), §11701(a), 11701(b)].

[10] The Staggers Rail Act, §10705a(m)(1), required ICC to determine variable costs by using its Rail Form A costing method or to adopt an alternative method.

[11] Cost accounting principles in Title III, Section 301, §11162 of the Staggers Rail Act of 1980.

was adopted in 1989 and shares a methodological approach with earlier cost accounting schemes and remains in use today.[12]

In our previous work, we review the URCS program in some detail and hold that it should be abandoned. Railroads produce thousands of outputs and URCS uses a series of assumptions that allocate costs to different cost categories and uses system-wide data to estimate the variable costs of a specific shipment. [13] A difficulty with this approach is that there are many common costs in railroad production. For example, a a train containing a 10-carload shipment of wheat and a 10-carload shipment of coal. The *total variable cost* of the train may be readily defined as all of the costs such as crew wages and fuel that can be avoided by not operating it.[14] The *incremental cost* of each set of cars is also readily defined. It is the difference between the cost of operating the train with and without each set—for example, the fuel saved by not having to move as much weight. However, the locomotive must be used even if only one set of cars is moved. Some of its operating costs, such as crew wages, are included in the train's total variable cost but not in the incremental cost of each set of cars. Any allocation of the total variable cost of the train among individual shipments must divide all the operating costs of the locomotive among the shipments, a division that has no basis in fact and is inherently arbitrary.

In addition, the criticism of allocating common costs arbitrarily, Rhodes and Westbrook (1986, p. 291) criticize several of the assumptions implicit in the URCS methodology, their primary focus is the validity of the econometric methods employed to estimate the variability ratios

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[12] ICC decided that Rail Form A's data structure and statistical techniques did not reflect the operation of the modern railroad industry (STB 2010, 2).

[13] The expense groups and methods used to allocate portions to traffic are described more fully by Wilson and Bitzan (2003).

[14] There may be variable costs of activities that support both this train and other trains; allocating them between this and other trains would be inherently arbitrary. This complication is ignored, and the train's total variable cost is assumed to be well defined.

used to compute the cost allocation factors that apportion shares of each accounting category total costs to individual shipments. They do not examine whether the URCS methodology yields an economically meaningful measure of the cost of a shipment. But, in our previous work (Wilson and Wolak (2016)), we found that URCS is a cost allocation scheme that has no economic foundation. The relevant foundation emanates from the theory of multiproduct production. In particular, we should that the proper concept is that of incremental and marginal costs of a shipment, which produce lower bound on the revenues that a profit-maximizing railroad will require to move a shipment.[15] We also illustrated that considerable shares of traffic moved at less than 100 percent of URCS generated variable costs (up to 20 percent for some products and time periods); results that provide strong evidence that URCS variable costs are not measures that any rational railroad would use for pricing or operating decisions. Finally, we examined the sensitivity of the R/VC measure to components of costs included in URCS which have no basis e.g., depreciation and return on investment and also the differences in costs for the same movement across railroads. We found that the R/VC for the same movement provided by different railroads differed substantially across railroads, and R/VC>180 were affected. We also found that exclusion of fixed factors from the calculation of variable costs also had significant effects on not only the R/VC's but also they affected whether or not the STB has jurisdiction.

Our conclusion is that the results from URCS cannot be represented as meeting the law's requirement for economic accuracy, and they cannot be portrayed as having any relevance to the price charged for a given unit of traffic as implied by their use in the law's R/VC formula. STB's

[15] Although Rhodes and Westbrook (1986, p. 291) criticize several of the assumptions implicit in the URCS methodology, their primary focus is the validity of the econometric methods employed to estimate the variability ratios used to compute the cost allocation factors that apportion shares of each accounting category total costs to individual shipments. They do not examine whether the URCS methodology yields an economically meaningful measure of the cost of a shipment.

own Railroad–Shipper Transportation Advisory Council has referred to URCS as "an outdated and inadequate costing system."[16]

A problem is that a costing program is mandated by legislation. In addition to being used in screening traffic for rate relief eligibility according to the R/VC formula, URCS is used in subsequent procedures to determine market dominance, to make assessments of whether a challenged rate is reasonable, and, if necessary, to prescribe the maximum tariff rate a railroad may charge. URCS is also used in measuring avoidable costs when a railroad applies to abandon a line and in calculating compensation fees for mandated access (STB 2010, 6–8). It is also used by others to judge levels of market power and trends in the industry. For example, in 2006 the U.S. Government Accountability Office (GAO) examined trends in shipments having rates with various R/VC percentages to determine whether railroads were obtaining and exercising more market power over time (GAO 2006). In finding that the share of traffic having R/VCs above 180 percent had dropped from 1985 to 2004, GAO surmised that the market power of railroads had been declining. Coincidental with these findings, however, GAO found that the amount of traffic having R/VCs exceeding 300 percent had increased from 4 to 6 percent, which caused the agency to question whether railroads were becoming more effective in exploiting market power when they possessed it (GAO 2006, 43). Fundamentally dependent on URCS-derived costs, such expanded uses of the R/VC formula have no basis in fact. We propose a benchmarking approach in the next section. This approach provides an entirely new approach to identifying rates that are potentially excessive and may warrant regulatory review for reasonableness.

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16 http://www.stb.dot.gov/stb/docs/RSTAC/RSTAC%20URCS%20White%20Paper%20on%20URCS%20November%2022.pdf.

III. BENCHMARKS

Our benchmarks are formed from data that pertain to movements that are exempt from regulatory oversight. These include both exempted traffic and contract movements. At the time Staggers was passed our approach was not feasible in that all rates were subject to regulation. But, Staggers allowed the regulatory authority to exempt traffic from regulation (49 USC §10502) and it allowed the use of confidential contracts which were not subject to regulation. Under partial deregulation, large classes of traffic were exempted by the ICC and the contracts became widely used.

The legislation declared that the new regulatory policy would be to allow "competition and the demand for services to establish reasonable rates for transportation by rail." (49 USC §10101 (1)). Regulators were instructed to be aggressive in fully exempting from any further regulatory control all traffic—truck-competitive traffic being the most obvious—for which regulation was "not needed to protect shippers from the abuse of market power."[17] ICC would have no control over the rates charged to shippers of exempt traffic or the amount and quality of service made available to them. For commodities that were not ruled exempt, such as coal, grain, chemicals, and other bulk freight, a critical reform was the law's legalization of confidential contracts between railroads and shippers. Any shipment moved under contract would be automatically excluded from any further regulation during the life of the contract; railroads would thus be free to tailor their rate and service offerings on a shipper-by-shipper basis.

The legalization of confidential contracting was a radical change in regulatory policy. Contracting had not been permitted by ICC because of the aforementioned value of service rate

[17] 49 USC §10502. Although the exemption provision is not explicit in identifying trucks as the competition of interest, trucks are the only ubiquitous mode, and thus a commodity's practical capability to be moved by truck became the de facto standard for deciding whether a commodity should be considered inherently competitive and granted a categorical exemption.

structure and expectations of the uniform treatment of shippers of "like traffic." The ability of a railroad to contract gave it substantial latitude to set rates differentially according to a shipper's individual circumstances and willingness to pay, since tariff (i.e., common carrier) rates were no longer generally applicable. The Act thus ended ICC prohibitions against "locational" and "personal" rate discrimination as applied to most traffic. Railroads would not only be allowed to compete more aggressively for the newly exempted freight that is inherently competitive with trucks but would also be allowed to set tariff rates for the nonexempt bulk commodities at levels equivalent to the most rail-dependent shipper's willingness to pay. While shippers with more transportation options would be expected to refuse to pay the higher rate, a railroad could simply negotiate a discounted contract rate with terms tailored to each shipper's specific situation and willingness to pay. The price-differentiating railroad would now be able to set rates at levels that avoid pricing any profitable traffic flows out of the market.[18] If successful, the deregulated railroads could earn the revenues needed to keep supplying rail service over the long term and perhaps earn even more.

In terms of benchmarking, we provide a brief overview. Data on shipment characteristics and rates in effectively competitive markets are used to construct a predicted, or competitive benchmark, rate for any given rail shipment in a potentially noncompetitive market on the basis of key observable characteristics of the shipment. The statistical model used to compute competitive benchmark rates is a conditional quantile function for the distribution of average rates (revenue per ton-mile) for the shipment conditional on observable characteristics of the shipment. These characteristics include the distance traveled, the number of carloads in the shipment, the number

[18] Because of the incentive to extract rents but not price traffic out of the market, the efficiency loss from railroads having pricing freedom is expected to be minimal. Indeed, limited deadweight loss was found by Grimm and Winston (2000, 65).

of railroads involved, and competitive circumstances at the origin and destination (i.e., number of competing railroads and availability of other transport modes), as well as controls such as calendar year and railroad and commodity fixed effects.

