

**BEFORE THE
SURFACE TRANSPORTATION BOARD

EX PARTE 766**

ENTERED
Office of Proceedings
September 1, 2020
Part of
Public Record

**JOINT PETITION FOR RULEMAKING
TO MODERNIZE ANNUAL REVENUE ADEQUACY DETERMINATIONS**

Sean Finn
Olivier Chouc
CN
935 de La Gauchetière Street
West 16th Floor
Montréal, QC H3B 2M9
CANADA

Kathryn Gainey
CN
Suite 500, North Building
601 Pennsylvania Avenue, N.W.
Washington, DC 20004

Vanessa A. Sutherland
Thomas E. Zoeller
Hanna Chouest
NORFOLK SOUTHERN CORP.
Three Commercial Place
Norfolk, VA 23510

Rhonda S. Ferguson
Craig V. Richardson
James B. Boles
UNION PACIFIC RAILROAD CO.
1400 Douglas Street
Omaha, NE 68179

Raymond A. Atkins
Matthew J. Warren
Morgan B. Lindsay
SIDLEY AUSTIN LLP
1501 K Street, N.W.
Washington, D.C. 20005

*Counsel for CN, Norfolk Southern
Railway Company, and Union
Pacific Railroad Company*

September 1, 2020

EXECUTIVE SUMMARY	1
I. Background	8
A. Regulatory Framework	8
i. Section 10704(a)(2): the Statutory Definition	8
ii. Rail Transportation Policy Factors	10
B. Prior ICC Decisions on Definition of Revenue Adequacy.	12
i. Use of Depreciated Original Costs.	13
ii. Removal of Deferred Taxes from Investment Base	13
C. Measurement Errors	15
II. The Board Should Establish A Comparison Approach For The Annual Revenue Adequacy Determinations.	20
A. The Comparison Proposal	20
B. The Comparison Proposal Is Justified By The Statute and Sound Public Policy.	24
i. The Comparison Proposal provides a reasoned way to include a “reasonable and economic profit or return” in the annual determination, as directed by Congress.	25
ii. The Comparison Proposal provides a reasoned way to address the known measurement error in the current annual calculations.	29
iii. The Comparison Proposal would offer a richer dataset to measure the relative financial success of the rail industry.	32
iv. The Comparison Proposal is easily implemented and verifiable.	36
III. The Board Should Also Adopt a Commonsense Approach to the Treatment of Deferred Taxes.	38
A. The Flow-Through Proposal	38
B. The Flow-Through Treatment of Deferred Taxes Avoids Absurd Results and Is A Better Fit For The Rail Industry.	40
i. The Current Utility-Based Method for Deferred Taxes Produces Absurd Results.	40
ii. The Utility Method Is a Poor Fit for the Railroad Industry.	44
iii. The Flow-Through Approach Has Many Benefits.	46
CONCLUSION	50

EXECUTIVE SUMMARY

The Surface Transportation Board (STB or Board) has committed itself to “evidence-based decision-making.”¹ No stakeholder has opposed this wise policy choice, which is consistent with sound regulatory policy and the Board’s responsibilities under the Interstate Commerce Act. Using data to guide policy decisions is superior to reliance on anecdotal complaints, one-sided testimony, or unproven assumptions.

Evidence-based decisionmaking requires good evidence. Congress charged the Board with annually measuring the financial health of the rail industry and assisting each railroad in achieving revenue adequacy. As Professors Kevin Murphy and Mark Zmijewski observe in the attached statement:

Congress and the Board have an interest in monitoring the health of the railroad industry, given the vital importance of the railroad industry in the United States and even world economies for transporting goods to domestic and international markets and avoiding taxpayer subsidization of unprofitable railroads. And because of the importance of having a healthy railroad industry in the United States, it is critical that metrics used and the context in which those metrics are evaluated provide an accurate assessment of the railroads’ financial health.²

The Board currently attempts to fulfill this statutory responsibility with flawed and incomplete data, using tools designed three decades ago. It relies on *accounting* measures of return on investment, rather than the current *economic* value of those investment assets. The agency then removes billions of dollars of accumulated deferred taxes from that investment base, adding yet another distortion made evident in 2017 when corporate tax rates changed.³ And the Board

¹ STB Budget Request, Fiscal Year 2020, at 10.

² Verified Statement of Kevin M. Murphy and Mark E. Zmijewski at ¶ 27 (“Murphy & Zmijewski V.S.”).

³ These recent distortions driven by exogenous tax policy changes have every chance of being repeated. Going forward, every time Congress decides to take a different

then analyzes these findings without considering evidence about typical rates of return for the companies with which railroads compete for capital. Modernization of this antiquated measurement would bring the annual revenue determinations closer to Congress's original purpose. In this Petition, Petitioners Union Pacific Railroad Company ("UP"), Norfolk Southern Railway Company ("NS"), and the U.S. rail operating affiliates of Canadian National Railway Company (collectively "CN") set forth a proposal to address these flaws and improve the evidence the Board considers to assist railroads in earning "a reasonable and economic profit or return (or both) on capital employed in the business." 49 U.S.C. § 10704(a)(2). Adoption of this proposal will provide the agency with publicly available information that can place its annual findings into the proper context.

This Petition does not focus on the debate over whether and how the Board might apply a "revenue adequacy constraint."⁴ It is focused on a different question: are the Board's annual revenue adequacy determinations designed so that the Board may fulfill its statutory duties in accurately measuring and properly promoting railroad revenue adequacy? The answer is clearly no.

approach to corporate tax policy, the Board will find itself having to make complex and awkward adjustments in its methodology.

⁴ Petitioners emphasize there is no basis in the law or in sound regulatory policy for the Board to impose a top-down revenue adequacy constraint. Congress instructed the agency to "promote" revenue adequacy and to monitor financial health of railroads, not to place a cap on earnings or otherwise impose restrictive regulation on railroads using blunt system-wide tools. . For those reasons, the Board should abandon the top-down revenue adequacy constraint as an antiquated and unnecessary form of economic regulation. *See* Comments of the Association of American Railroads at 7-35, *Hearing on Railroad Revenue Adequacy*, Ex Parte 761 (filed Nov. 26, 2019). But regardless of what action it takes on the revenue adequacy constraint, the Board surely cannot make any rational and non-arbitrary decisions in this area without a more accurate measure of railroads' actual financial health. Nor can the Board comply with Congress's command to monitor and promote the health of the railroad industry without accounting for the abundant, readily available evidence of how the rail industry compares to other industries.

Specifically, this Petition outlines two changes by which the Board could provide itself, the public, and Congress with a better perspective on the “revenue adequacy” of the freight rail industry. First, the Board should use a comparison approach that contrasts its annual revenue adequacy determinations (however calculated) against the performance of other companies in the S&P 500, using the same methodology for both. Second, the Board should modify its treatment of deferred taxes in annual revenue adequacy determinations in order to provide an accurate view of railroad returns (and so the Board will not need to make manual adjustments every time Congress changes corporate tax policy).

The first proposal is the centerpiece of this Petition. One of the hallmarks of the Staggers Rail Act of 1980 was Congress’s desire to “treat[] the American railroad industry as any other business.”⁵ An essential part of treating railroads like other businesses is recognizing that railroads compete for capital in the same markets as other firms in a variety of industries. Investors have a multitude of options for investing their capital, and they are naturally inclined to seek out options where they expect to earn more than the cost of capital. For this reason, the financial health of the railroad industry cannot be viewed in isolation, but rather must be considered in relation to the competition railroads face in the capital markets from other, unregulated firms.

