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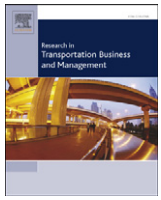

A further look at the Staggers Rail Act: Mining the available data ☆

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ABSTRACT

The Staggers Rail Act of 1980 has been intensively studied, but quantitative evaluations of the impacts of the Act have been affected by limitations in publicly available information. In particular, analyses of tariffs (revenue/ton-mile) and profitability (R/VC cost ratios) at the level of particular commodities have been affected by *revenue masking*, a practice in which actual revenues from contract movements are disguised ("masked") in publicly available waybill data in order to keep contract pricing terms confidential. This paper describes a method for using publicly available data in making useful estimates of *unmasked* revenues in a number of important commodity groups. The paper argues that the net effect of revenue masking has been to make commodity specific revenues reported in public waybill data appear significantly higher than they actually are. As a result, the favorable impact of the Act on these tariffs may have been understated and the apparent market power of the railroads may have been exaggerated. Enhanced railroad efficiency due to the interaction of contract tariffs with improved technology and network rationalization has yielded not only significant savings to shippers but also a much stronger financial position for the U.S. Class I railroads.

1. Introduction

1.1. Background

Many studies have analyzed the results of the Staggers Act,[1] generally concluding that it led to significant reductions in average freight rates and improvements in railroad financial performance. Both railroads and shippers benefited from greater rate flexibility and from the ability to link investment to traffic commitments that the legalization of contract rates permitted. While virtually all analyses have shown the Act to be successful in overall terms, a lack of publicly available data on the actual revenues from railroad contract tariffs due to revenue masking has made it difficult to assess changes in actual revenue per ton-mile or revenue-to-variable-cost (R/VC) ratios at a commodity-specific level.

One of the critical innovations in the Staggers Act was to make voluntary contracts between carriers and shippers explicitly legal for the first time. In these contracts, railroads and shippers are allowed to enter into voluntary agreements that include volume commitments and related discounts, investment commitments by railroads and/or shippers, minimum service requirements with related incentives, and escalation agreements, among other provisions. Railroads can maintain the confidentiality of the rate provisions of the contract by masking the revenue entry in the waybill data they file with the Surface Transportation Board (STB). They can perform the masking themselves or the STB will do the masking for them. In either event, contract waybills must be identified to the STB and actual revenue must be recoverable by the STB even though this information is not released to the public or to researchers.

Contracts have had a significant effect on the economic performance of rail freight markets. From a railroad perspective, contract commitments permit carriers to make long-term investments in cost-saving technologies (thus accelerating implementation of technological innovation), new market opportunities and human capital. From a shipper perspective, contract commitments permit shipping firms to make parallel investments in logistical capabilities. Also, many rail customers are larger firms that can exercise significant bargaining power in contract negotiations.

The extent to which rail shippers use contracts, or the effect that these contracts have had on rail markets, is not well understood, even by government policymakers. In a recent report on the freight rail industry, the Congressional Budget Office (CBO) concluded that it was unable to determine the proportion of rail traffic that moves by contracts or the typical length of contracts. The CBO cited an earlier study by the General Accounting Office (GAO) that about 70% of rail tonnage in 1997 moved under long term contracts. CBO speculated that "the percentage of traffic under contract has probably declined

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[1] See Section 1.3 below.

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since then as some coal and agricultural movements have shifted to common-carrier rates".[2]

We begin our analysis with the fact that the exact contract masking procedures are confidential and closely held. What is known about these procedures can be summarized as follows: 1) they must be disclosed to and accepted by the STB; 2) they are only applied to contract waybills in order to protect confidentiality; 3) the masking procedure is generally stable from year to year; and, 4) the procedure may include a random element acting through a masking formula applied separately to each waybill so that identical shipments on different waybills might well be masked differently.[3] The masking formulae may be different for each railroad.

It is not possible to back-calculate an actual revenue amount from the masked amount, either for a specific shipment or for revenues aggregated at a broader commodity level. As a result, while the existence of masking is clearly linked to tariff contracting, and changes in the amount of masking may indicate changes in the amount of contracting, the level of masking per se should not be over-interpreted. Specifically, the masked revenue may bear no direct correspondence to what the published tariff for a movement may be, so it may not be valid to infer that the difference between masked and unmasked revenue indicates the savings due to the contract.[4]

1.2. Research objective

In this paper we develop a method for making useful estimates of actual (unmasked) revenues in a number of important commodity groups. We use these estimates to show that in real terms actual tariffs and contribution levels are significantly different from what the use of masked revenues indicates.

1.3. Literature review

Literature on the effects of the Staggers Rail Act is extensive. Studies of the relationship between the 1980 legislation and railroad pricing are reviewed in the revised final report (pp. 4–6 to 4–8) of *The Study of Competition in the U.S. Freight Railroad Industry* by Christensen Associates (2010). Analyses range from Boyer (1987) who finds no direct relationship between the Staggers Rail Act and rail rate reductions to Wilson and Wilson (2001) who find that regulatory reform had a large negative effect on agricultural rates. Of particular note is a study by Barnekov and Kleit (1990) who use the number of contract rates as a proxy measure for deregulation and find that deregulation had a negative and significant impact on rates. Dennis (2000) uses demand estimates to control for price markups and finds that post-Staggers productivity improvements are the primary source of rate reductions.

The Christensen study was commissioned by the STB in response to a 2006 GAO report on competitive concerns about U.S. freight railroads. The GAO study used unmasked data from the Carload Waybill Sample to develop rail rate indexes for the period 1985–2004. It concluded that real rates had decreased by more than 20% through 2004 and that traffic moving at rates below a regulatory threshold of 180% of variable costs had decreased by 40%. The GAO measures were updated in 2007 and the agency reported that the 2005 rates had increased on average by 7% but were still below their 1985 levels. Christensen Associates used the same unmasked waybill data to construct four separate rail rate indexes. The indexes which were based on nominal rates showed very little price change between 1987 and 2004, followed by changes of 7% in 2005 and 2006. In its 2010 *Update to the Study of Competition in the U.S. Freight Railroad Industry* Christensen found another significant rate increase in 2008, but preliminary results indicated a downturn in rates in 2009.