Separate models and benchmark rates are developed for four broad commodity groups: food products, coal, chemicals, and petroleum. Models could readily be developed for more commodities and for narrower product groups (e.g., grain, hazardous materials) as long as there are enough observations for precise estimation of the parameters. Once the effectively competitive benchmark model has been constructed for each commodity, a shipper could determine how close its common carrier rate is to the competitive benchmark rate for shipments having the same set of observable characteristics but in markets with effective competition. When such tests are performed, a significant fraction of rates tested will exceed the competitive benchmark rate even if pricing is not affected by the level of competition. All the conditional quantile models have a prediction error. None can include all relevant rate-determining variables because some are not currently available. Therefore, each tested rate that exceeds its benchmark value should not be presumed unusually high. Nevertheless, some of the tested rates will be much higher than their predicted values. The larger the margin is in percentage terms (i.e., the higher the ratio of the tested rate to the benchmark rate), the higher is the likelihood that this ratio was caused by something other than the prediction error in the model and can plausibly be attributed to the railroad exploiting the lack of competition.

All else equal, the larger the ratio of an actual rate in a potentially noncompetitive market to the rate predicted for the observed shipment characteristics from the benchmark group, the more likely the actual rate will be found unreasonable after further scrutiny. Determining the minimum ratio that should entitle a shipper to such scrutiny is not a technical problem but rather a policy choice. A lower ratio would allow more shippers who are paying reasonable rates to seek rate relief, whereas a higher ratio would deny relief to more shippers whose rates might otherwise have been found unreasonable. A low ratio could threaten the ability of a railroad to earn sufficient revenues to cover its overhead costs.

Regulators could set this threshold in many ways. For example, they could select the conditional median as the appropriate benchmark rate and rule that any rates 1.5, 2, 3, or some other multiple higher than the median are unusually high. Alternatively, the conditional 85th, 90th, 95th, or some other percentile of the distribution of predicted values could be set as the appropriate upper bound on the benchmark rate, meaning that all rates above this threshold are presumed to be unusually high. Consequently, there is a trade-off between the size of multiplier that is selected and how the benchmark rate is identified (i.e., the percentile of the conditional distribution that is designated, such as the median or the 90th percentile).

V. DATA

The primary source of data for developing and testing the benchmark models was the STB's Carload Waybill Statistics (CWS) from 2000 through 2013. Each year's CWS consists of more than 500,000 sampled shipments with information on revenue, distance, shipment size, and the railroads that provided the service. The CWS records also contain codes that can be linked with Oakridge Rail Network files allow shipper and receiver locations to be identified. Specifically, rail station records are identified by a Standard Point Location Code. The identifiers permitted the mapping of stations into the CWS and the assignment of latitude and longitude values to each shipment origin and destination. These data, along with railroad network geographic information system data,[19] were combined to identify locations of stations and shipment origins and

[19] http://www-cta.ornl.gov/transnet/RailRoads.html.

destinations and to develop measures of railroad competition. The data were also used in conjunction with the Port Series[20] data produced by the U.S. Army Corps of Engineers to measure the presence of water competition. The Port Series data indicate the location of ports on U.S. waterways along with the commodities handled by each port. Finally, all rates from the CWS were adjusted to constant 2009 dollar values by using the gross domestic product price deflator available from Federal Reserve Economic Data through the Federal Reserve Bank of Saint Louis.[21]

VI. EMPIRICAL APPLICATION

In the approach illustrated here, shipment rates (rate) are modeled as a function of shipment distance (X_1), shipment size (number of cars) (X_2), the number of railroads involved in the movement (X_3), the number of Class I railroads within 10 miles of the origin (X_4) and destination (X_5), a dummy to indicate whether the shipper owns the cars (X_6), and a dummy to indicate that there is no water port within 50 miles of the origin (X_7) or destination (X_8); if water is present, the distances of the origin (X_9) and destination (X_{10}) from the nearest port are included. Additional variables can be added to the vector of shipment characteristics, X, on the basis of further review and assessment. The elements of X selected for this implementation were based on two factors: (*a*) previous empirical research on the determinants of shipment rates and (*b*) the availability of the variables in the CWS and other publicly available data sets.[22] All of the continuous variables—distance, size, number of railroads, and proximity to the nearest water ports—are measured in natural logarithms.[23] Finally, fixed effects are included: β_t for the year (t), β_r for the primary

[20] http://www.navigationdatacenter.us/ports/ports.htm.
[21] http://research.stlouisfed.org/fred2/.
[22] See, for example, MacDonald (1987 and 1989) and Wilson (1994).
[23] A variety of functional forms were explored before the linear conditional quantile model was selected. Its transformation of the continuous variables performed best across the four commodities.

railroad in the movement (r), and β_c for the five-digit STCC categories (c). The parametric form of the model is given by the following:

$$\ln(\text{rate}_{rtc}) = \beta_r + \beta_t + \beta_c + \sum_{k=1}^{10} \beta_k X_{k,rtc} + \varepsilon_{rtc}$$

The error term, ε_{rtc}, is included to account for the fact that unobserved factors explain differences in rates across shipments that are not captured in the observed shipment characteristics and fixed effects included on the right-hand side of the equation. The presence of this unobserved random variable is the major reason why all rates in excess of the predicted competitive rate for a particular shipment's characteristics should not be deemed unreasonably high. Certain factors that are unobserved by the analyst and that may be either observed or unobserved by the parties may influence the price set for this route.

This parametric model is estimated by both OLS and quantile regression methods. There are many possible ways to compute the benchmark price. The results reported below are based on the conditional median function, $Q(0.5|X)$, which is the 0.5 quantile function of the conditional distribution of the shipment price given the vector of shipment characteristics, X. The first step is to compute the ratio of the actual price for each shipment in the noncompetitive (non-benchmark or test group) sample to the value of $Q(0.5|X)$ for the set of characteristics, X, of that route. This is followed by a presentation of the distribution of the ratio of the actual price to $Q(0.5|X)$ for each observation in the noncompetitive sample. These plots are useful for determining the appropriate value of the multiplier to apply to $Q(0.5|X)$ to compute the maximum price for a shipment with characteristics X that would not be subject to mitigation.

Imposition of a linear functional form restriction on the conditional quantile function is unnecessary. This restriction is imposed for the current application as a means of simplifying the presentation. Nonparametric methods could be used to estimate the conditional distribution of y given the vector of observable shipment characteristics, $F(y|X)$. For example, kernel density estimation methods could be used to compute an estimate of $F(y|X)$ for the effectively competitive sample of shipments.[24] Such an estimate of $F(y|X)$ could then be used to compute the conditional median function $Q(0.5|X)$ or a conditional quantile function for any other quantile of $F(y|X)$ that does not rely on a parametric functional form assumption. Such a nonparametric procedure for computing $F(y|X)$ would counter the possibility that small changes in functional form might unduly benefit some railroads or shippers when parametric-based approaches to the computation of conditional quantile functions are used.

The value of y, the dependent variable, in all regression models is the average revenue per ton-mile deflated by the gross domestic product price deflator. This variable is simply the revenue received from a shipment divided by the product of the number of tons in the shipment and the distance traveled. Revenues are the sum of freight revenues (transportation-related revenues), miscellaneous charges, and fuel surcharges. Fuel surcharges were introduced by railroads in 2003 but were reported in different CWS fields by different railroads. Some railroads included surcharges in the freight revenue field and others included them in the miscellaneous revenue field. From 2009 forward, CWS has had a separate field for fuel surcharges. In the calculation for ton-miles, the variable “billed weight” was used for tons, and distance was calculated as the “total miles traveled for the shipment.”

[24] Silverman (1986) provides an accessible introduction to these estimation methods.