Moreover, comparing railroad performance against other companies in the S&P 500—using the same methodology—mitigates some of the measurement errors in the current approach. For example, using accounting rather than economic measurements of profits has long bedeviled the agency. Use of economic

⁵ *Burlington N. R.R. Co. v. Pub. Util. Comm’n of Texas*, 812 F.2d 231, 235 (5th Cir. 1987) (citing 126 Cong. Rec. 28,431 (1980) (statement of Rep. Staggers)); see *Groome & Assocs., Inc. v. Greenville Cty. Economic Develop. Corp.*, STB Docket No. 42087, at 12 (served July 27, 2005) (“Congress directed [in the Staggers Act] that railroads be treated more like ordinary businesses than like public utilities.”).

measurements is superior, but has been considered impractical because of the complexities in calculating the replacement cost of assets. Yet examining companies in the S&P 500 using a consistent measurement provides the Board an important perspective into the relative performance of the industry, which is the most relevant inquiry that will guide the flow of capital.⁶

The Board has a rich dataset from which it can develop that comparative analysis. University of Chicago Professors Kevin Murphy and Mark Zmijewski have analyzed data on the relative performance of every company in the S&P 500 from 2006 to 2019. This data was first presented in summary form at the Railroad Revenue Adequacy hearing on December 13, 2019. It is presented herein again and in full.

Simply put, Professors Murphy and Zmijewski used the Board's own methodologies to derive a revenue adequacy calculation for nonrailroads in the S&P 500. The two professors painstakingly replicated the STB's approach. They calculated the ROI and cost of capital from the same public sources and using the same methodology used by the Board. So, for example, they used the average of the CAPM and MSDCF models to estimate the cost of equity, they used the same accounting measures of investment, and they removed (at least initially) the accumulated deferred taxes from that investment base. They even replicated the Board's adjustment to the 2017 findings that ignored the effect of the changes in corporate tax rates on the accumulated deferred taxes. In every respect, the S&P 500 dataset mirrors the Board's current method for determining revenue adequacy.

⁶ This change is thus in line with the suggestions by the Transportation Research Board's *Modernizing Freight Rail Regulation* report that the Board "obtain a richer set of information" to determine "whether a railroad's profits are consistently outside a reasonable band of profitability that characterizes many other industries over a business cycle." Transportation Research Board, *Modernizing Freight Rail Regulation*, at 8, 155, 202 (2015), available at <https://doi.org/10.17226/21759>.

All of these data are from public sources. They can be calculated, updated, and verified by any member of the public, and could be provided to the STB annually.

The results are striking. Using the Board’s “essentially mechanical” analysis,⁷ Professors Murphy and Zmijewski show there is nothing unusual about a company earning an ROI above its cost of capital. Indeed, 89% of the S&P 500 earn ROIs over their cost of capital (using the same methodology the Board uses to calculate railroad ROI and cost of capital).⁸ In other words, *a substantial majority of major public companies in nearly every industry is “revenue adequate” under the Board’s current definition—but by margins that dwarf those achieved by any railroad.*

This reality is at odds with the current dialogue before the agency. The agency has heard for years, from those who stand to gain from agency rent-seeking, that revenue adequacy is a sign of excessive profits that could only have been earned through abuses of market power. Parties then urge the Board to adopt aggressive regulatory changes that would snap into place once the Board calculated that a railroad’s return on investment exceeded the industry cost of capital by any amount over the measured period.

While snapping constraints into place would be misguided at any profit level, it is particularly inappropriate to trigger such constraints using a hurdle that nearly the entire S&P 500 clears. Put simply, the Board’s current revenue adequacy “thermometer” indicates everyone has a fever. To accurately measure where railroads stand, the Board should consider whether railroads are earning returns on cost of capital substantially higher than those of companies in other industries. If the goal is for the Board to determine whether system-wide earnings are evidence of

⁷ *Railroad Revenue Adequacy—2018 Determination*, at 1, STB Ex Parte No. 552 (Sub-No. 23) (served Sept. 5, 2019).

⁸ Murphy & Zmijewski V.S. at 80 Table 7.

an abuse of market power, the Board cannot even begin to make that determination unless at the very least it finds railroads are earning substantially more than peer companies and rivals for capital.⁹

The Board would have a more accurate view of railroads' actual financial health if its annual revenue adequacy determinations incorporated information on whether railroads are earning ROIs over their cost of capital that are out of line from what a typical company earns. As detailed below, that could be done by an annual comparison to a representative group of peer firms, drawn from the S&P 500. This publicly available information could then be incorporated in the Association of American Railroads' filings in annual cost of capital proceedings and made available for comment and review by Board staff and interested parties.

In addition to incorporating public data on other peer firms into the revenue adequacy evaluation, Professors Murphy and Zmijewski recommend changing how the Board treats accumulated deferred taxes and including non-goodwill intangible assets in a company's investment base. As the data show, the median S&P 500 company earns an ROI 19% over its industry average cost of capital, if one copies the STB's methodology precisely. But these two flaws in the current 33-year old approach are distorting both the *absolute* measure of railroad financial health and the *relative* performance of the railroad industry.

Therefore, Professors Murphy and Zmijewski recommend two simple adjustments to improve the precision of the comparison. First, the Board should

⁹ To be sure, the fact that a company is earning substantially more than its cost of capital is not *per se* evidence of an abuse of market power, because such returns could be the result of innovation and competitive success that should be encouraged. But for purposes of the § 10704(a)(3) measuring stick, the Board would be justified in assuming that a railroad earning substantially over the median amount that a S&P 500 company earns over its cost of capital in a given year is "revenue adequate" for that year. Only then might further inquiry by the Board on the cause for such results be warranted.

include non-goodwill intangible assets. This change has little impact on railroads, which typically do not have significant non-goodwill intangible assets, but it has a significant effect on certain firms that do have such assets in the form of brand names or trademarks. Making this change thus allows for more meaningful comparisons between railroad performance and that of other firms. Second, the Board should remove the distorting effect of deferred taxes by adopting a “flow-through” approach like the one originally endorsed by the Department of Transportation, as discussed further below.¹⁰

These adjustments are *not* favorable to the railroad industry in this comparison analysis. Quite the contrary. But even with these adjustments, 84% of companies *still* earn an adjusted ROI above the cost of capital, but the median difference is now only 10%. So while it remains the case that a substantial majority of major public companies in nearly every industry are “revenue adequate,” these dual adjustments bring the railroad industry *closer* to the median performance of the S&P 500. Because the goal of this Petition is to provide the Board with a rich and reliable dataset for a comparative analysis, the railroad petitioners support the recommendations of Professors Murphy and Zmijewski, because they rest on a sound economic foundation and provide the Board with better data for evidence-based decisionmaking.

¹⁰ As demonstrated below, the flow-through approach produces a more accurate assessment of current cash flows and thus a more useful tool for the Board to measure railroad financial health. It also carries the significant benefit of not requiring regular manual adjustments upon changes in tax policy. The Board recently made a one-time adjustment to the 2017 revenue adequacy determination to prevent the absurd results that would have occurred as a result of the 2017 reduction in the corporate tax rate. If the Board does not change course, future adjustments may become a matter of course every time Congress amends the tax laws.

In sum, Petitioners urge the Board to initiate a rulemaking proceeding to solicit public comment on this proposal. In light of the Board's responsibility accurately to measure and analyze railroad ROI and to support the economic health of the railroad industry, the Board should institute a rulemaking to adopt rules that would (1) add a comparative analysis to the annual revenue adequacy determinations that calculates the amount by which the median S&P 500 company's ROI exceeded (or fell short of) its cost of capital ("S&P Differential"); (2) for purposes of annual determinations, define revenue adequacy to mean that a railroad's annual ROI exceeds the industry cost of capital net of the S&P Differential; and (3) use the flow-through method for deferred taxes when calculating ROI.