The Christensen study reported revenue-to-variable-cost ratios based on unmasked waybill data and cost estimates from the STB's Uniform Rail Cost System (URCS). These estimates showed that R/VC ratios had gradually increased from 117% to 137% between 1987 and 2004. The Update focused on the distribution of R/VC ratios. It estimated that 83% of 2008 Class I traffic (on a ton-mile basis) moved at rates below the 180 percent threshold. The report acknowledged the potential limitations of the URCS variable cost estimates, however, since 34% of the 2008 traffic moved at R/VC ratios of less than 100%.

1.4. Structure of the article

Section 2 describes the fundamental problem that rail analysts face in using the two main data bases available to them — an inability to provide commodity specific estimates of actual (unmasked) unit revenues. It also presents our proposed solution to the problem — combining the two different databases. Section 3 uses our estimates to provide a better look at the movement of rail rates, R/VC margins, and commodity specific Lerner indices. Section 4 takes a closer look at rail contracts. Section 5 summarizes our results.

2. The analytical approach: methodology for linking data in the *Analysis of Class I Railroads* and Carload Waybill Statistics

There are two major sources of information available to rail researchers. The *Analysis of Class I Railroads* (*Analysis*) published annually by the Association of American Railroads (AAR) and based on the Form R-1 Annual Reports submitted by Class I railroads to the Surface Transportation Board (STB). The Public Use Carload Waybill Sample is available in an annual form from the STB and is based on waybills submitted from all railroads terminating more than 4500 carloads per year. Neither of these public data sources provides all the information needed for detailed evaluation of railroad revenues per ton-mile at the commodity level.

2.1. Analysis of Class I Railroads

Analysis is a compendium of the Form R-1 reports, Freight Commodity Statistics reports, and Wage Form A&B reports filed with the STB.[5] Form R-1 is a sworn statement containing nearly 800 lines of data for each year covering financial and operational results; the data in the annual issues of *Analysis* are as accurate and reliable as the scale of the industry permits.

Analysis includes a statement of carloads originated (accounts 533–553); tons originated (accounts 554–573); and gross freight revenue (accounts 577–599) for 20 commodity groups (including a group for "all other"). This information is based on the Freight Carload Statistics reports filed by the Class I railroads with the STB.

A limitation of the *Analysis* data is that even though it includes commodity-specific information on revenue and carloads, it does not include ton-miles attributable to the individual commodity groups. Thus it is not possible to use the gross freight revenues in accounts 577–599 of *Analysis* to identify revenue per ton-mile or the R/VC ratios at the commodity group level.

[2] CBO (2006, page 15).

[3] See 49 CFR Ch. X, Part 1244, §1244.3.

[4] This was not always the case. In an early masking agreement between Conrail and the Interstate Commerce Commission Conrail agreed to report contract data for the waybill sample "except that the revenue field may be replaced with a calculated revenue amount *intended to* represent *the revenue from a comparable traffic move* (italics added)." ICC Memorandum dated January 14, 1993 from Leslie J. Selzer, Acting Director, Office of Economics, to S. Arnold Smith, Freedom of Information Act Officer. Comparable traffic moves are, presumably, non-contract tariff moves, but because current masking agreements between railroads and the STB are confidential it is not possible to determine whether masked revenues represent comparable non-contract rates.

[5] Class I railroads are the largest U.S. freight railroads. In 2009, class I railroads were defined as having annual revenues of greater than $379 million.

2.2. The Carload Waybill Sample

The second source of data available to analysts is the STB's Public Use Carload Waybill Sample. A waybill is a transactional document issued by the railroad acknowledging receipt of goods from a shipper. Each waybill contains, among other information, the number of tons, carloads, shipment distance, revenue generated and the commodity in the shipment.[6] Since the number of waybills is large (over 500,000 in 2009), there has long been a practice of sampling waybills and then estimating the total population by expanding the sample. In its most recent form, the ICC (now STB) required a stratified sampling approach with sampling rates that range from 2.5% for single carload movements to 50% for shipments of greater than 100 carloads.[7]

The Public Use Carload Waybill Sample contains data for each two digit STCC commodity group.[8] A restricted version of the Carload Waybill Sample (called CWS below) is available on request to researchers and contains a commodity specific variable cost measure calculated by the STB that is used to estimate revenue-to-variable cost margins. The data set reported in CWS raises a number of measurement issues, including: 1) the inherent error when a large population is represented by expanding a much smaller sample; 2) potential miscounting of measures such as carloads or tons (but not ton-miles or revenue) when a shipment is re-billed en route or at the Mexican or Canadian borders; 3) revenue "masking," in which the actual revenue is deliberately disguised in order to protect the confidentiality of the terms of the shipment; and, 4) the definition, calculation and meaning of the variable cost measure.[9] The revenue masking and variable cost issues are especially relevant to our paper.

A 2012 Railinc report for the STB provides a description of the masking procedures in the CWS: "[b]eginning with the 1986 Sample, railroads were allowed to disguise their contract revenues through factoring them by a scalar value at the three digit STCC level. Carriers employing this contract revenue masking technique provide the STB with a table indicating that all waybills with a 'calculated rate flag' have their revenues scaled up or down by the table factor corresponding to the waybill three digit STCC." More important in the context of this paper, Railinc said: "…failure to understand the nature of revenues reported in the Sample may lead to erroneous conclusions." [10]

Unlike *Analysis*, however, the CWS *does* contain enough information on revenues, output levels and costs to permit estimation of rate levels (revenues per ton-mile) and contribution levels (R/VC levels) on a broad commodity basis. The problem is that estimates of rates or profitability based on revenues in the CWS are inaccurate because they include masked contract revenue along with non-masked revenue for non-contract traffic.

2.3. Combining Analysis and CWS: unmasking revenues

Our proposed solution to this problem is to combine the commodity-level gross freight revenue data from *Analysis* with comparable commodity-level ton-mile and estimated variable cost data from the CWS. The revenues by commodity reported in *Analysis* are taken from accounting records that are accurate and necessarily not disguised. The ton-mile data and variable cost estimates from the CWS are not subject to masking. This permits us to calculate unmasked revenues per ton-mile and unmasked revenue-to-variable-cost ratios for a number of major commodity groups.