The explanatory variables used in the model are based on past econometric studies that examine how rail rates relate to shipment characteristics such as distance, shipment size, and number of railroads involved in the shipment, as well as various measures of intramodal and intermodal competition (Boyer 1987; Barnekov and Kleit 1990; McFarland 1989; Burton 1993; Wilson 1994; Dennis 2000; Schmidt 2001; MacDonald 1987; MacDonald 1989; Grimm et al. 1992; Burton and Wilson 2006).[25] The specific explanatory variables used in the models estimated include distance, shipment size (in carloads), the number of Class I carriers within a specified distance from the origin and destination, whether the cars are owned privately or by a railroad, the presence of waterway competition, and distance to the nearest waterway locations. Shipment distance, shipment size, the number of railroads involved in the movement, and the private cars dummy variable are directly observed in the CWS or are easily constructed from the data.

Railroad competition is measured as the number of Class I railroads within 10 miles of the origin and of the destination. Other options considered, such as the number of competing railroads within 20, 30, and so on up to 200 miles, produced similar results. They had relatively stable measures of fit and coefficient estimates. The measure of waterway competition was computed in a similar but more involved manner. It required that both the shipment origin and the destination be within a specified distance of ports on the same waterway system.[26] This reflects the fact that an origin near the Mississippi River System and a destination near the Columbia River System are unlikely to constrain railroad pricing. As with railroad options, multiple distances to waterways

[25] Shipment size is measured by carloads in the shipment. It is common practice for railroads to offer lower rates for multiple-car shipments as well as unit train shipments. Unfortunately, there is no unambiguous identifier for unit train shipments in the data. Various conventions for defining unit train shipments were explored; the results on reported coefficients were nearly identical across the specifications.

[26] Waterway systems were defined as the Mississippi River (including tributaries and the Great Lakes), the Columbia River, the East and Gulf Coasts, and the West Coast.

were considered. The distances ranged from 20 to 200 miles. In the models reported here, waterway competition is captured by two variables. First, a dummy (Nowater) was given a value of 1 if there are no water ports within 50 miles of the origin and destination. Second, for locations within 50 miles, distances to water were included for both the origin and the destination.

The remaining variables are fixed-effect controls for the year of the movement, STCC category, and railroad. STTCs are two- to seven-digit codes. As discussed below, estimation proceeds for different STCCs at the two-digit level, but five-digit commodity fixed effects are used to control for differences between more narrowly defined commodities (e.g., wheat versus corn). Finally, a railroad dummy variable is introduced to control for differences across railroads. For single-line hauls, it is simply the railroad that provided the service. For multiple-railroad movements, the dummy was assigned to the railroad that hauled the movement the longest distance.

To recap, a number of decisions would need to be made before a competitive rate benchmarking methodology could be put into practice. They would need to address at least the following: (*a*) the validity and integrity of the random sampling scheme used by the CWS; (*b*) the criteria to be used in identifying the set of shipments to be included in the effectively competitive sample used to estimate the competitive benchmark rate function; (*c*) the set of economically relevant shipment characteristics, *X*; (*d*) the statistical methodology to be used in estimating the conditional quantile function; and (*e*) the procedure to be used in computing the maximum price for a tested shipment that would qualify it for further scrutiny as being unreasonable.

Summary statistics are presented in the subsections that follow for the models developed and applied for each of the four commodity groupings: farm products (STCC = 01), coal (STCC = 11), chemicals (STCC = 28), and petroleum (STCC = 13 and the portion of 29 corresponding to petroleum products). The first table shown for each commodity model contains descriptive statistics of the shipments that make up the benchmark and nonbenchmark samples. The statistics for both samples are for 2000 through 2013. Only the 2013 observations from the nonbenchmark sample are subsequently used to illustrate the model, and they are referred to as the test group.[27] Because the statistics presented are averages (i.e., average distance shipped, average rate, average number of railroads at origin), each observation is weighted on the basis of its sampling rate (i.e., expanded to the full population).[28]

A second table summarizes the nonintercept effects for each model as estimated by quantile regression for quantiles 0.25, 0.5, 0.75, and 0.9 (i.e., the intercept effects, railroad dummies, annual dummies, and STCC dummies are suppressed), each weighted by the expansion factor. The application of the benchmarking methodology required the designation of a specific quantile of the estimated conditional distribution for construction of the competitive benchmark rate. The median (quantile = 0.5) was designated for this purpose. Ordinary least squares (OLS) estimates are also reported in the tables as an informal specification test of the functional form for the linear conditional quantile functions.[29]

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[27] Of course, all the 2000–2013 nonbenchmark records could have been used in applying the model. Only the 2013 records were used for illustrative purposes and to make the applications manageable.

[28] The STB expansion factor for a shipment is equal to the number of shipments that this shipment represents in the population of shipments served by the railroad annually (as described in Box 1). For example, each shipment that consists of one or two carloads is sampled at a rate of 1:40, and therefore these observations are expanded by 40, whereas each shipment consisting of 100 or more carloads is sampled at a rate of 1:2, and therefore these observations are expanded by 2. The averages shown in the descriptive statistics tables, such as those for rates and distances, should not be compared with those elsewhere in the report, which are weighted by ton-miles rather than shipments.

[29] Koenker and Bassett (1982) show that under the joint hypothesis that the functional form for the conditional quantile function is correctly specified and the error terms, ε_{rtc}, are independent and identically distributed, the slope coefficients in the OLS model and all conditional quantile functions should have the same probability limit. Although a formal statistical test of this joint

As noted, the models are applied with only the 2013 test group observations. Two graphs are provided showing the distribution of the actual-to-predicted rates for the 2013 test group. The first graph shows the entire distribution. The more heterogeneous commodity groups (chemicals and petroleum) produce long tails, perhaps because of the wide range of products in these commodity groups. A second graph shows a truncated distribution that removes the upper and lower 1 percentiles of observations. The truncated versions make the density of observations exceeding the median rate by a factor of 2 to 3 easier to see.

A table follows the second graph showing the number of observations with actual-to-predicted rate ratios at various intervals above 1. The observations are disaggregated further into tariff and contract shipments. The tables provide a general sense of the relative shares of shipments that would be candidates for scrutiny if different intervals (i.e., bins) above the median were selected as benchmark cutoff points. The columns labeled "expanded" in this table report the expansion-factor frequency of a given ratio in each bin. This calculation is reported to determine whether high-ratio shipments are over- or undersampled relative to their frequency of occurrence in the population of total shipments.

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null hypothesis was not performed, the slope coefficients are very similar across the columns of the tables for all four commodity groups.

The results from the application of the four illustrative models indicate that regulators may need to establish commodity-specific thresholds for identifying a tested rate that qualifies as being unusually high and deserving of further scrutiny as a candidate for relief. Important factors to consider in making such determinations are the number of likely excluded shipment characteristics that have economic meaning and the precision with which the conditional quantile function is estimated. However, the competitive rate benchmarking process is intended only to identify rates that are unusually high and deserving of further scrutiny; it is not intended as the final arbiter of rate reasonableness.

Farm Products

The descriptive statistics for the observations used in the construction and application of the farm products model are provided in Table 1. There are a total of 169,872 observations, with 53,778 in the benchmark sample and 116,094 in the nonbenchmark sample. The large number of shipments in the nonbenchmark sample reflects the substantial use of common carriage (tariff) service by shippers of farm products, especially grain and oilseeds shipments. In 2009 dollars, the average rate for the combined sample is 4.7 cents per ton-mile. The average distance traveled is 896 miles, and the average shipment size is 9.4 cars. Most shipments involve only one railroad in the move. On average, shippers have 1.8 railroads within 10 miles of the origin and 2.4 railroads within 10 miles of the destination. In view of the large amount of Midwestern corn and wheat in the sample, the lack of water options within 50 miles for nearly 90 percent of shipments is interesting. Finally, about 40 percent of movements are made in private cars. There is little difference across the two sample groups in most variables. However, the nonbenchmark observations tend to ship in greater quantities, and by construction they tend to have less competition (both rail and water).

TABLE 1 Farm Products Summary Statistics, 2000–2013

Variable	Combined Samples	Benchmark Sample	Nonbenchmark Sample
Observations	169,872	53,778	116,094
Revenue per ton-mile (2009 dollars)	0.047	0.049	0.045
Distance (miles)	896	950	854
Shipment size (number of cars)	9.4	5.5	12.3
Number of railroads in shipment	1.17	1.20	1.15
Number of Class I railroads within 10 miles of origin	1.84	2.32	1.47
Number of Class I railroads within 10 miles of destination	2.42	2.75	2.17
No water ports within 50 miles (binary)	0.89	0.87	0.91
Distance to water from origin (miles)	158.5	146.4	167.9
Distance to water from destination (miles)	109.1	96.3	119.0
Private car (binary)	0.40	0.41	0.40

NOTE: All values are means weighted by the expansion factor associated with each sampled shipment.