I. Background

A. Regulatory Framework

As noted above, the centerpiece of this Petition is for the agency to use a comparison approach that contrasts its annual revenue adequacy determinations (however calculated) against the performance of other companies in the S&P 500, using the same methodology for both railroad performance and non-railroad performance. This concept finds ample support in the plain language of the statute and the rail transportation policies of the United States.

i. Section 10704(a)(2): the Statutory Definition

Congress has instructed the STB and its predecessor to promote the revenue adequacy of railroads since enactment of the Railroad Revitalization and Regulatory Reform Act of 1976 ("4-R Act").¹¹ The Staggers Act included a further

¹¹ Pub. L. No. 94-210, 90 Stat. 31 (1976).

requirement for the agency to annually measure revenue adequacy for each Class I railroad. This requirement is currently codified at 49 U.S.C. § 10704(a)(2) and (3):

- (2) The Board shall maintain and revise as necessary standards and procedures for establishing revenue levels for rail carriers providing transportation subject to its jurisdiction under this part that are adequate, under honest, economical, and efficient management, for the infrastructure and investment needed to meet the present and future demand for rail services and to cover total operating expenses, including depreciation and obsolescence, plus a reasonable and economic profit or return (or both) on capital employed in the business. The Board shall make an adequate and continuing effort to assist those carriers in attaining revenue levels prescribed under this paragraph. Revenue levels established under this paragraph should—
 - (A) provide a flow of net income plus depreciation adequate to support prudent capital outlays, assure the repayment of a reasonable level of debt, permit the raising of needed equity capital, and cover the effects of inflation; and
 - (B) attract and retain capital in amounts adequate to provide a sound transportation system in the United States.
- (3) On the basis of the standards and procedures described in paragraph (2), the Board shall annually determine which rail carriers are earning adequate revenues.

This provision calls for affirmative Board action to promote adequate revenues for every carrier. “Adequate” means “equal to, proportionate to, or fully sufficient for a specified or implied requirement.”¹² Section 10704(a)(2) defines that specific requirement as revenues that are sufficient to: i) allow for infrastructure and investment needed to meet present and future demand for rail services; ii) cover total operating expenses, including depreciation; and iii) provide for “a reasonable and economic profit or return (or both) on capital employed in the business.” The provision goes on to require that the Board make an “adequate and continuing effort to assist . . . carriers in attaining revenue levels” in accordance

¹² 1 WEBSTER’S THIRD NEW INT’L DICTIONARY 25 (1976).

with this prescribed definition. 49 U.S.C. § 10704(a)(2). In other words, the statute calls for the Board to assist carriers in earning not up to their cost of capital, but rather revenue levels described by Section 10704(a)(2), which describes revenue *above and beyond* the cost of capital.

ii. Rail Transportation Policy Factors

The Rail Transportation Policy (“RTP”) factors, contained in 49 U.S.C. § 10101, are not independent sources of regulatory authority but rather express the policies that are to guide the STB’s exercise of authority granted elsewhere in the statute.¹³ In other words, the general provisions in § 10101 cannot trump the specific provisions dealing with rate reasonableness.¹⁴ Nevertheless, the RTP factors reinforce the point that revenue adequacy is a goal toward which to strive, and they express the expectation and desire for carriers to earn returns comparable to other unregulated industries.

First, the legislative history of the Staggers Act explains the overall thrust of the (then) new RTPs. In reference to the RTPs, the conference report on the Staggers Act explains:

¹³ See *CSX Transp., Inc.—Abandonment Exemption—in LaPorte, Porter, & Starke Ctys., Ind.*, AB 55 (Sub-No. 643X) et al., slip op. at 6 (STB served May 31, 2017) (“[T]he RTP does not create an independent basis for Board action in the absence of a violation of a substantive provision in the Interstate Commerce Act.”) (citations omitted).

¹⁴ See *Perez-Guzman v. Lynch*, 835 F.3d 1066, 1075 (9th Cir. 2016) (The “canon [of] *generalia specialibus non derogant*—i.e., “the specific governs the general”] provides that a ‘narrow, precise, and specific’ statutory provision is not overridden by another provision ‘covering a more generalized spectrum’ of issues. *Radzanower v. Touche Ross & Co.*, 426 U.S. 148, 153–54 (1976). When two statutes come into conflict, courts assume Congress intended specific provisions to prevail over more general ones, see *Fourco Glass Co. v. Transmirra Prods. Corp.*, 353 U.S. 222, 228–29 (1957), the assumption being that the more specific of two conflicting provisions ‘comes closer to addressing the very problem posed by the case at hand and is thus more deserving of credence,’ Antonin Scalia & Bryan A. Garner, *Reading Law: The Interpretation of Legal Texts* 183 (2012).”).

Consistent with the new rail transportation policy of this Act, the Conferees intend that competition be recognized as the best control on the ability of railroads to raise rates. The purpose of this legislation is to reverse the decline of the railroad industry, which has been caused, in part, by excessive government regulation. The Conferees believe that by allowing the forces of the marketplace to regulate railroad rates wherever possible the financial health of the railroad industry will be improved and will benefit all parts of the economy, including shippers, consumers, and rail employees.¹⁵

Second, the agency is expressly encouraged to rely on unregulated markets to the maximum extent possible. Another provision of the RTP states that “[t]his new section [section 10101] directs the Commission to encourage primary reliance on the marketplace rather than regulation, to limit regulation of railroads to those areas where there is an absence of effective competition and to permit rates which provide revenues necessary to maintain the rail system and to attract capital.”¹⁶ Here, this Petition would have the STB look to other industries and markets with whom the railroads compete for capital to gauge the relative financial success of the freight rail industry. At all times, these unregulated marketplaces should be the benchmark against which this regulated market is judged.

Finally, various specific RTP provisions promote the concept of comparing the performance of the rail industry to other industries Congress chose not to regulate. Specifically, RTP(3) contains the one express instruction on revenue adequacy in the RTP factors. RTP(3) directs the Board to “promote a safe and efficient rail transportation system by allowing rail carriers to earn adequate revenues.”¹⁷ RTP(3) would be undermined if railroads were handicapped in their ability to

¹⁵ H.R. REP. NO. 96-1430, at 89 (1980) (Conf. Rep.), *as reprinted in* 1980 U.S.C.C.A.N. 4110, 4120-21.

¹⁶ H.R. REP. NO. 96-1035, at 54 (1980), *as reprinted in* 1980 U.S.C.C.A.N. 3978, 3999.

¹⁷ 49 U.S.C. § 10101(3).

compete for capital with other firms in the S&P 500. Indeed, RTP(6) makes this point bluntly. It declares Congress’s policy “to maintain reasonable rates where there is an absence of effective competition and where rail rates provide revenues which exceed the amount necessary to maintain the rail system and to attract capital.”¹⁸

In sum, Congress made clear “revenue adequacy” was about more than covering costs, but rather also required railroads to earn “a reasonable and economic profit or return (or both) on capital employed in the business” and necessitated an income flow sufficient to “permit the raising of needed equity capital.” *Id.* § 10704(a)(2)(A) It naturally follows from that directive to use an approach that *compares* the financial performance of freight railroads against other, unregulated firms with which railroads compete for capital.

B. Prior ICC Decisions on Definition of Revenue Adequacy.

In the wake of the Staggers Act, the Interstate Commerce Commission (“ICC”) developed standards for measuring railroad revenue adequacy in 1981.¹⁹ These standards were amended in 1986, but have since undergone little significant change.²⁰ The Board has recognized that the process it inherited from the ICC is an “essentially mechanical” one, in which “a railroad is considered revenue adequate under 49 U.S.C. § 10704(a) if it achieves a rate of return on net investment (ROI) equal to at least the current cost of capital for the railroad industry.”²¹

¹⁸ *Id.* § 10101(6).