There are 20 commodity groups in *Analysis* and 38 different two digit STCC groups in the CWS. These differences cannot be wholly reconciled, but a significant part of railroad traffic can be mapped from the two digit STCCs to the *Analysis* commodity groups. Table 1 shows the mapping approach in which 18 *Analysis* groups are combined with 15 two digit STCC groups to yield 12 mapped commodity groups.

The mapped commodity groups account for a large majority (63.6% of carloads, 92.2% of tons, 78% of masked revenue and 86.8% of ton-miles) of traffic in 2009. Unfortunately, two STCC commodity groups – transportation equipment and containers, representing 29% of carloads, 7% of tons, 18% of masked revenue and 11% of ton-miles – are not mapped and thus are unfortunately not amenable to our unmasking approach. The commodity group Motor Vehicles and Equipment in *Analysis* is a subset (STCC 371) of the broader Transportation Equipment (STCC 37) category in CWS and Containers (STCC 46) in CWS has no direct counterpart in *Analysis*.

Fig. 1 provides a graphical view of the relationship between *Analysis* and the CWS. In it we display the ratios of tons, carloads, ton-miles and revenue from the CWS to the same measure in *Analysis*. Note that the ton-mile ratio remains close to 1.00 (RMS deviation is 0.037), meaning that the ton-miles in the CWS are quite close to those in *Analysis*. This establishes the fact that the underlying activity populations are effectively the same and that it is appropriate (in our view) to relate CWS ton-miles to *Analysis* revenues.

The correspondences between tons and carloads in the CWS and tons and carloads in *Analysis* shown in Fig. 1 are not as close. At the beginning and at the end of the period the ton and carload ratios are close to 1.0. In the middle of the period, however, these ratios average 1.2. The reason for this discrepancy is largely explained by double counting in the CWS of carloads or tons as a result of rebilling, which appears to have increased over the time period being examined. The problem was

Table 1
Mapping from the *Analysis of Class I Railroads* to the 2 digit STCCs.

Line no. from *Analysis*	Description in *Analysis*	STCC	Description of STCC
Maps directly: one line from Analysis to one 2 digit STCC			
556	Metallic ores	10	Metallic ores
557	Coal	11	coal
564	Pulp, paper and allied products	26	Pulp, paper or allied products
567	Stone, clay and glass products	32	Clay, concrete, glass or stone products
Sum of 2 lines from Analysis maps to one 2 digit STCC			
554	Grain (including soybeans)	01	Farm products
555	Other farm products		
558	Crushed stone, gravel and sand	14	Non-metallic minerals; except fuels
559	Non-metallic minerals		
560	Grain mill products	20	Food or kindred products
561	Food and kindred products		
562	Primary forest products	24	Lumber or wood products; except furniture
563	Lumber and wood products		
One line from Analysis includes two 2 digit STCCs			
569	Metals and products	33	Primary metal products
		34	Fabricated metal products
572	Forwarder and shipper association	44	Freight forwarder traffic
		45	Shipper association or similar traffic
Sum of 3 lines from Analysis maps to two 2 digit STCCs			
565	Chemicals and allied products	28	Chemical or allied products
566	Petroleum products	29	Petroleum or coal products
568	Coke		

[6] See Railinc Business Services Division (2012) for a detailed description of the data fields in waybills.

[7] See Fine and Owen (1981) for a more detailed discussion. See also 49 CFR Ch X, Part 1244, §1244.4 (2004).

[8] Standard Transportation Commodity Code (STCC). STCC codes may contain as many as 7 digits depending on the degree of specificity. For example, STCC group 01 represents all farm products, while STCC code 01 129 15 would represent raw cotton bolls. See Railinc (1997).

[9] There could also be a minor issue of consistent definition of the railroads and traffic to be included from year to year. We do not believe that that is significant for the purposes of this study.

[10] Railinc Business Services Division (2012, page 181).

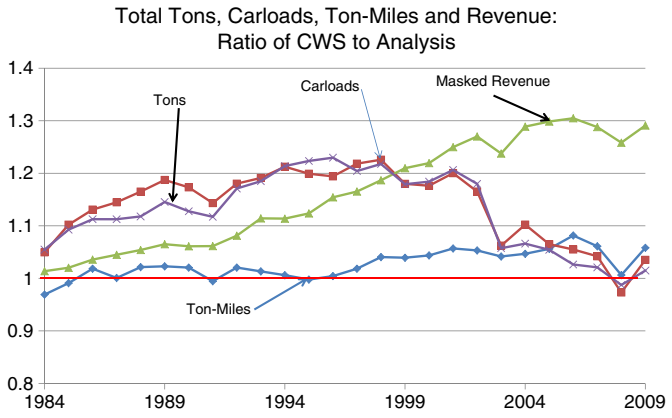

Fig. 1. Total tons, carloads, ton-miles and revenue: ratio of CWS to *Analysis*.

not serious at the beginning but became more serious in the middle of the period because the waybill flag meant to identify and correct for rebilled shipments was inoperative. By the end of the period, the problem had been fixed and over counting due to rebilling is now corrected.[11] In addition, a number of railroad mergers occurred during the period, which would de facto reduce the possibility of double counting. Finally, commodities for which regional, Class II, or Canadian and Mexican railroads originated a significant share of the traffic that was then terminated by a U.S. Class I could affect the measurement.[12] None of these possibilities is fatal for our analysis, however, since we use the CWS only for ton-miles and not for tons or carloads.

We are also able to use the revised revenue data to estimate Lerner indices, commonly used measures of market power, for each rail commodity market. Following Viscusi, Vernon, and Harrington (2005), the Lerner index, L, is defined as

$$L = \frac{P - MC}{P} = \frac{1}{\eta}$$

where P is price, MC is marginal cost, and η is the absolute value of the price elasticity of demand. If, to use Viscusi's example, a firm's price is double its marginal cost, then the Lerner index is 0.5 (the ratio of (price-marginal cost) to price) and the price elasticity of demand is 2. Thus L can be used to estimate elasticities in markets where sellers have market power.