The benchmark sample was used to develop the farm products model, as was the case for all models. The model nonintercept effects are summarized in Table 2 for the regression quantiles 0.25, 0.5, 0.75, and 0.9. OLS estimates are also reported. The coefficient estimates for the same variable have the same sign across columns of the table. The magnitudes are also stable across the columns. Increases in shipment distance and shipment size tend to predict lower rates (revenue per ton-mile), while increases in the number of railroads involved in the shipment tend to predict higher rates. The competition variables, rail and water, are statistically important and have signs consistent with intuition and the literature cited above.

TABLE 2 Benchmark Models—Farm Products (Based on Competitive Benchmark Data)

		Quantile			
Variable	OLS	0.25	0.5	0.75	0.9
ln(distance)	–0.467	–0.431	–0.464	–0.482	–0.515
	(0.00300)	(0.00276)	(0.00234)	(0.00234)	(0.00388)
ln(cars)	–0.0406	–0.0344	–0.0403	–0.0360	–0.0400
	(0.00145)	(0.00118)	(0.00113)	(0.00120)	(0.00196)
ln(number of RR involved in movement)	0.244	0.189	0.209	0.236	0.331
	(0.00952)	(0.00441)	(0.00733)	(0.00607)	(0.0139)
No. of Class I within 10 mi of origin	–0.0224	–0.0207	–0.0212	–0.0206	–0.0122
	(0.00117)	(0.000983)	(0.00105)	(0.00104)	(0.00157)
No. of Class I within 10 mi of destination	–0.0207	–0.0232	–0.02326	–0.0210	–0.0195
	(0.00125)	(0.00108)	(0.00108)	(0.000893)	(0.00129)
Nowater (binary)	0.0735	0.0962	0.0762	0.0314	0.0696
	(0.0116)	(0.00743)	(0.00987)	(0.00723)	(0.0174)
ln(mi from origin to port)	0.0231	0.0203	0.0197	0.0128	0.0245
	(0.00383)	(0.00226)	(0.00336)	(0.00251)	(0.00534)
ln(mi from destination to port)	0.0218	0.0277	0.0217	0.00939	0.0201
	(0.00380)	(0.00261)	(0.00326)	(0.00320)	(0.00604)
Private car	–0.134	–0.116	–0.109	–0.129	–0.116
	(0.00443)	(0.00370)	(0.00358)	(0.00316)	(0.00539)
Observations	53,205	53,205	53,205	53,205	53,205
R^2	0.731				

NOTE: All standard errors are $p < .01$. All results are weighted by the expansion factor. OLS estimates are reported as an informal specification test of the functional form for the linear conditional quantile functions.

The 2013 test group consists of 6,319 observations. The median regression model in Table 2 is used to predict their competitive benchmark rates. The ratios of actual rate to predicted rate for the 6,319 shipments are summarized in Figures 1 and 2 and in Table 3. Figure 1 provides the entire distribution, while Figure 2 provides the distribution with the largest ratios (i.e., rates that are more than 3 times their predicted rate) excluded. As shown in Figure 1, most of the ratios are near 1, but the distribution is positively skewed, with some very large values. As indicated in Table 3, 75 percent of the observations have ratios of less than 1.2. The maximum ratio is 9.35. Most of the ratios are between 0 and 2, as portrayed in the truncated distribution in Figure 2 and by the cumulative percentages in Table 3.

The close agreement between the percentages in the "observations" and "expanded" columns in Table 3 suggests that high ratios occur at roughly the same frequency in the sample as in the population of shipments. Because this finding holds across all four models, it is not repeated.

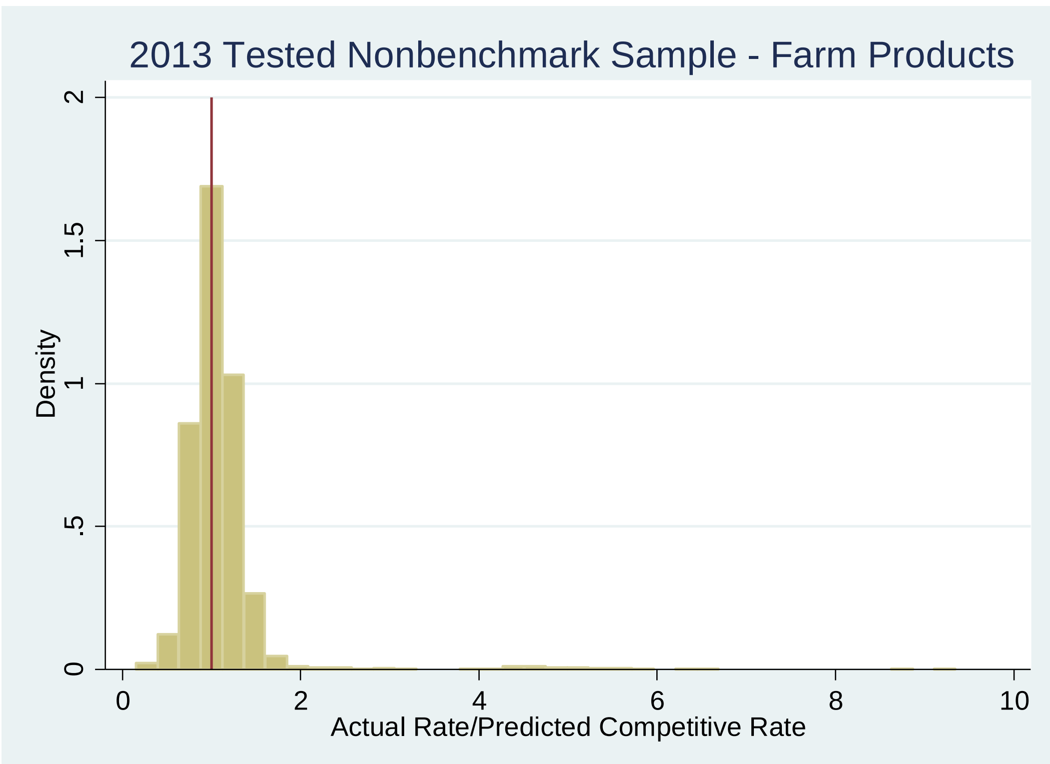

FIGURE 1 Distribution of ratios of actual to predicted rates, nonbenchmark sample, farm products, no ratios excluded. ARTM = actual revenue per ton-mile.

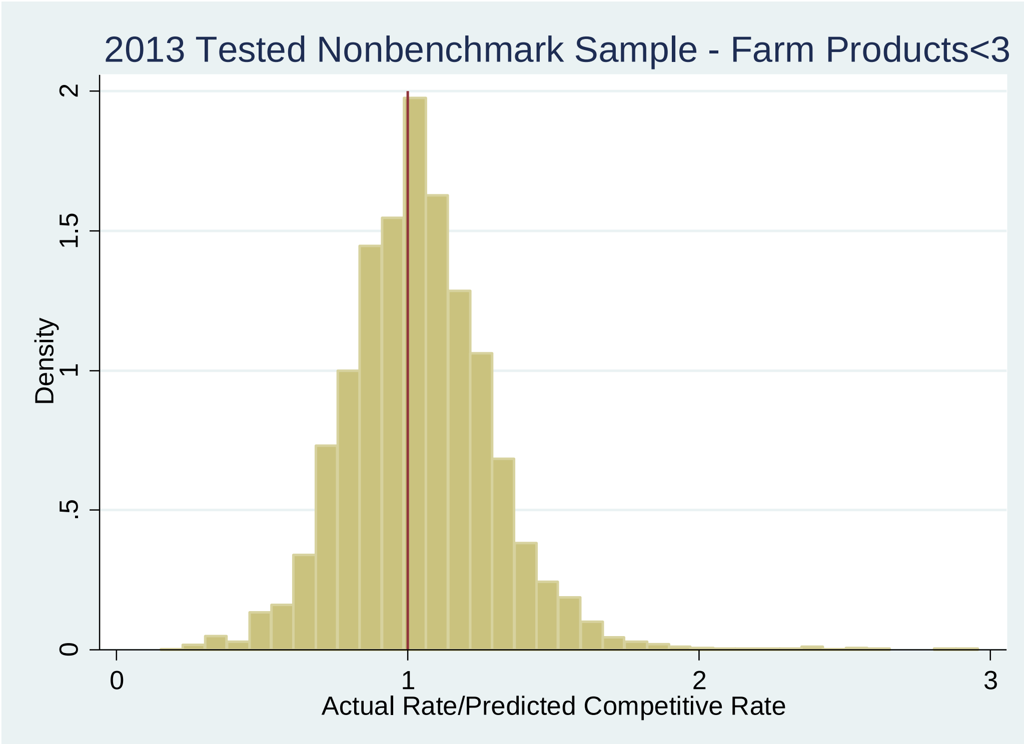

FIGURE 2 Distribution of ratios of actual to predicted rates, nonbenchmark sample, farm products, ratios greater than 3 excluded.