¹⁹ *Standards for Railroad Revenue Adequacy*, 364 I.C.C. 803 (1981) (“*Standards I*”).

²⁰ *Standards for Railroad Revenue Adequacy*, 3 I.C.C.2d 261 (1986) (“*Standards II*”).

²¹ *Railroad Revenue Adequacy—2018 Determination*, at 1, Ex Parte No. 552 (Sub-No. 23) (served Sept. 5, 2019).

i. Use of Depreciated Original Costs.

Under *Standards I* and *Standards II*, the Board uses accounting book values (*i.e.*, depreciated original costs) to determine each railroad's investment base, and thus to measure ROI. The agency has long recognized that replacement cost valuation is superior to book valuation, both because replacement costs "may better reflect the true economic costs associated with an investment" and because replacement costs "come[] closer to the competitive result." *Standards I*, 364 I.C.C. at 818. However, the ICC concluded that the replacement cost method was too difficult to implement, in part because of the "major difficulty with . . . the estimation of the actual value of individual investments." *Id.* at 819.²² In 2008, the Board rejected a petition for rulemaking by the Association of American Railroads asking it to reconsider the ICC's decision and to adopt a mechanism for considering replacement costs in the annual revenue adequacy determinations.²³ The Board concluded that the AAR's proposal "failed to overcome the practical difficulties associated with using a replacement-cost approach."²⁴

ii. Removal of Deferred Taxes from Investment Base

The ICC took different approaches to deferred taxes during its history of developing revenue adequacy measurements. The ICC initially chose to remove deferred taxes from the investment base (as the Board does today).²⁵ But in *Standards I*, the ICC chose the "hybrid method," which excludes deferred taxes

²² See also *Standards II*, 3 I.C.C.2d at 277 ("While current cost accounting is theoretically preferable to original cost valuation, it cannot be practically implemented in a manner that we can be confident would produce accurate and reliable results.").

²³ *Association of American Railroads—Pet. Regarding Methodology for Determining Railroad Revenue Adequacy*, STB Ex Parte No. 679, at 7 (served Oct. 24, 2008).

²⁴ *Id.*

²⁵ *Standards and Procedures for the Establishment of Adequate Railroad Revenue Levels*, 358 I.C.C. 844, 890 (1978) ("*Standards and Procedures*").

from ROI, but does not remove the accumulated deferred taxes from the investment base. The ICC reasoned that it would “thwart the intent of Congress . . . to provide business enterprise with tax benefits as a means of spurring capital spending” if “railroads are not allowed to earn a return on investments made with these funds.” *Id.* at 813-14. On appeal, the Third Circuit found the agency’s economic analysis reasonable because, for all businesses, tax benefits are “a source of funds which may be reinvested” such that if railroads are precluded from earning a rate of return on the investment of such funds, they would be at a “competitive disadvantage in seeking equity capital” and “would be encouraged to invest the funds . . . elsewhere than in the railroad business.”²⁶

Three years later, the ICC changed course again, returning to its prior practice of removing deferred taxes from the investment base (an approach known as the “Utility Method”). The agency based this decision on a “double benefit” theory that would apply in only public-utility style regulation. *See Standards II*, 3 I.C.C.2d at 272. The Third Circuit affirmed *Standards II*, but with deep reservations—noting that the ICC was depriving railroads of their ability to earn a return on investments from tax savings, and thus putting them in a worse position than “unregulated firms which do retain the second benefit of an opportunity to earn a return on those funds.”²⁷ Given the deferential scope of its review, however, the Third Circuit affirmed *Standards II* in light of the ICC’s rationale that the hybrid method had created inaccuracies it wished to avoid by switching to the Utility Method. *Id.* at 93.

²⁶ *Bessemer & Lake Erie R.R. Co. v. Interstate Commerce Comm’n*, 691 F.2d 1104, 1116 (1983) (“*Bessemer*”).

²⁷ *Consolidated Rail Corp. v. United States*, 855 F.2d 78, 90 (3d Cir. 1988) (the ICC was disadvantaging railroads that “have to *compete* for capital with unregulated firms which do retain the second benefit of an opportunity to earn a return on those funds.”) (emphasis in original).

C. Measurement Errors

If the STB is going to make data-driven decisions, then the data supporting those decisions must be as accurate as possible. As Professors Murphy and Zmijewski caution, “[b]ecause of the importance of having a healthy railroad industry in the United States, it is critical that metrics used and the context in which those metrics are evaluated provide an accurate assessment of the railroads’ financial health. If the Board adopts and relies on a metric that systematically under- or overestimates the economic rate of return earned by railroads, then it cannot provide the oversight and monitoring guidance that Congress requires.”²⁸

Unfortunately, the Board’s method of calculating revenue adequacy has significant measurement errors that result in a distorted and inaccurate picture of railroad revenue adequacy. The data problems are twofold: the use of book values and the treatment of deferred taxes.

The Board currently calculates railroad ROI for purposes of determining revenue adequacy by using the book value of railroad assets, rather than replacement value. This is despite the fact that both the ICC and the Board have repeatedly acknowledged that the preferred way to value the assets of a firm for purposes of assessing the adequacy of the firm’s revenues is the replacement cost of the assets.²⁹ As the Professors explain, “Economic research has shown that the limitations and inaccuracies of accounting-based rates of return make it difficult, some say impossible, to infer economic rates of return from accounting rates of

²⁸ Murphy & Zmijewski V.S. at ¶ 27.

²⁹ *Standards I*, 364 I.C.C. at 820 (“While we perceive some difficulty in implementing a replacement cost valuation method, we believe that it is conceptually the best method available.”); *Standards II*, 3 I.C.C.2d at 277 (“While current cost accounting [*i.e.*, current replacement cost of assets] is theoretically preferable to original cost valuation, it cannot be practically implemented in a manner that we can be confident would produce accurate and reliable results.”).

return.”³⁰ In the attached report, the Professors summarize the peer-reviewed economic literature from the last 50 years. That literature has identified the well-known limitations and inaccuracies with accounting rates of return as measures of financial performance.

Once again, the Professors echo the consensus view of other notable economists. For example, Professor Joseph Kalt has explained that *accounting* rates of return are not probative of whether a railroad is actually earning an *economic* rate of return that exceeds its cost of capital, much less of any kind of anticompetitive conduct or exercise of market power as a source of returns in excess of the cost of capital.³¹ Especially with the kind of durable and long-lived capital found in the rail industry, non-economic accounting measures of depreciated original book costs readily yield economically nonsensical conclusions as to the adequacy of revenues and returns. For example, using book value overstates railroad ROIs (and thus revenue adequacy).³² Professor Kalt has also explained that the Board’s perceived difficulty in using current replacement cost as a measure “cannot justify the use of economically incoherent rates of return on depreciated

³⁰ Murphy and Zmijewski Verified Statement at 8 & ¶ 83.

³¹ Opening Comments of The Association of American Railroads, EP 722, Verified Statement of Joseph P. Kalt, at 4, 30-31 (filed Sep. 5, 2014) (“2014 Kalt V.S.”); see Franklin M. Fisher & John J. McGowan, *On the Misuse of Accounting Rates of Return to Infer Monopoly Profits*, 73 AM. ECON. REVIEW 82, 90 (1983) (“[T]here is no way in which one can look at accounting rates of return and infer anything about relative economic profitability or, a fortiori, about the presence or absence of monopoly profits”); *Hearing on Railroad Revenue Adequacy*, Ex Parte 722, Written Testimony of Joseph P. Kalt V.S. ¶ 34 (filed Nov. 26, 2019 (“Kalt 2019 Written Testimony”) (“It is important to note that even properly conceived measures of revenue adequacy do not provide sufficient evidence on which to base a finding of anticompetitive conduct or the exercise of market power.”)).