There are two *caveats*. First, L is derived mathematically from the firm's first order condition for maximizing profits. The formula above makes no assumptions about fixed costs. If, as is surely true in the railroad case, there are fixed costs, then the Lerner index, becomes

$$L = \frac{P - SRMC}{P} = \frac{1}{\eta}$$

where SRMC is short run marginal cost. Second, the cost estimates that we use in applying the second equation are URCS estimates of the average variable cost from CWS. Putting aside general concerns about the accuracy of URCS estimates, average variable costs are (at best) approximations of short-run marginal costs. If, as most econometric evidence suggests, railroads experience increasing returns to density, then the SRMC curve will lie below the average variable cost curve and average variable costs will be higher than the short-run marginal cost.[13] This means that Lerner indices based on average variable costs will be less than the "true" Lerner indices and estimates of the absolute value of the elasticity will be greater than the true elasticity. In other words, the degree of market power will be underestimated.[14]

3. A further look at rail rates

The CWS has been a primary source of information about rail revenue and it is here that we begin our analysis. For context, in Section 3.1, we first present an analysis of revenue per ton-mile at the aggregate level using data on aggregate revenue and ton-miles (not commodity-specific) that is available in *Analysis*. We have extended the data back to 1960 using prior issues of *Analysis*. We then use combined data from *Analysis* and the CWS to analyze revenue trends on a commodity specific basis. We present commodity-specific analyses of revenue-to-variable-cost ratios in Section 3.2 and commodity-specific Lerner indices in Section 3.3.

3.1. Revenue per ton-mile trends

Fig. 2 shows the tariff performance of the U.S. Class I railroads since 1960, a period showing performance before and after the Staggers Act. In current dollars, the average revenue per ton-mile doubled between 1960 and 1981 and, absent change, there is no reason to think that this trend would not have continued: indeed, opposition to the Act at the time was based partly on the argument that the railroads would be able to use enhanced rate flexibility and perceived market power to continue to increase their tariffs. To the contrary, after the Act's passage revenue per ton-mile stabilized and then began to decrease, a trend that continued until the mid-2000s when rising congestion (due to strong traffic demand and increased tonnage density) combined with increases in fuel prices to exert upward pressure on costs and on the entire spectrum of tariffs. Even so, average tariffs today are essentially the same as they were thirty years ago in current dollars. The tariff trends are much more evident in real (constant 2010 dollar) terms.[15] Average tariffs in 2010 were only 42% of their 1981 levels at the outset of the Act and about 35% of their levels in 1960.

We acknowledge that these comparisons do not adjust for changes in traffic commodity mix (percent of ton-miles by commodity). Specifically, the percentage of ton-miles represented by coal was about 32% in 1984 versus 42% in 2009: this change in mix would in itself reduce the average tariff rate since coal generally travels at a lower than average rate (2.22¢/ton-mile for coal versus 3.83¢/ton-mile for all commodities in 2009). Adjusting for this change in coal tonnage, if we assume that the 2009 traffic traveled at 2009 tariffs but at the 1984 ton-mile distribution, the average tariff in 2009 would have been 4.27¢/ton-mile rather than the actual 3.83¢/ton-mile — an 11 percent increase, which would not change the conclusion that overall average rail tariffs have fallen significantly.

To provide a more detailed assessment of the movement of rail rates we now present the trends in actual revenue per ton-mile for the 12 commodity groups mapped in Table 1. For each group, commodity-specific but masked real revenues ($2010) from the CWS are divided by ton-miles from the CWS and presented in Table 2 as "masked"

[11] Ton-miles, revenue and cost are inherently not subject to double counting, though they might be subject to some of the above issues of minor changes in the railroads included in the sample.

[12] This problem may be especially significant in metallic ores (smaller iron ore railroads such as DMIR and LSI originate large quantities) and pulp and paper (Canadian sources) and may have some effect on lumber and wood products as well. Also, DMIR was merged in 2005 into Canadian National's U.S. operations (grand trunk) so this iron ore tonnage flowed back into the class I *Analysis* data. In any event, during the middle of the period tons and carloads have to be viewed with suspicion because they are not accurate and are, in any case, not consistent between *Analysis* and the CWS. Perhaps more important, the calculated average lengths of haul at the 2 digit STCC level using CWS data are almost certainly understated for some of the commodity groups because the tonnages are overstated.

[13] See Ivaldi and McCullough (2001).

[14] It is interesting to note in this context that the STB-sponsored study of the U.S. railroad industry by Christensen Associates (2010) developed econometric estimates of rail costs. It estimated average variable costs at about $0.02 per ton-mile and short-run marginal costs at about $0.015 per ton-mile. URCS-estimated average variable costs were about $0.025 per ton-mile.

[15] We use constant $2010 calculated from the GDP deflator provided by the Bureau of Economic Analysis. See http://www.bea.gov/national/index.htm.

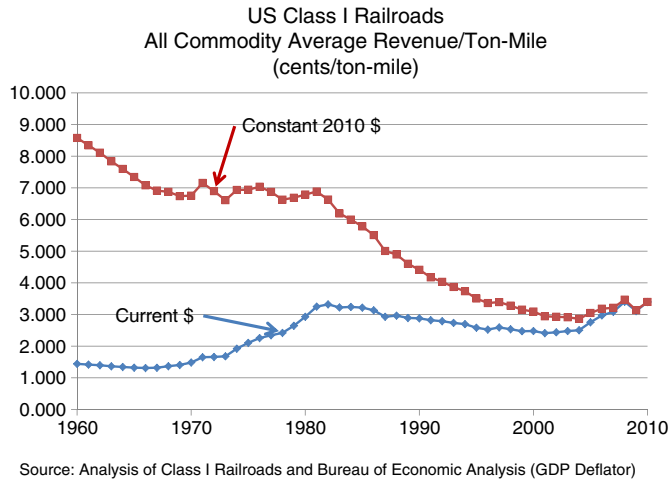

Fig. 2. U.S. Class I Railroads. All commodity average revenue/ton-mile (cents/ton-mile). Source: *Analysis of Class I Railroads* and Bureau of Economic Analysis (GDP deflator).

estimates. For each group, commodity-specific real revenues (2010$) from *Analysis* are also divided by ton-miles from the CWS and presented in Table 2 as "unmasked" estimates.