TABLE 3 Farm Products Model: Distribution of 2013 Test Group Observations, Ratios of Actual Rate to Benchmark Rate

	Observations					Expanded	
Group	Contract No.	Tariff No.	Total	%	Cum. %	%	Cum. %
$r \leq 1$	255	2,512	2,767	43.2	43.2	41.7	41.7
$1 < r \leq 1.2$	96	1,971	2,067	32.3	75.5	31.4	73.1
$1.2 < r \leq 1.4$	25	1,017	1,042	16.3	91.8	16.3	89.4
$1.4 < r \leq 1.6$	1	299	300	4.7	96.5	6.6	96
$1.6 < r \leq 1.8$	1	72	73	1.1	97.7	1.3	97.3
$1.8 < r \leq 2.0$	0	22	22	0.3	98.0	0.6	97.9
$r > 2.0$	5	123	128	2.0	100	2.1	100
Total	383	6,016	6,399	100		100	

NOTE: The groups are defined by the ratio (r) of ARTM to the predicted 50th percentile. Cum. = cumulative. The columns showing expanded percentages use the sample rate expansion factor associated with each observation.

Coal

The descriptive statistics for coal are provided in Table 4. There are 446,820 total observations, with 291,431 in the competitive benchmark sample and 155,389 in the nonbenchmark sample. The benchmark sample rates are lower on average (3.4 cents versus 4.2 cents per ton-mile), shipment distances are longer (721 versus 473 miles), and shipment sizes are greater (82 versus 24 cars). Water is a less likely competitive option for the benchmark group, since 36 percent of the observations have no water access within 50 miles, compared with 16 percent of the nonbenchmark group. Furthermore, the distances to water are higher for the benchmark group—304 miles from the origin and 89 miles from the destination versus 137 miles and 53 miles, respectively, for the nonbenchmark group. Finally, the percentage of private cars is much higher for the benchmark group (58 versus 23 percent).

The regression results are shown in Table 5. The coal model was developed with a binary variable (West), which was set at 1 for shipments originating west of the Mississippi River. This variable was added to account for western coal shipments typically being much larger and moving longer distances than eastern coal shipments and because western coal has lower sulfur content than eastern coal, which makes them somewhat different products. Again, the intercept effects (rail, STCC level 5, and annual dummies) are suppressed. As in the case of farm products, the signs of the coefficients are consistent across columns, and the results are stable across columns in terms of the magnitudes of the coefficient estimates. As might be expected, longer shipment distances and larger shipment sizes tend to predict lower rates (revenue per ton-mile). One anomaly is the number of railroads involved in the shipment. In some specifications this coefficient is negative, while in other specifications it is positive. However, for nearly 90 percent of the observations, one railroad is involved in the shipment. Rail competition at the origin or destination predicts lower prices in all specifications. The presence of water competition and shorter distances to water from the origin and destination both predict lower rates, while the use of private cars predicts lower rates. Western coal tends to have lower rates, all else equal, than eastern coal.

TABLE 4 Coal Summary Statistics, 2000–2013

Variable	Combined Samples	Benchmark Sample	Nonbenchmark Sample
Observations	446,820	291,431	155,389
Revenue per ton-mile (2009 dollars)	0.039	0.034	0.042
Distance (miles)	569	721	473
Shipment size (number of cars)	46	82	24
Number of railroads in shipment	1.19	1.30	1.16
Number of Class I railroads within 10 miles of origin	1.84	1.91	1.80
Number of Class I railroads within 10 miles of destination	2.52	2.72	2.40
No water ports within 50 miles (binary)	0.24	0.36	0.16
Distance to water from origin (miles)	202	304	137
Distance to water from destination (miles)	67	89	53
Private car (binary)	0.37	0.58	0.23

NOTE: All values are means weighted by the expansion factor associated with each sampled shipment.

As before, the results in Table 5 for the 50th percentile (median) are used to predict the rates for the 3,670 observations in the 2013 test group. The ratio of the actual rate to the predicted rate is summarized in Figures 3 and 4 and in Table 6. Most of the observations are clustered around 1, but some values exceed 3.

TABLE 5 Benchmark Models—Coal (Based on Competitive Benchmark Data)

		Quantile			
Variable	OLS	0.25	0.5	0.75	0.9
ln(distance)	–0.436	–0.362	–0.446	–0.510	–0.527
	(0.00201)	(0.00132)	(0.00128)	(0.00148)	(0.000850)
ln(cars)	–0.114	–0.111	–0.112	–0.113	–0.103
	(0.00153)	(0.000684)	(0.000634)	(0.000701)	(0.000821)
ln(number of railroads)	–0.0703	–0.0994	–0.0871	0.135	0.213
	(0.00619)	(0.00319)	(0.00409)	(0.00437)	(0.00504)
No. of Class I within 10 mi of origin	–0.0899	–0.0807	–0.0965	–0.101	–0.0952
	(0.00104)	(0.000464)	(0.000541)	(0.00109)	(0.00136)
No. of Class I within 10 mi of destination	–0.0468	–0.0481	–0.0521	–0.0429	–0.0418
	(0.000902)	(0.000616)	(0.000689)	(0.000653)	(0.000644)
West (binary)	–0.265	–0.346	–0.235	–0.0335	–0.0400
	(0.00833)	(0.00430)	(0.0114)	(0.00459)	(0.00988)
Nowater (binary)	0.204	0.166	0.203	0.273	0.160
	(0.00901)	(0.00425)	(0.00427)	(0.00556)	(0.00706)
ln(mi from origin to port)	0.0299	0.0235	0.0275	0.0414	0.0112
	(0.00145)	(0.000901)	(0.000657)	(0.000977)	(0.00125)
ln(mi from destination to port)	0.0257	0.0279	0.0280	0.0290	0.0249
	(0.000825)	(0.000679)	(0.000453)	(0.000692)	(0.000607)
Private car (binary)	–0.124	–0.115	–0.104	–0.0671	–0.107
	(0.00297)	(0.00204)	(0.00213)	(0.00208)	(0.00206)
Observations	289,718	289,718	289,718	289,718	289,718
R^2	0.785				

NOTE: All standard errors are $p < .01$. All results are weighted by the expansion factor.

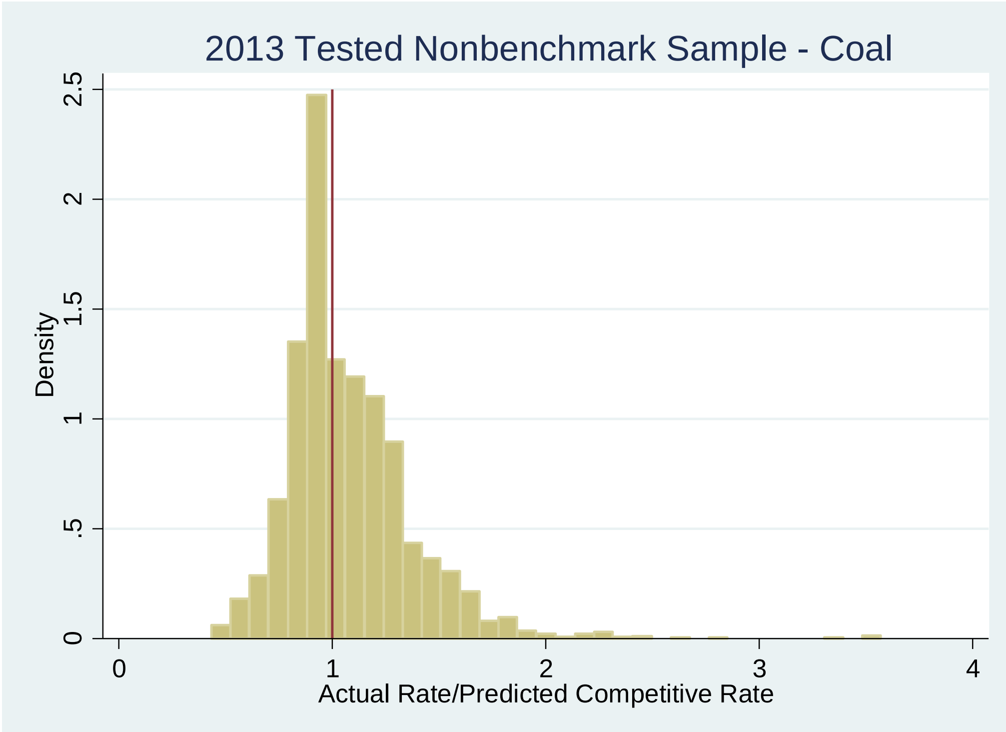

FIGURE 3 Distribution of ratios of actual to predicted rates, nonbenchmark sample, coal, no ratios excluded.