³² Opening Comments of The Association of American Railroads, EP 722, Verified Statement of Roger Brinner, at 14-26 (filed Sep. 5, 2014) (“2014 Brinner V.S.”). As Dr. Brinner explains, book value is based on the historic cost of assets carried on a firm’s books as opposed to the current cost of assets.

historical book value to determine whether a railroad is realizing ‘excess revenues.’”³³ The flaws with using *accounting* measurements of ROI are now well documented. “The infirmities of using accounting profitability and rates of return to infer market power or above-competitive returns, particularly for capital industries like railroading with long-lived equipment, are well known. As starkly summarized by the classic treatment of the issue, ‘there is no way in which one can look at accounting rates of return and infer anything about relative economic profitability or, a fortiori, about the presence or absence of monopoly profits.’”³⁴ Notable economists caution against the use of accounting rather than economic measures of financial health. “If book depreciation and economic depreciation are different (they are rarely the same), then the book profitability measures will be wrong; that is, they will not measure true profitability.”³⁵ And “[p]rice regulation based on such misguided conclusions would likely make it more difficult for railroads to attract and retain capital investment on account of not being able to realize economically required rates of return.”³⁶ Celebrated economists Franklin Fisher and John McGowan long ago expressed one of the strongest conclusions against using accounting rates of return as estimates of economic rates of return:

[T]here is no way in which one can look at accounting rates of return and infer anything about relative economic profitability. . . . Economists (and others) who believe that analysis of accounting rates of return will tell them much (if they can only overcome the various definitional

³³ 2014 Kalt V.S. at 31; *see also* Kalt 2019 Written Testimony at ¶¶ 34-47.

³⁴ 2014 Kalt V.S. at 32 (quoting Fisher & McGowan, *supra* note 30, at 90).

³⁵ RICHARD BREALEY, STEWART MYERS & FRANKLIN ALLEN, *PRINCIPLES OF CORPORATE FINANCE* 317 (8th ed. 2005).

³⁶ Opening Comments of Norfolk Southern Railway Company, EP 722, Verified Statement of Bradford Cornell, at 18 (filed Sep. 5, 2014).

problems which separate economists and accountants) are deluding themselves.³⁷

Another problematic measurement error relates to the Board's treatment of deferred taxes. The ICC's treatment of deferred taxes has swayed back and forth.³⁸ The Commission eventually settled on the so-called "Utility Method," where accumulated deferred taxes are excluded from the investment base.³⁹ Even though the Third Circuit, reviewing the ICC's decision, believed that the Utility Method created a powerful disincentive for investment in the railroad industry, it felt compelled to reject the railroads' challenge due to the deferential scope of its review.⁴⁰

Excluding deferred taxes from the investment base makes little economic sense. Because deferred taxes are a source of funds that railroads use to invest in their assets (*i.e.*, a source of capital that may be reinvested), it makes sense to treat deferred taxes in the same way as any other source of capital rather than remove them from the investment base. A group of leading economists urged the ICC back in 1985 to take this very stance and measure revenue adequacy as "a rate of return equal to the current cost of capital on the replacement value of all rail assets that are required to meet the demands for railroad service, *regardless of the source of*

³⁷ Fisher & McGowan, *supra* note 30, at 90-91.

³⁸ See *Standards and Procedures*, 358 I.C.C. at 890 (excluding deferred taxes); *Standards I*, 364 I.C.C. at 813-14 (not excluding deferred taxes); *Standards II*, 3 I.C.C.2d at 269 (excluding deferred taxes).

³⁹ See *Standards II*, 3 I.C.C.2d at 271.

⁴⁰ See *Consolidated Rail Corp.*, 855 F.2d at 90 ("Given the competition between the railroads and unregulated firms for capital, the railroads are substantially disadvantaged by being deprived of the opportunity to earn a return on the funds in comparison to the unregulated firms, and therefore the incentive to all investors, including the railroads, is to invest in the unregulated firms where the advantage of the 'double benefit' is retained.").

*funds used in investing in those assets.”*⁴¹ In other words, the appropriate standard for measuring return on investment does not depend on the source of those investment funds. Whether the source is debt financing, equity financing, returns from existing traffic, or tax benefits bestowed by Congress, the standard should be the same: a rate of return equal to the current cost of capital on the replacement value of all rail assets required to meet the demand for railroad service.

Leading economists concur. Professors Murphy and Zmijewski explain how the current treatment of deferred taxes is contrary to basic valuation principles and amplifies the distortions from using accounting rate of returns to measure the financial health of the railroad industry.⁴² Professor Kalt agrees. As he explained last year, the Board’s current practice “in effect assumes that investors expect no return on assets ‘financed’ by deferred taxes. But such an assumption provides no incentive to the investors to keep those assets deployed in the rail industry. They have the incentive to, and would be better off, re-deploying that capital in industries where they could earn their cost of capital. It is therefore rational that investors do expect to earn a return on deferred taxes and such expectations are reflected in the market-based determinations of the cost of equity used by the STB. Therefore, the STB’s exclusion of deferred taxes overstates the attractiveness of railroad industry investments.”⁴³

Moreover, the Board’s treatment of deferred taxes creates worrisome practical problems. As the Board experienced in 2017, changes to corporate tax rates can produce ridiculously inaccurate measurements of financial health. If the

⁴¹ Opening Comments of Norfolk Southern Railway Company, EP 722, Attachment A, Economists’ Statement in Support of Staggers Act (Feb. 25, 1985) (emphasis added).

⁴² Murphy & Zmijewski V.S. at ¶¶ 57-59.

⁴³ Kalt 2019 Written Testimony at ¶ 68.

Board had not wisely acted, its 2017 figures would have suggested a one-year phantom surge in railroad profitability, as the net operating incomes would be inflated to reflect the change in accumulated deferred taxes. This is unlikely to be the last time the Board will have to manually adjust its ROI calculation. While the corporate tax rate was stable for years, one can anticipate the rate changing in future administrations, leaving the Board's revenue adequacy measurement at the mercy of changes in future corporate tax rates.

II. The Board Should Establish A Comparison Approach For The Annual Revenue Adequacy Determinations.

The Board's revenue adequacy methodology has existed essentially unchanged in the over three decades since *Standards II* was decided in 1986. In light of the Board's recent interest in revenue adequacy, the Board should consider whether the methodology it inherited from the ICC is actually measuring railroad revenue adequacy in a reliable and accurate way. In other words, is it true that a railroad whose Board-calculated ROI exceeds the industry cost of capital has reached a point where it has adequate revenues to "support prudent capital outlays," earn "a reasonable and economic profit," and "attract and retain capital in amounts adequate to support a sound transportation system in the United States"?⁴⁴ Both sound economic theory and an empirical analysis of data from comparable firms show that the Board's current method is not providing accurate annual determinations, and thus is not providing good evidence from which the Board can assess its progress in assisting railroads in achieving revenue adequacy.

A. The Comparison Proposal

To better align the annual revenue adequacy determinations with Congress's purpose, *the Board should define annual revenue adequacy to mean that a railroad's*

⁴⁴ 49 U.S.C. § 10704(a)(2).