A comparison of the trends for the major commodity groups in Table 2 reveals common elements. In most of the major commodity groups [farm products (STCC 01), food or kindred products (STCC 20), lumber and wood products (STCC 24), paper, pulp and allied products (STCC 26), chemicals and allied products (STCCs 28 and 29)] real tariffs have declined by average annual rates of 1 to 2% between 1984 and 2009 when tariffs are computed using masked revenue from the CWS. When revenues from *Analysis* (reflecting actual contract tariff receipts) are used, the average annual declines in real tariffs range from 2 to 3%. The declines in the coal market where contracts are known to be particularly prevalent are even more dramatic — a 2.6 percent average annual decline when masked revenues are used and a 3.5 percent average annual decline using unmasked revenues. The implication is that use of the CWS to assess railroad rate behavior overstates the actual tariffs charged (and understates the benefits) to shippers by significant amounts.[16]

3.2. Revenue to variable cost ratios

As part of its regulatory framework, in order to protect against predatory pricing, the Staggers Act required that all shipments travel at rates equal to or above what it termed a "presumptive" cost floor equal to the "directly variable cost" (DVC).[17] To protect shippers, the Act also specified a ratio of revenue to direct variable cost (R/VC ratio) of 180% as a jurisdictional threshold beyond which some degree of market power *might* be inferred and some form of maximum rate regulation *might* be imposed.

Since 1987 the CWS data available to researchers on request has included an estimate of the average variable cost associated with the movement of different commodities. The Uniform Rail Costing System (URCS), which the STB uses to develop these estimates, has been criticized by econometricians and by government-appointed accounting experts at the Railroad Accounting Principles Board.[18] Nevertheless, we include URCS estimates in this paper because they are used by the STB to establish R/VC ratios for regulatory purposes. However accurately or inaccurately variable costs are defined and measured, if revenue is misstated, the R/VC ratio will be misstated.[19] This could be particularly significant in cases where misstatement of revenues would cause the R/VC ratio to appear to exceed the 180 percent trigger point.

Table 3 displays our estimates of R/VC ratios in the 12 commodity groups for the period 1987–2009. The table displays results for each group using CWS masked revenues, unmasked *Analysis* revenues and, in all cases, the CWS (URCS) calculation of variable cost. For the reasons stated in footnotes 13 and 17, we consider the R/VC ratio for metallic ores to be unreliable. The freight forwarder and shipper association ratio is also suspect.

Of the 12 mapped commodity groups studied, seven appear to have experienced increases in R/VC ratios calculated using actual revenues from *Analysis*. Most of the increases are relatively small, however, and two groups, metallic ores (STCC 10) and freight forwarder and shipper association traffic (STCCs 44 and 45) are suspect. Nevertheless, the results indicate that since 1987 railroads have increased their margins in the markets for farm products (STCC 01), food and kindred products (STCC 20), stone, clay and glass (STCC 32), and waste and scrap (STCC 40). Five other groups saw decreases in R/VC ratios based on actual revenues from *Analysis*. These included coal (STCC 11), lumber and wood (STCC 24), pulp, paper and allied products (STCC 26), chemicals and allied products (STCCs 28 and 29), and primary metals. Perhaps most significant, while six of the groups appear to have R/VC ratios greater than 180% when revenues are drawn from CWS, in fact only one group (freight forwarder and shipper association traffic) appears to exceed the regulatory trigger point when actual revenues from *Analysis* are used.

We should emphasize here that the result of masking is to distort the apparent R/VC ratio upward and to create the appearance that average tariffs in a commodity group may be above the regulatory threshold. In fact, rail traffic now falls into two groups — contract and common carriage. If it were possible to separate these groups, we could focus on the behavior of contract tariffs (that are neither public nor regulated) directly and could isolate their impact from the behavior of common tariffs in the same commodity group that are public and regulated. Unfortunately, revenue masking will make this impossible unless more information about masking is released.

3.3. Lerner indices

Lerner indices presented in Table 4 present credible estimates of the degree of market power in current rail markets.[20] The lower

[16] To develop these findings the authors requested from the AAR and were granted access to aggregate-level, commodity-specific unmasked data from the confidential Carload Waybill Sample for the years 2002–2009. We compared the values during this period of two ratios — revenue per ton-mile using unmasked CWS revenues divided by CWS ton-miles and revenue per ton-mile using *Analysis* revenues divided by CWS ton-miles. Significantly for this paper, the RMS deviation of *Analysis* revenue/CWS ton-mile from CWS revenue/CWS ton-mile is very small; in five cases (coal, food, lumber and wood, chemicals and waste and scrap) the difference is less than 5%, in another 5 cases (farm, non-metallic minerals, pulp and paper, stone, clay and glass) the difference is between 5 and 10%, and in only two cases (metallic ores and freight forwarder and shipper association) is the difference greater than 10%. Based on these results, we believe that use of *Analysis* revenues and CWS ton-miles gives reasonable estimates of actual (unmasked) revenue per ton-mile for the commodity groups studied, with the clear exception of metallic ores. Freight forwarder and shipper association Traffic results should also be viewed with appropriate qualification.

[17] DVC is intended to reflect those costs that vary with the shipment, and gives a railroad the opportunity to approximate "marginal cost" in a specific rate case. The average variable cost as calculated in the CWS includes a number of factors (e.g. depreciation) that would not generally be considered marginal costs.

[18] Economists' criticisms of URCS are summarized in McCullough (2008). A critique by government-appointed accounting experts is in Railroad Accounting Principles Board (1987).

[19] A detailed discussion of the URCS costing procedure is outside the scope of this paper. Basically, URCS uses the parameter results from 15 separate regressions in which the dependent variable is a railroad expenditure account grouping and the independent variables include one output-related variable and one capacity-related variable (In fact, the regressions were performed on a dataset of 126 observations for the years 1979–1987). URCS then combines the parameter results with firm-level railroad operating and financial data to assign firm-level unit costs to the output-related variables.