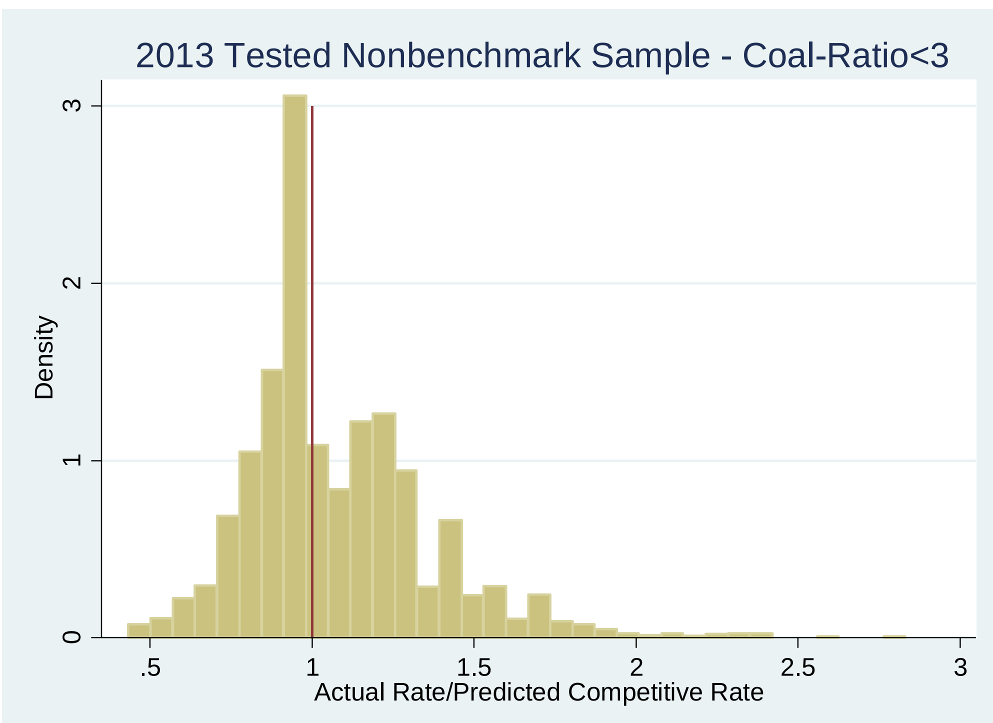

FIGURE 4 Distribution of ratios of actual to predicted rates, nonbenchmark sample, coal, ratios greater than 3 excluded.

TABLE 6 Coal Model: Distribution of 2013 Test Group Observations, Ratios of Actual Rate to Benchmark Rate

	Observations					Expanded	
Group	Contract No.	Tariff No.	Total	%	Cum. %	%	Cum. %
$r \leq 1$	679	1,175	1,854	50.5	50.5	54.7	54.7
$1 < r \leq 1.2$	85	657	742	20.2	70.7	20.1	74.9
$1.2 < r \leq 1.4$	167	412	579	15.8	86.5	12.9	87.7
$1.4 < r \leq 1.6$	77	213	290	7.9	94.4	6.9	94.6
$1.6 < r \leq 1.8$	61	50	111	3.0	97.4	2.5	97.1
$1.8 < r \leq 2.0$	13	24	37	1.0	98.4	1.1	98.2
$r > 2.0$	10	47	57	1.6	100	1.8	100
Total	1,092	2,578	3,670	100		100	

NOTE: The groups are defined by the ratio (*r*) of ARTM to the predicted 50th percentile. Cum. = cumulative. The columns showing expanded percentages use the sample rate expansion factor associated with each observation.

Chemicals

The descriptive statistics for chemicals for 2000 through 2013 are provided in Table 7. There are 556,467 total observations, with 357,998 in the competitive benchmark group and 198,469 in the nonbenchmark group. In 2009 dollars, the average rate for the combined sample is 8.6 cents per ton-mile. The average distance traveled is 778 miles, and the average shipment size is 1.2 cars. Most shipments involve only one railroad, and shippers have on average 2.6 railroads within 10 miles of the origin and 2.5 railroads within 10 miles of the destination. About 20 percent of shipments have no water options within 50 miles. Finally, about 96 percent of movements are made in private cars, since railroads own few tank cars. There is little difference across the two groups for most variables. However, the nonbenchmark shipments tend to have less access to rail and water.

TABLE 7 Chemicals Summary Statistics, 2000–2013

Variable	Combined Samples	Benchmark Sample	Nonbenchmark Sample
Observations	556,467	357,998	198,469
Average revenue per ton-mile (2009 dollars)	0.086	0.090	0.082
Distance (miles)	778	757	815
Shipment size (number of cars)	1.20	1.20	1.21
Number of railroads in shipment	1.30	1.31	1.28
Number of Class I railroads within 10 miles of origin	2.59	2.79	2.23
Number of Class I railroads within 10 miles of destination	2.54	2.59	2.44
No water ports within 50 miles (binary)	0.20	0.16	0.27
Distance to water from origin (miles)	95	76	129
Distance to water from destination (miles)	94	86	109
Private car (binary)	0.96	0.97	0.94

NOTE: All values are means weighted by the expansion factor associated with each sampled shipment.

In the chemical specification, a dummy variable is added to denote hazardous materials in recognition of potential added costs associated with transporting hazardous chemicals. About 38 percent of the shipments are hazardous materials. The estimation results are summarized in Table 8, excluding all fixed effects. The coefficient estimates for the same variable have the same sign across table columns. The magnitudes are also stable across columns. Increasing shipment distance and size both predict lower rates (revenue per ton-mile), while an increase in the number of railroads involved in the move predicts higher rates. The competition variables for both rail and water are statistically important and have signs that are consistent with the cited literature.

TABLE 8 Benchmark Models—Chemicals (Based on Competitive Benchmark Data)

		Quantile			
Variable	OLS	0.25	0.5	0.75	0.9
ln(distance)	–0.537	–0.478	–0.526	–0.576	–0.611
	(0.00106)	(0.00105)	(0.00115)	(0.00100)	(0.00134)
ln(cars)	–0.0674	–0.0584	–0.0643	–0.0682	–0.0705
	(0.00133)	(0.000811)	(0.00108)	(0.00123)	(0.000964)
ln(number of railroads)	0.314	0.248	0.269	0.294	0.350
	(0.00307)	(0.00246)	(0.00256)	(0.00253)	(0.00385)
No. of Class I within 10 mi of origin	–0.0093	–0.0204	–0.0233	–0.0171	–0.0076
	(0.000603)	(0.000452)	(0.000580)	(0.000563)	(0.000718)
No. of Class I within 10 mi of destination	–0.0521	–0.0609	–0.0570	–0.0470	–0.0362
	(0.000607)	(0.000557)	(0.000665)	(0.000649)	(0.000517)
Nowater (binary)	0.0564	0.0739	0.0687	0.0614	0.0333
	(0.00364)	(0.00300)	(0.00371)	(0.00356)	(0.00419)
ln(mi from origin to port)	0.00864	0.00947	0.00963	0.00653	0.00285
	(0.000572)	(0.000484)	(0.000586)	(0.000557)	(0.000617)
ln(mi from destination to port)	0.0146	0.0194	0.0189	0.0168	0.0135
	(0.000574)	(0.000521)	(0.000612)	(0.000579)	(0.000649)
Private car (binary)	–0.102	–0.115	–0.0940	–0.0817	–0.0924
	(0.00437)	(0.00320)	(0.00411)	(0.00350)	(0.00465)
Hazmat (binary)	0.0708	0.0434	0.0701	0.0666	0.0511
	(0.00273)	(0.00203)	(0.00244)	(0.00258)	(0.00295)
Observations	356,187	356,187	356,187	356,187	356,187
R^2	0.656				

NOTE: All standard errors are $p < .01$. All results are weighted by the expansion factor.