Adjusted STB ROI exceeded the industry cost of capital by more than the median S&P 500 firm's ROI exceeded its cost of capital. The STB would implement this proposal by modifying the ROI calculation for the Class 1 carriers by including non-goodwill intangible assets in the investment base, removing the effect of annual deferred taxes from the ROI numerator, and removing the effect of accumulated deferred taxes liabilities from the ROI denominator. Professors Murphy and Zmijewski referred to this modified calculation as the Adjusted STB ROI. Second, the STB would direct the AAR to submit annually the Adjusted STB ROI and cost of capital calculations for every company in the S&P 500, using the same methodology used to measure the financial health of the freight railroads. From this robust dataset, the STB would calculate the median difference between the Adjusted STB ROI and the cost of capital for all companies in the S&P 500, except for banking and real estate companies. This median difference is referred to as the S&P Differential. Finally, the STB would re-define “revenue adequacy” for purposes of the annual revenue adequacy determination as earning an Adjusted STB ROI above the industry average cost of capital in excess of the S&P Differential.

To allow the Board to measure the practical effects of this proposal, Professors Murphy and Zmijewski have calculated the proposed S&P Differential from 2006 through 2019. A summary of the results is provided below, from Table 4 of the Professors' report, and more detailed year-by-year calculations are provided in their accompanying report and workpapers. As shown, the *typical, unregulated non-railroad firms* in the S&P 500 from 2006 through 2019 earned a median adjusted ROI over the cost of capital (the S&P Differential) of 10 percent.⁴⁵ And

⁴⁵ As the Professors' report shows, the median S&P 500 firm's *unadjusted* ROI is 19% above its cost of capital. Petitioners recommend, however, that the Board use the *adjusted* ROI to enable a superior comparison for the reasons described in the Professors' report.

using that same accounting measurement of financial performance, the railroad industry was outperformed by 87% of those unregulated firms with whom they compete for capital. As the Professors explain, “If the railroads earn a rate of return net of cost of capital no higher than the average or median S&P firm, then there would be no presumption that railroads are earning abnormal returns and can set rates without constraint from competition, or that shippers’ current protections under the Board’s SAC and related proceedings are not sufficient.”⁴⁶

Table 4 S&P500 Companies Excluding Railroads, Financial Institutions and Real Estate Companies				
Number of Observations, Median, 25th Percentile, and % Positive ROIC minus COC Over 2006-2019 Period				
	Minimum	Maximum	Median	Average
Number of Observations in Sample	393	415	409	406
Median Adjusted ROIC minus COC	5%	12%	10%	9%
25th Percentile Adjusted ROIC minus COC	-2%	3%	2%	2%
% with ROIC minus COC > 0.0%	68%	87%	84%	83%
Railroad Percentile in the Distribution of Adjusted ROIC minus COC				
Industry Weighted Average ROIC	9	23	13	14
BNSF Railway	8	24	14	15
CSX Corporation	6	25	10	12
Grand Trunk Corporation	4	15	9	10
Kansas City Southern	5	20	10	11
Norfolk Southern Corporation	7	21	11	13
Soo Line Corporation	1	34	13	14
Union Pacific Corporation	8	34	17	19

The Board should use this rich dataset to place the financial performance of the freight rail industry into proper context when evaluating railroad revenue adequacy. Consideration of this market evidence is consistent with Congress’s direction to “treat[] the American railroad industry as any other business.”⁴⁷ An

⁴⁶ Murphy & Zmijewski V.S. ¶ 32.

⁴⁷ *Burlington N. R.R. Co.*, 812 F.2d at 235 (citing 126 Cong. Rec. 28,431 (1980) (statement of Rep. Staggers)); see *Groome & Assocs., Inc.*, STB Docket No. 42087, at

essential part of treating railroads like other businesses is recognizing that railroads are private enterprises that must compete with other private enterprises for capital. As the ICC observed,

[R]ailroads can obtain funds for investment only by offering rates of return comparable to other investment opportunities. Investments earning less than the cost of capital will not be able to retain existing funding or obtain new funding, because investors could invest available funds elsewhere at a higher rate of return.⁴⁸

And as Professors Murphy and Zmijewski explain, “the relevant question is what rate of return is consistent with a competitive market and how does the profitability of the railroads compare with competitive market outcomes? Only if that comparison shows that the railroad industry has been unusually profitable *measured against typical, unregulated non-railroad firms* for a sufficiently long period of time is there a reason to investigate whether there might be a market failure that has permitted railroads to charge noncompetitive rates to at least some shippers, and to consider whether the Board’s existing tools to evaluate and constrain unreasonable exercise of a railroad’s market power in the places where it possesses and has exercised such power are not sufficient.”⁴⁹

The comparison approach outlined above is feasible and would substantially improve the revenue adequacy evidence the Board considers. The methodology set forth in the Verified Statement could be used on an annual basis to calculate an S&P Differential to be added to the annual revenue adequacy determinations. The Board could direct the AAR to supply the necessary data analysis with its annual

12 (“Congress directed [in the Staggers Act] that railroads be treated more like ordinary businesses than like public utilities.”).

⁴⁸ *Coal Rate Guidelines, Nationwide*, Ex Parte No. 347 (Sub-No. 1), Notice of Proposed Policy, at 7 (served Feb. 24, 1983).

⁴⁹ Murphy & Zmijewski V.S. ¶ 31.

cost of capital submission, so that it would be available for review by Board staff and comments from interested parties.

Moreover, the approach is fair and impartial to all parties. Because the comparison approach is keyed to the S&P 500, railroads are not given any special advantage. Rather, railroads are simply compared to the other companies in the S&P 500—an independently determined collection of major firms available to investors. Indeed, an understanding of how railroads compare to their competitors for capital is *essential* for the Board to assess and promote revenue adequacy in the way that Congress instructed. Congress’s definition of revenue adequacy requires evidence about whether railroads are earning “a reasonable and economic profit or return (or both) on capital employed in the business” and whether their returns “permit the raising of needed equity capital.” 49 U.S.C. § 10704(a)(2). Adoption of the S&P Differential gives the Board essential evidence to measure its progress toward assisting railroads with achieving those statutory goals.

B. The Comparison Proposal Is Justified By The Statute and Sound Public Policy.

There are compelling reasons to adopt the Comparison Proposal. The change would give effect to Congress’s definition of revenue adequacy as including a reasonable profit. A comparison approach would mitigate some of the known measurement errors that the ICC and STB have acknowledged are embedded in the accounting measurement currently used, but for which the agency has been unable to find any feasible fix. Adopting a comparison proposal would provide Congress, the STB, and the general public with a superior dataset to gauge whether the agency is carrying out its responsibility to “make an adequate and continuing effort to assist those carriers in attaining revenue levels.” And the data are public, readily available, easily verifiable, and would impose virtually no burden on the agency.

i. The Comparison Proposal provides a reasoned way to include a “reasonable and economic profit or return” in the annual determination, as directed by Congress.

As discussed above, section 10704(a)(2) states that for a carrier’s revenues to be considered adequate, those revenues must be sufficient not only to cover infrastructure costs and operating expenses, but also to earn a profit. The level of profit required is specifically defined as “a reasonable and *economic* profit or return.” 49 U.S.C. § 10704(a)(2) (emphasis added). The word “economic” used as a modifier of “profit or return” has a plain meaning. First, it is widely understood that an “economic” profit or return is different from an “accounting” profit or return.⁵⁰ Unlike an “accounting” profit, which is based on the historical book value of assets, an “economic” profit must be based on a replacement cost assessment of asset values. As the Eleventh Circuit has explained:

Accounting profits differ from economic profits in several important ways [A]ccounting profits exceed economic profits. Thus, the perfectly competitive firm in equilibrium earns zero economic profits though its normal returns are reflected in positive accounting profits. Hence, substantial accounting profits—say, 20 percent—may be consistent with trivial or zero economic profit and thus do not necessarily indicate any market power.⁵¹

Thus, because the STB’s revenue adequacy calculations are based on “accounting” profits, the STB’s calculations necessarily overstate a railroad’s “economic” profitability. Likewise, section 10704(a)(2)’s revenue adequacy definition

⁵⁰ See *In re Coca-Cola Co.*, 117 F.T.C. 795, 950 n.93 (1994) (“Economic profit accounts for the opportunity costs of all the assets that a firm uses in its business, while accounting profit reflects a firm’s explicit historical expenditures.”).