[20] It should also be noted that "total operating cost" from *Analysis* and "variable cost" from CWS have tended to converge since 1987. In the first years after 1987, the ratio of TOC to VC was over 1.2. By 1993, this ratio had fallen to 1.045, and has mostly remained between 0.95 and 1.05 since then. To the extent that AVC is a reasonable representation of marginal cost, this would suggest that Lerner indices based on average variable cost and the "true" indices may have also converged yielding better estimates in the later years.

Table 2
Average revenue/ton-mile (constant 2010 cents).

Mapped commodity group		1984	1985	1990	1995	2000	2005	2009	Average annual growth
01 farm products	Masked	4.20	3.97	3.21	3.01	2.72	2.86	3.05	−0.012
	Analysis/waybill	4.30	4.16	3.13	2.70	2.44	2.40	2.45	−0.021
	Ratio: masked to analysis	0.979	0.953	1.025	1.116	1.113	1.191	1.246	
10 metallic ores	Masked	5.90	5.94	4.84	3.37	3.98	3.77	4.89	−0.007
	Analysis/waybill	5.80	4.58	3.34	2.31	2.75	2.93	3.84	−0.016
	Ratio: masked to analysis	1.017	1.299	1.450	1.463	1.445	1.288	1.273	
11 coal	Masked	4.45	4.09	3.18	2.48	2.01	1.95	2.23	−0.026
	Analysis/waybill	4.53	4.00	3.02	2.26	1.79	1.60	1.77	−0.035
	Ratio: masked to analysis	0.982	1.022	1.054	1.095	1.124	1.216	1.258	
14 non-metallic minerals	Masked	5.63	5.50	4.37	4.17	3.75	4.00	4.70	−0.007
	Analysis/waybill	5.52	5.36	4.08	3.20	2.91	3.08	3.68	−0.015
	Ratio: masked to analysis	1.021	1.026	1.073	1.302	1.288	1.298	1.277	
20 food or kindred	Masked	6.58	5.99	4.39	4.03	3.68	3.84	4.13	−0.018
	Analysis/waybill	6.67	6.05	4.32	3.68	3.03	3.04	3.36	−0.026
	Ratio: masked to analysis	0.987	0.990	1.016	1.096	1.214	1.263	1.231	
24 lumber and wood	Masked	6.37	5.67	4.45	4.08	3.89	4.14	4.14	−0.016
	Analysis/waybill	5.43	4.94	3.89	3.24	2.63	2.79	2.80	−0.025
	Ratio: masked to analysis	1.173	1.149	1.142	1.262	1.475	1.484	1.476	
26 pulp, paper and allied	Masked	7.41	7.07	6.00	5.11	4.94	5.59	5.69	−0.010
	Analysis/waybill	6.25	5.94	4.76	4.09	3.25	3.77	3.84	−0.019
	Ratio: masked to analysis	1.185	1.190	1.261	1.248	1.521	1.481	1.483	
28 + 29 chemicals and allied	Masked	7.29	7.07	5.80	5.16	4.42	4.56	5.48	−0.011
	Analysis/waybill	6.93	6.69	5.43	4.70	3.75	3.46	4.13	−0.020
	Ratio: masked to analysis	1.052	1.058	1.069	1.098	1.179	1.317	1.326	
32 stone, clay and glass	Masked	6.76	6.22	5.09	4.87	4.44	5.14	5.82	−0.006
	Analysis/waybill	7.03	6.40	4.82	4.38	3.53	3.96	4.48	−0.017
	Ratio: masked to analysis	0.962	0.973	1.055	1.113	1.257	1.300	1.299	
33 + 34 primary metals and products	Masked	7.24	6.68	4.93	4.29	4.14	5.12	5.97	−0.007
	Analysis/waybill	6.97	6.45	4.38	3.83	3.39	3.88	4.31	−0.018
	Ratio: masked to analysis	1.039	1.036	1.126	1.120	1.222	1.319	1.385	
40 waste and scrap	Masked	9.28	8.52	6.42	5.02	4.63	5.41	5.85	−0.018
	Analysis/waybill	9.36	8.27	5.95	4.63	3.79	4.21	4.44	−0.028
	Ratio: masked to analysis	0.992	1.030	1.079	1.083	1.224	1.285	1.318	
44 + 45 freight forwarder & shipper assoc	Masked	8.07	7.57	4.69	5.52	5.22	5.22	5.23	−0.017
	Analysis/waybill	8.04	8.63	4.02	5.15	4.47	5.50	5.24	−0.016
	Ratio: masked to analysis	1.004	0.876	1.167	1.072	1.167	0.948	0.999	

elasticity markets where shippers would be more dependent on rail are metallic ores (STCC 10), coal (STCC 11), chemicals and allied products (STCCs 28 and 29), and stone, clay and glass (STCC 32). The higher elasticities are in the truck-competitive markets for food and kindred products (STCC 20), pulp, paper and allied products (STCC 26), and primary metals and products (STCCs 33 and 34). Farm products (STCC 01) and waste and scrap products (STCC 40) appear to have intermediate-level price elasticities.

Fig. 3 traces the path of rail Lerner indices since 1987. It shows that an aggregate (un-weighted) Lerner index for the Class I railroad industry fell between 1987 and 2002, rose in 2003, and has remained essentially stable since then. The Lerner index for the industry is now the same as it

Table 3
Revenue to variable cost ratios (stated in percent to compare with regulatory threshold of 180%).