The median regression (quantile = 0.5) results in Table 8 are again used to predict the rates for the 2013 test group, which totaled 8,176 observations. The ratios of actual to predicted rates are summarized in Figures 5 and 6 and in Table 9. As shown in Figure 5, the distribution is positively skewed, with some very large values. The maximum ratio is 19.8. As noted earlier, this large dispersion (compared with the other models), with more than 6 percent of observations having ratios greater than 2, may stem from the variability in the types of chemical products and their associated shipping characteristics. A more refined chemical model based on product may be warranted.

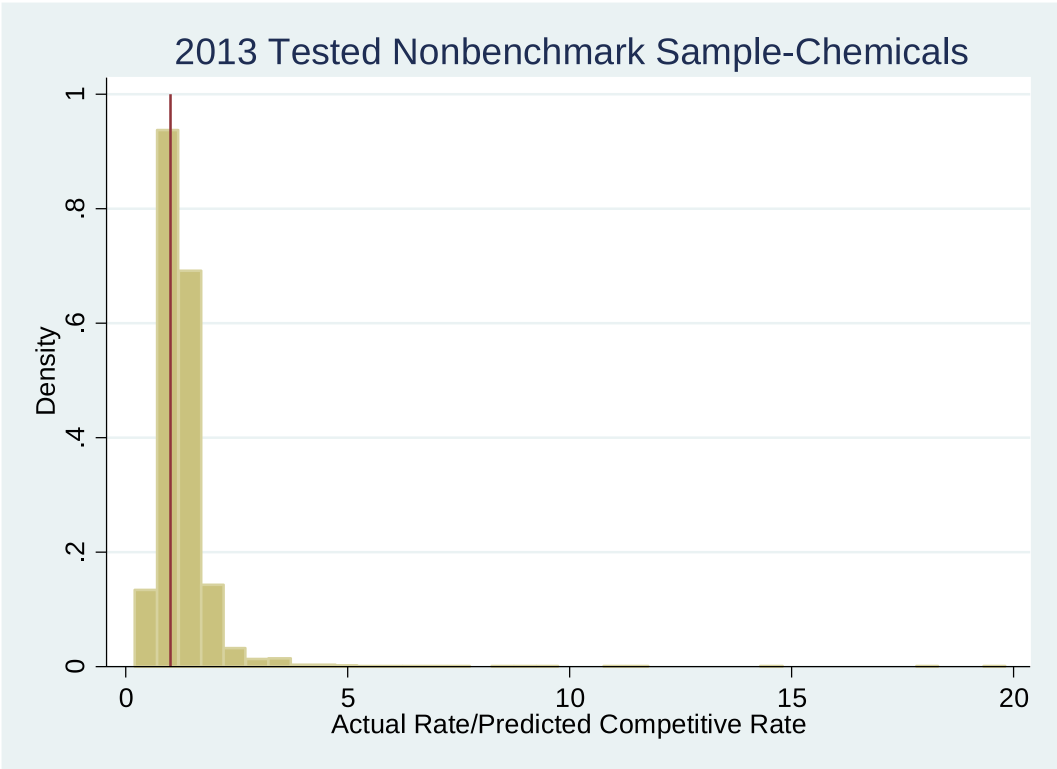

FIGURE 5 Distribution of ratios of actual to predicted rates, nonbenchmark sample, chemicals, no ratios excluded.

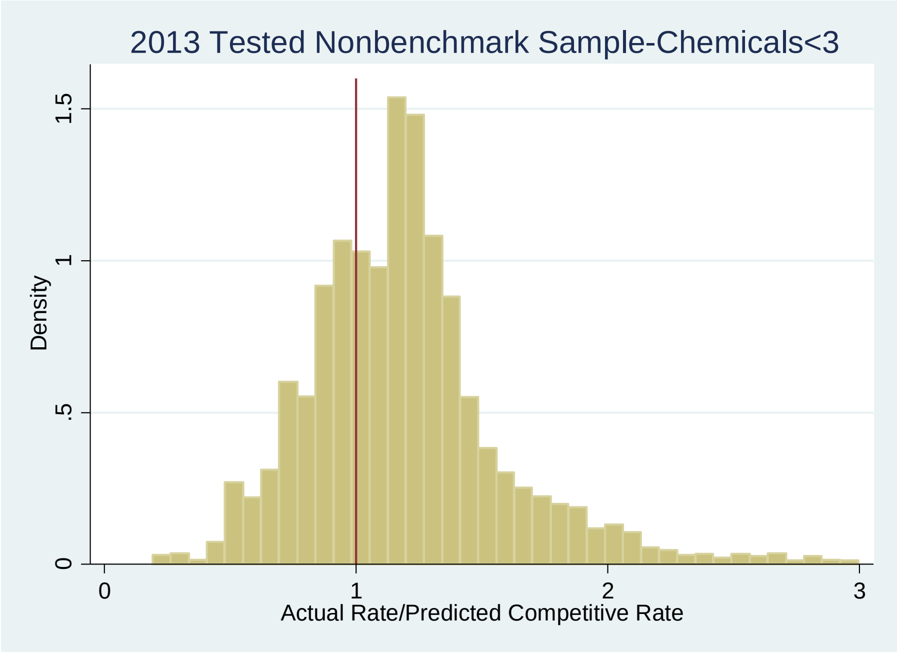

FIGURE 6 Distribution of ratios of actual to predicted rates, nonbenchmark sample, chemicals, ratios greater than 3 excluded.

TABLE 9 Chemicals Model: Distribution of 2013 Test Group Observations, Ratios of Actual Rate to Benchmark Rate

	Observations					Expanded	
Group	Contract No.	Tariff No.	Total	%	Cumulative %	%	Cumulative %
$r \leq 1$	521	1,991	2,512	30.7	30.7	33.0	33.0
$1 < r \leq 1.2$	187	1,719	1,906	23.3	54.0	24.1	57.1
$1.2 < r \leq 1.4$	108	1,774	1,882	23.0	77.1	21.4	78.5
$1.4 < r \leq 1.6$	71	658	729	8.9	86.0	7.7	86.2
$1.6 < r \leq 1.8$	60	328	388	4.7	90.7	4.4	90.6
$1.8 < r \leq 2.0$	44	223	267	3.3	94.0	3.1	93.7
$r > 2.0$	26	466	492	6.0	100	6.3	100
Total	1,017	7,159	8,176	100		100	

NOTE: The groups are defined by the ratio (*r*) of ARTM to the predicted 50th percentile. The columns showing expanded percentages use the sample rate expansion factor associated with each observation.

Petroleum

The descriptive statistics for petroleum for 2000–2013 are provided in Table 10. There are 86,678 total observations, with 50,487 in the competitive benchmark group and 36,191 in the nonbenchmark group. In 2009 dollars, the average price for the combined sample is 9.9 cents per ton-mile. The average distance traveled is 793 miles, and the average shipment size is 1.1 cars. Most shipments involve only one railroad, and shippers on average have 2.5 railroads within 10 miles of the origin and 2.4 railroads within 10 miles of the destination. About 15 percent of total shipments have no water options within 50 miles, but the benchmark shippers have more access, with only about 9 percent having no water options; the nonbenchmark shippers are somewhat more restricted in their water options (about 23 percent have no water options). Finally, virtually all movements occur in private cars because railroads own very few tank cars. There is little difference across the two samples in most variables other than the water options and the distance to water for both origins and destinations.

TABLE 10 Petroleum Summary Statistics, 2000–2013

Variable	Combined Samples	Benchmark Sample	Nonbenchmark Sample
Observations	86,678	50,487	36,191
Average revenue per ton-mile (2009 dollars)	0.099	0.095	0.104
Distance (miles)	793	786	804
Shipment size (number of cars)	1.10	1.09	1.12
Number of railroads in shipment	1.31	1.34	1.28
Number of Class I railroads within 10 miles of origin	2.50	2.70	2.21
Number of Class I railroads within 10 miles of destination	2.37	2.48	2.20
No water ports within 50 miles (binary)	0.15	0.09	0.23
Distance to water from origin (miles)	92	64	131
Distance to water from destination	92	76	113
Private car (binary)	0.99	0.99	0.99

NOTE: All values are means weighted by the expansion factor associated with each sampled shipment.