⁵¹ *Bailey v. Allgas, Inc.*, 284 F.3d 1237, 1252 n.21 (11th Cir. 2002); see *In re Coca-Cola Co.*, 117 F.T.C. at 950 n.93 (1994) (“For purposes of antitrust analysis, ‘economic profit,’ rather than ‘accounting profit,’ is the appropriate measure of firm performance.”).

requires a greater level of profitability than that currently reflected by the STB's annual calculations.

This distinction between economic and accounting profit is widely acknowledged by economists as well:

- “The two concepts of profit differ because total cost, in the economist’s definition, includes the opportunity cost of any capital, labor, or other inputs supplied by the owner of the firm. Thus, if a small business earns just enough to pay the owner the fees (say, \$35,000 per year) that her labor and capital could have earned if they had been sold to others, economists say she is earning zero *economic* profit. In contrast, most accountants will say her profit is \$35,000.”⁵²
- “In the calculation of the implicit rental rate of capital used to determine long-run economic profits, capital assets should be valued at **replacement cost**, which is the long-run cost of buying a comparable-quality asset.”⁵³

With regard to “economic . . . return,” the Antitrust Division of the Justice Department has recognized that accounting returns do not reflect “true economic rates of return”:

High accounting profits do not necessarily reflect the exercise of monopoly power. In particular, cost measures are normally available only from reports prepared in conformity with accounting conventions, but economics and accounting have significantly different notions of cost. Accounting figures seldom reflect the firm’s true economic cost of producing its goods and services, and accounting rates of return will often differ from true economic rates of return. For example, determining if a firm is earning an economic profit requires accounting properly for depreciation and the economic replacement cost of the assets the firm is using to generate its income. Yet the information

⁵² WILLIAM J. BAUMOL & ALAN S. BLINDER, *ECONOMICS—PRINCIPLES AND POLICY* 108 (6th ed. 1994) (emphasis in original).

⁵³ DENNIS W. CARLTON & JEFFREY M. PERLOFF, *MODERN INDUSTRIAL ORGANIZATION* 247 (4th ed. 2005) (emphasis in original).

reported by accountants frequently is not designed to measure and accurately reflect those costs.⁵⁴

Because the Board assesses revenue adequacy using “accounting” profits/returns based on the book value of a carrier’s assets, the Board’s revenue adequacy calculations say nothing about the level of “economic profit or return” the STB is to assist railroads in earning.

Second, the term “reasonable and economic profit or return (or both)” means a profit or return (or both) *above* the cost of capital, not a profit or return *equal* to the cost of capital (as the Board currently measures revenue adequacy).⁵⁵ For example, in *Bailey v. Allgas, Inc.*, the Eleventh Circuit explained that “[e]conomists regard capital’s opportunity cost as a cost and define *economic profit* as the return to investors *above and beyond* what is necessary to induce them to invest.” 284 F.3d at 1252 n.21. Likewise, the Transportation Research Board has stated that “zero economic profits” means “break even.”⁵⁶ Zero profit—*i.e.*, a break-even earning of no more than the cost of capital—is not a profit; it is, by definition, the absence of

⁵⁴ U.S. Dep’t of Justice, *Competition and Monopoly: Single-Firm Conduct under Section 2 of the Sherman Act*, Chapter 2 (IV)(A) (2008) (internal citations omitted); *see id.* at 29 (contrasting accounting return with economic return: “[A]vailable estimates of a firm’s capital costs, an important input into calculating a firm’s profitability, are generally based on accounting rules that do not account for the riskiness of the investment. If the investment, at the time it was made, was quite risky, a very high accounting rate of return may reflect a modest economic return. More generally, when all relevant economic costs are properly accounted for, what may at first seem to be a supracompetitive return may be no more than a competitive one (or vice versa).”).

⁵⁵ As noted above, section 10704(a)(2) defines adequate revenues as those sufficient to: i) allow for infrastructure and investment needed to meet present and future demand for rail services; ii) cover total operating expenses, including depreciation; and iii) provide for “a reasonable and economic profit or return (or both) on capital employed in the business.” The STB’s current revenue adequacy measurement fails to effectively reflect these three requirements.

⁵⁶ *Modernizing Freight Rail Regulation*, *supra* note 6, at 125.

profit.⁵⁷ The reference to a “reasonable” economic profit or return naturally implies some *positive* amount of profit.

Economic literature is in accord. “Economic profit . . . is the amount a firm earns *over and above* the payments for all inputs, including the interest payments for the capital it uses and the opportunity cost of any capital provided by the owners of the firm.”⁵⁸ Accordingly, the Board’s determination that a railroad is “revenue adequate” when its accounting ROI equals the COC—and the unsupported statements in *Guidelines*, which suggested a revenue adequacy constraint would be triggered if accounting ROI equals the COC—are inconsistent with the requirements of Section 10704(a)(2). Such an interpretation reflects no economic profit to the railroad at all, much less a “reasonable” amount as required by the statute, while simultaneously overstating a railroad’s actual “economic” profits or returns.

Moreover, it cannot be disputed that the railroad industry competes for capital with all the other companies listed in the S&P 500. Capital flows from industry to industry based on the relative returns offered by each.

Subsections 10704(a)(2)(A) and (B) provide further support for a comparison approach to monitor revenue adequacy. Congress explained that adequate revenue levels must “permit the raising of needed equity capital” and “attract and retain capital in amounts adequate to provide a sound transportation system.” Any significant regulatory movements tied just to cost of capital risks putting railroads at a permanent disadvantage relative to other firms in the economy competing for capital, which is the exact opposite of Congress’s goal in the 4-R Act and Staggers Act. As demonstrated in this Petition, if the Board’s methods for calculating return

⁵⁷ *Id.*

⁵⁸ WILLIAM J. BAUMOL & ALAN S. BLINDER, *ECONOMICS—PRINCIPLES AND POLICY* 412 (11th ed. 2009) (emphasis in original, and some emphasis omitted).

on invested capital and railroad industry cost of capital were applied to other firms in the S&P 500, the median S&P 500 firm would have an ROI well above its cost of capital.⁵⁹ If railroads face the risk of heightened regulatory intrusion merely for earning no more than their cost of capital (as calculated by the STB), they would not be able to compete fairly or equally for capital investment, as envisioned by the statutory revenue adequacy definition.

ii. The Comparison Proposal provides a reasoned way to address the known measurement error in the current annual calculations.

The Verified Statement of Kevin Murphy and Mark Zmijewski explains why the Board’s annual revenue adequacy determinations are flawed from an economic perspective. A meaningful measurement of revenue adequacy must be forward-looking, not backward-looking.⁶⁰ As the Professors explain, “Expected future returns determine investors’ decisions about where to invest their capital and business executives’ decisions how to allocate their scarce resources—they look for opportunities that generate the greatest return on incremental investment, and not to average rate of return on all invested capital.”⁶¹ For this reason, a revenue adequacy measurement ideally would assess the expected *future* rate of return on a railroads’ actual investment base—not the rate of return on the accounting book value reflected on a balance sheet.⁶² “Accounting measures based on backward

⁵⁹ *Hearing on Railroad Revenue Adequacy*, Ex Parte Nos. 761 & 722, Written Testimony of Professor Kevin Murphy, Ph.D., and Professor Mark Zmijewski, Ph.D., on behalf of UP, NS, and CN, at 5 (Nov. 26, 2019).

⁶⁰ Murphy & Zmijewski V.S. at ¶ 22.