		1987	1990	1995	2000	2005	2009
01 farm prods	CWS masked rev/CWS cost	114.9	121.9	140.1	156.3	167.2	168.6
	Analysis rev/CWS cost	116.0	119.0	125.6	140.4	140.4	135.3
10 metallic ores	CWS masked rev/CWS cost	180.0	174.2	159.7	180.4	188.8	202.8
	Analysis rev/CWS cost	131.9	120.1	109.1	124.9	146.6	159.3
11 coal	CWS masked rev/CWS cost	190.3	184.4	192.4	184.1	171.0	189.1
	Analysis rev/CWS cost	181.6	175.0	175.6	163.7	140.6	150.4
14 non-metallic minerals	CWS masked rev/CWS cost	145.8	133.9	135.6	149.8	167.9	183.7
	Analysis rev/CWS cost	137.9	124.8	104.2	116.3	129.3	143.9
20 food or kindred	CWS masked rev/CWS cost	116.9	111.0	117.3	134.5	147.7	157.2
	Analysis rev/CWS cost	114.7	109.3	107.0	110.8	116.9	127.6
24 lumber and wood	CWS masked rev/CWS cost	138.7	133.6	126.7	131.2	182.1	135.5
	Analysis rev/CWS cost	128.6	117.0	100.4	89.0	122.7	91.8
26 pulp, paper and allied	CWS masked rev/CWS cost	173.6	162.9	137.2	134.7	181.3	154.3
	Analysis rev/CWS cost	139.2	129.2	109.9	88.5	122.4	104.1
28 + 29 chemicals and allied	CWS masked rev/CWS cost	183.2	172.7	164.6	191.5	203.5	215.3
	Analysis rev/CWS cost	170.3	161.6	149.9	162.4	154.5	162.4
32 stone, clay and glass	CWS masked rev/CWS cost	144.1	136.0	147.9	158.6	185.0	199.5
	Analysis rev/CWS cost	140.1	128.9	132.9	126.2	142.3	153.6
33 + 34 primary metals and products	CWS masked rev/CWS cost	148.1	143.4	140.0	141.7	169.4	162.0
	Analysis rev/CWS cost	133.3	127.4	125.0	115.9	128.4	117.0
40 waste and scrap	CWS masked rev/CWS cost	134.2	128.0	115.8	129.4	165.5	172.6
	Analysis rev/CWS cost	123.3	118.6	107.0	105.7	128.8	131.0
44 + 45 freight forwarder & shipper assoc	CWS masked rev/CWS cost	109.6	92.3	103.6	115.8	183.6	199.6
	Analysis rev/CWS cost	102.9	79.1	96.7	99.2	193.6	199.7

Table 4
Lerner indices.

	Lerner Indices						
	1987	1990	1995	2000	2005	2009	2009 Elasticity
All traffic	0.305	0.284	0.184	0.185	0.277	0.302	3.32
01 farm prods	0.138	0.159	0.204	0.288	0.288	0.261	3.83
10 metallic ores	0.242	0.167	0.083	0.199	0.318	0.372	2.69
11 coal	0.449	0.429	0.431	0.389	0.289	0.335	2.98
14 non-metallic minerals	0.275	0.199	0.040	0.140	0.227	0.305	3.28
20 food or kindred	0.128	0.085	0.066	0.098	0.145	0.217	4.62
24 lumber and wood	0.223	0.145	0.004	(0.124)	0.185	(0.090)	(11.16)
26 pulp, paper and allied	0.282	0.226	0.090	(0.129)	0.183	0.039	25.56
28+29 chemicals and allied	0.413	0.381	0.333	0.384	0.353	0.384	2.60
32 stone, clay and glass	0.286	0.224	0.247	0.208	0.297	0.349	2.87
33+34 primary metals and products	0.250	0.215	0.200	0.137	0.221	0.145	6.88
40 waste and scrap	0.189	0.157	0.065	0.054	0.223	0.237	4.22
44+45 freight forwarder & shipper assoc	0.028	(0.265)	(0.034)	(0.008)	0.484	0.499	2.00
	Indicates displayed in Figure 3						

indicates entries displayed in Fig. 3.

was in 1987. The index for coal (STCC 11), once the highest indexed commodity (lowest estimated price elasticity), has continuously fallen and now approximates the aggregate industry index. The index for chemicals and allied products (STCCs 28 and 29) has remained stable over the 1987 to 2009 period, but remains higher than the industry index and is now slightly higher than coal. The index for farm products (STCC 01) increased steadily from 1987 to 2004, but has fallen since and is now below the aggregate index and equal to its level in 1999. The index for food and kindred products (STCC 20) has increased since 1998, but is still well below the aggregate average. The general conclusion is that railroad shippers have continued to benefit despite the integration of the industry into seven Class I firms.

4. A further look at rail contracts

We see in Fig. 1 that the ratio of masked revenue to actual (unmasked) revenue has *steadily increased* from close to 1.0 in 1986 (when masking began) to around 1.3 in 2009. On average, current studies using CWS masked revenues are about 30% too high, leading to overestimates of revenue/ton-mile and R/VC ratios and consequent underestimates of the downward pressures on prices resulting from contract ratemaking and productivity improvements in the Staggers Act.[21]

The exact significance of the increase in the masking ratio is less clear and could be attributable to several causes. First, masking began in 1986 and was not immediately applied, so some portion of the growth in the early years is clearly related to increasing use of masking itself ("ramping up"). Second, masking ratios in the underlying formulae might be increasing year-to-year, though there is no indication that this is happening. Third, since *only* contract tariffs are masked, some portion of the increase in the ratio must be caused by an increase in the amount of revenue generated by contract tariffs.

A general indication of the underlying dynamics can be seen in Fig. 4. If we assume that virtually all unit train shipments travel under contract, then the blue curve (percent of carloads in unit trains) gives a lower bound for the application of contract tariffs, as there are almost certainly contract tariffs that do not move in unit train shipments.[22] Since masking began only in 1986, the masking curve starts near 1.0, below the unit train percentage, and then grows more rapidly because masking apparently overstates revenue for all contract tariffs. The masking curve thus gives an indication of the rate of implementation of masking and thus of contract ratemaking.

Table 2 provides the commodity specific detail on the ratios of masked to unmasked revenues. First, the ratios are all greater than 1.0, indicating that contract tariffs are used in all commodities, not just in the major bulk commodities such as coal. Second, the degree of masking and, presumably, the degree of contracting have increased in all but the freight forwarder and shipper (STCCs 44 and 45) categories over the period. Third, the degree of masking differs over the commodities studied, ranging from about 25% for farm products (STCC 01), coal (STCC 11), and food or kindred products (STCC 20) to 30% for chemicals and allied products (STCCs 28 and 29) to nearly 50% for lumber and wood (STCC 24) and pulp, paper and allied products (STCC 26).