The estimation results are summarized in Table 11 with the intercept effects (railroad dummies, annual dummies, and STCC dummies) suppressed. In general, the coefficient estimates for the same variable have the same sign across columns of the table for most of the variables (i.e., distance, number of railroads in the movement, the number of Class I carriers within 10 miles of the destination, the presence of water, and the distance to water from the destination). However, there are some differences. They include shipment size, the number of Class I railroads within 10 miles of the origin, and the distance to water from the origin.

TABLE 11 Benchmark Models—Petroleum and Products (Based on Competitive Benchmark Data)

		Quantile			
Variable	OLS	0.25	0.5	0.75	0.9
ln(distance)	–0.617	–0.553	–0.606	–0.638	–0.668
	(0.00247)	(0.00229)	(0.00236)	(0.00230)	(0.00274)
ln(cars)	0.0196	0.0311	0.00899**	–0.00350	–0.0115
	(0.00470)	(0.00478)	(0.00366)	(0.00402)	(0.00275)
ln(number of railroads)	0.358	0.326	0.308	0.326	0.424
	(0.00680)	(0.00498)	(0.00502)	(0.00563)	(0.00796)
No. of Class I within 10 mi of origin	0.00518	–0.0165	–0.0137	0.00330**	0.0273
	(0.00158)	(0.00147)	(0.00148)	(0.00149)	(0.00216)
No. of Class I within 10 mi of destination	–0.0569	–0.0624	–0.0671	–0.0515	–0.0344
	(0.00161)	(0.00119)	(0.00139)	(0.00156)	(0.00214)
Nowater (binary)	0.113	0.0965	0.0759	0.0513	0.0181**
	(0.00784)	(0.00654)	(0.00880)	(0.00728)	(0.00843)
ln(mi from origin to port)	0.00669	0.00492	0.00698	0.00120	–0.00727
	(0.00116)	(0.00115)	(0.00113)	(0.00103)	(0.00143)
ln(mi from destination to port)	0.0127	0.0155	0.0106	0.00278**	0.00336**
	(0.00118)	(0.00121)	(0.00108)	(0.00109)	(0.00145)
Private car	0.0863*	–0.180	0.000810	0.134	0.0414
	(0.0509)	(0.0204)	(0.0153)	(0.0768)	(0.125)
Observations	50,340	50,340	50,340	50,340	50,340
R^2	0.749				

Note: All standard errors are $p < .01$, except ** = $p < .05$ and * = $p < .1$. All results are weighted by the expansion factor.

As with the other models, the median regression (quantile = 0.5) results in Table 11 are used to predict the rates for the 2,670 observations in the test group. The ratios of actual to predicted rates are summarized in Figures 7 and 8 and in Table 12. As shown in Figure 7, the distribution is positively skewed, with some very large values. The maximum ratio is 10.31. However, most of the ratios are between 0 and 2, as shown in Figure 8 and Table 12.

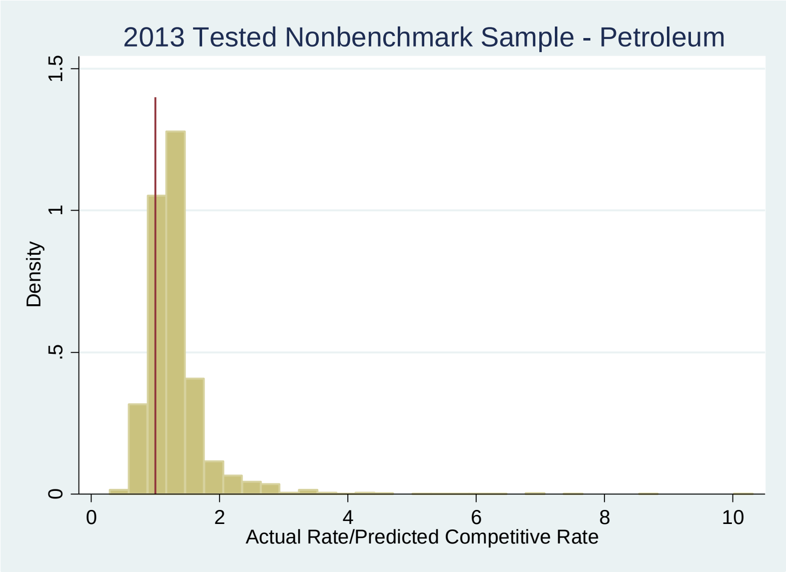

FIGURE 7 Distribution of ratios of actual to predicted rates, nonbenchmark sample, petroleum, no ratios excluded.

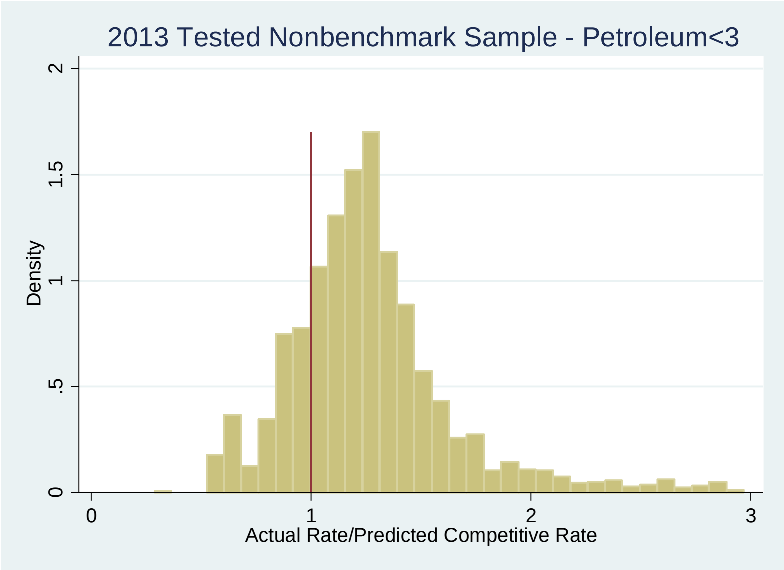

FIGURE 8 Distribution of ratios of actual to predicted rates, nonbenchmark sample, petroleum, ratios greater than 3 excluded.

TABLE 12 Petroleum Model: Distribution of 2013 Test Group Observations, Ratios of Actual Rate to Benchmark Rate

	Observations					Expanded	
Group	Contract No.	Tariff No.	Total	%	Cumulative %	%	Cumulative %
$r \leq 1$	117	418	535	20.0	20.0	19.3	19.3
$1 < r \leq 1.2$	4	665	669	25.1	45.1	24.9	44.3
$1.2 < r \leq 1.4$	9	724	733	27.5	72.5	27.6	71.9
$1.4 < r \leq 1.6$	6	354	360	13.5	86.0	13.8	85.7
$1.6 < r \leq 1.8$	0	137	137	5.1	91.2	5.3	91.0
$1.8 < r \leq 2.0$	10	43	53	2.0	93.1	2.0	93.0
$r > 2.0$	9	174	183	6.9	100	7.0	100
Total	155	2,515	2,670	100		100	

NOTE: The groups are defined by the ratio (*r*) of ARTM to the predicted 50th percentile. The columns showing expanded percentages use the sample rate expansion factor associated with each observation.

CONCLUSIONS

Railroads are subject to maximum rate regulation intended to allow the railroads to earn revenues adequate to cover their common costs while protecting shippers with few competitive options from unreasonably high common carrier rates. A major problem for regulators has been in determining whether a particular rate is high enough to warrant additional regulatory scrutiny. The current system uses a threshold of 180 percent of the Uniform Railroad Costing System–estimated average “variable cost” for this purpose, which is unreliable and arbitrary.

An alternative approach for identifying unusually high rates is demonstrated in this paper. The concept is that some shipments whose rates are determined under competitive conditions can be used to estimate competitive benchmark prices for other shipments with varying degrees of competition and cost-related characteristics. The method was demonstrated for movements of farm products, coal, chemicals, and petroleum. In general, the predictive models of the price of an effectively competitive movement given the route characteristics perform well in explaining the data. For the most part, the tested rates were close to the competitive rates, but the procedure identifies traffic having rates that far exceed the competitive benchmark rate. These rates might be candidates for further scrutiny for reasonableness.

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