5. Conclusions

With reasonable accuracy, we can now estimate the actual revenue per ton-mile from 1984 to the present and actual R/VC ratios from 1987 to the present, both at the mapped commodity group level. These estimates indicate that the known positive impact of Staggers Act related changes for shippers has, if anything, probably been *understated*. In the coal market, for example, which is still arguably the most important rail commodity, masked revenue information suggests that revenue per ton-mile fell by an average annual rate of 2.6% per year, whereas an *Analysis*-based measure shows it falling by an average 3.5% a year over 25 years. Published reports based on masked revenue suggest that the R/VC ratio for coal remained essentially constant at about 190% (above the 180 percent threshold), whereas our analysis argues that the ratio for coal actually *fell* from just over 180% to about 150%.[23]

[21] See, e.g., AAR (2011, page 44), for an example of the use of masked revenue/ton-mile at the commodity group level.

[22] We speculate that both the tons/carload and the average length of haul for contract tariffs, especially coal, may be somewhat higher than average, so that the impact of contracting on tons and ton-miles may have been somewhat higher than on carloads, per se.

[23] We acknowledge a mix issue within the 2 digit STCC group for coal since production during the period studied shifted from eastern to western states where, because of longer distances and lower BTU content, tariff rates are lower. In 1985, the tonnage production percentages were: Appalachia, 48%; interior states, 21%; Powder River Basin, 20%; and other western states, 11%. By 2010, these percentages had shifted to: Appalachia, 32%; other interior states, 13%; Powder River Basin, 45%; and, other western states, 10%. Mix changes alone clearly caused part of the reduction in coal tariffs. If the mix issue causes R/VC ratios to fall, though, it must also indicate a shift from more profitable to less profitable coal being shipped.

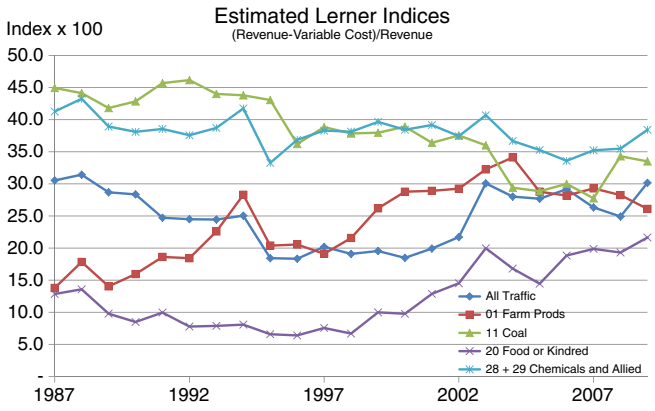

Fig. 3. Estimated Lerner indices (revenue-variable cost)/revenue.

Our estimates of Lerner indices do not support an argument that the industry has measurably increased its pricing power since 1987 (the earliest year for which the indices can be estimated), either in the aggregate or for any of the significant capable commodity groups. In fact, for aggregate industry output and prices, and for coal and chemicals, the indices are shown to have decreased.

Finally, the ratio of masked revenue to actual revenue has been increasing over time both overall and for each commodity group studied, though the ratio does differ by commodity group. This establishes that contract ratemaking occurs in all commodity groups studied and that the significance of contracting has increased over time. While it is difficult to distinguish between the actual growth in contract tariffs and the ramping up of masking itself, a comparison of the growth of unit train volumes with changes in masking effects suggests that both have occurred, with ramping up probably having most of its impact in the early years of contracting.

5.1. Further research recommendations

Our analysis has revealed at least two major issues which bear further investigation. First, it would be interesting to see how our results would change if properly estimated marginal costs were used to develop the Lerner indices. We have indicated above that there are significant differences between the URCS estimates of unit costs and estimates proposed by Christensen Associates (2010) and others. It would be interesting to develop these differences in more detail.

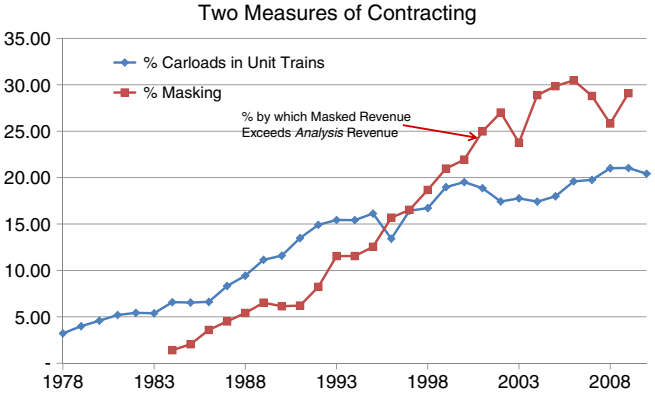

Fig. 4. Two measures of contracting. Note: % carloads in unit trains from Analysis calculated as accounts (718/(718 + 719 + 720)).

Second, it would be interesting to explore in more detail the actual share of contracts in current freight markets, whether that share is increasing or decreasing (and why), and what has been the overall effect of contracts. Ultimately, what portion of the $13.8 billion ($2010) increment between unmasked and masked revenues in 2009 can actually be attributed to contract reductions? Our analysis of the data fields in the CWS indicates that it may be possible to develop a clearer set of measures of the impact of contract tariffs without divulging confidential information.

5.2. Implications for the practitioner

The three measures that we have calculated – revenue per ton-mile, R/VC ratio and Lerner indices – when taken together give a favorable picture of the positive effects of the Staggers Act, not just at the overall industry level for all commodities, where the picture has long been clear, but also at the level of the major commodity groups. Rate flexibility and contract ratemaking have contributed to significantly lower tariffs; these forces, combined with technological advances, network rationalization (also partly facilitated by the Act, which permitted faster abandonments but did not affect mergers) and traffic growth, have engendered much lower costs and better service. Both shippers and downstream consumers have benefited; in addition, improved productivity and finances in the industry have meant that the bankrupt, poorly maintained railways of the 1960s and 1970s have been rebuilt and are on a stronger financial footing. We hope that continuing work to improve URCS and to develop better estimates of revenues and variable costs at commodity group levels will improve the understanding of the impact of the Act and of proposals to modify it.

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