⁶¹ *Id.*

⁶² *Id.* ¶¶ 22-25.

looking historical purchase prices and depreciation of the railroad's assets often are uninformative about a firm's ability to attract capital in the future."⁶³

The current measurement relies solely on inherently unreliable accounting measurements. The Verified Statement details "the limitations and inaccuracies of accounting-based rates of return as estimates of economic rates of return."⁶⁴ As Professors Murphy and Zmijewski explain, the consensus in economic literature is that accounting measures based on depreciated historical costs "often are uninformative about a firm's ability to attract capital in the future."⁶⁵ The current replacement cost of assets is the economically appropriate value for determining return on investment, as the Board has heard previously from multiple leading economic experts.⁶⁶

The case for using replacement costs is strongly supported by the economic consensus. Indeed, the Board has long recognized that replacement costs are conceptually superior to book value.⁶⁷ However, the Board has held that it is difficult to implement a replacement cost solution and therefore has rejected past proposals to do so.⁶⁸

Petitioners emphatically support a Board effort to revisit the question of using replacement costs in the annual determination and in efforts to develop a data-driven method of estimating replacement costs. Until such time as that fundamental flaw in the Board's use of accounting measures is resolved, and in

⁶³ *Id.* at ¶ 23.

⁶⁴ *Id.* at ¶ 82.

⁶⁵ V.S. at ¶ 23.

⁶⁶ *See, e.g.*, 2014 Brinner V.S. at 14-26; 2014 Kalt V.S. at 31.

⁶⁷ *Standards I*, 364 I.C.C. at 818 (replacement costs "may better reflect the true economic costs associated with an investment").

⁶⁸ *See supra* at 13-14.

light of the Board's longstanding concerns about the "practicality" of such an analysis, this Petition proposes a more modest path by which the Board can incrementally improve the accuracy and reliability of its methodology – even as the inherent shortcomings of using book values remain unaddressed. Using a comparative approach to see how the returns of other S&P 500 companies on their book value compare to their cost of capital would give the Board information from the marketplace about typical relationships between accounting book values and cost of capital. While replacement costs would be superior, use of this marketplace information would improve the accuracy of revenue adequacy determinations.

For example, assume the STB were charged by Congress with determining whether the temperature in Washington D.C. was above or below the average for other major U.S. cities. But the only thermometer type the agency had was old and plagued with known measurement error and bias. One option would be to try to build a better thermometer. Another would be to use its existing flawed thermometer to measure the temperature for all major U.S. cities. Even though the thermometer might not be a trustworthy guide as to the precise D.C. temperature, using the same flawed thermometer across the board would still provide guidance as to whether D.C. was hotter or colder than the average.

Finally, contextualizing the Board's annual findings would address the flawed assumption that the cost of capital is a clear demarcation between revenue adequacy and revenue inadequacy. As Professors Murphy and Zmijewski explain, firms in a competitive marketplace often earn returns above their cost of capital.⁶⁹ Moreover, Congress specifically provided that revenue adequacy should provide for "a reasonable and economic profit or return." 49 U.S.C. § 10704(a)(2). What is reasonable economic profit? This S&P 500 comparison proposal can answer that

⁶⁹ See Murphy & Zmijewski V.S. at ¶¶ 33-34.

question too. The median S&P Differential—the difference between accounting ROI enjoyed, and the cost of capital confronted, by S&P 500 firms—will capture both the measurement error and the normal and reasonable economic profit enjoyed by other unregulated companies in competitive markets. If the Board is interested in determining whether railroads are unusually profitable in a way that could be attributed to the undue exercise of market power, the test is not to compare accounting ROI to an arbitrary cost-of-capital line, but rather to compare the railroad industry to the normal profits in other competitive industries. If railroads are earning returns net cost of capital that are consistent with those earned by other large-scale companies, there can be no reasonable presumption that railroads are earning supra-competitive profits. Rather, contextualizing the annual findings would show whether the railroads are earning the “reasonable and economic profit or return” contemplated by Congress. 49 U.S.C. § 10704(a)(2).

iii. The Comparison Proposal would offer a richer dataset to measure the relative financial success of the rail industry.

The best way to assess the reliability of the Board’s 33-year-old methodology is to measure railroad financial performance against the performance of other companies in the marketplace with which railroads compete for capital. Georgetown University’s Professor Jeffrey Macher urges that “[d]espite the general inability to interpret increased profitability as an indication of excessive or monopolistic returns, it is nonetheless instructive to compare rail industry returns with those from other comparable industries.”⁷⁰ And the 2015 report, *Modernizing Freight Rail Regulation*, published by the Transportation Research Board, similarly noted that the “ritualistic” annual findings offered “little substantive information for

⁷⁰ See Jeffrey T. Macher et al., *Revenue Adequacy: The Good, the Bad, and the Ugly*, 41 Transp. L.J. 85, 106 (2014).

regulators and policy makers” and urged the Board to “obtain a richer set of information” to determine “whether a railroad’s profits are consistently outside a reasonable band of profitability that characterizes many other industries over a business cycle.”⁷¹

Petitioners are providing the Board with that richer dataset to compare railroad returns with other industries. This proposed methodology measures railroads’ performance against their rivals in the marketplace for capital. As demonstrated by Professors Murphy and Zmijewski, under the Board’s methodology, the vast majority of firms in the S&P 500 earn returns on investment far above their cost of capital.

Table 1 from the Professors’ report shows the crux of the analysis, a survey of S&P 500 firms’ ROI relative to their cost of capital from 2006 through 2019. This analysis shows that an average of 88% of all firms earned an ROI above their cost of capital, and that the median firm earned an ROI at 19% above its cost of capital. (In other words, if the cost of capital were 10%, the median firm earned an ROI of 29% using the Board’s existing methodology.) Under this analysis, each of the Class I railroads earned an ROI net cost of capital substantially below the median S&P 500 company in each of the studied years.

⁷¹ *Modernizing Freight Rail Regulation*, *supra* note 6, at 8, 155, 202, 215.

Table 1
S&P 500 Companies Excluding Railroads, Financial Institutions and Real Estate Companies

Number of Observations, Median, 25th Percentile, and % Positive ROIC minus COC Over 2006-2019 Period				
	Minimum	Maximum	Median	Average
Number of Observations in Sample	368	405	395	391
Median ROIC minus COC	13%	29%	19%	20%
25th Percentile ROIC minus COC	-1%	6%	5%	4%
% with ROIC minus COC > 0.0%	73%	91%	89%	88%
<u>Railroad Percentile in the Distribution of ROIC minus COC</u>				
Industry Weighted Average ROIC	9	22	13	14
BNSF Railway	9	23	15	15
CSX Corporation	6	23	10	12
Grand Trunk Corporation	3	16	10	10
Kansas City Southern	4	18	8	9
Norfolk Southern Corporation	10	24	13	15
Soo Line Corporation	2	26	13	13
Union Pacific Corporation	8	30	22	20

The assumptions and methodology of this comparative analysis are set forth in the Verified Statement, and the key assumptions are summarized below.

Cost of Capital. Cost of Capital for each comparison firm was determined using the same methodology used by the STB, as explained in Appendix A to the Verified Statement.

Comparables. The S&P 500 was selected as the comparable group because it represents the largest companies in the United States, and thus is a proxy for the firms with which railroads compete for capital. The S&P 500 is a stock market index that measures the stock performance of 500 leading companies listed on stock exchanges in the United States.⁷² It is one of the most commonly followed equity indices, and many consider it to be one of the best representations of the U.S. stock market.⁷³ In fact, the ICC and STB have consistently used data from the S&P 500

⁷² See *Dow Jones & Co. v. Int'l Securities Exchange, Inc.*, 451 F.3d 295, 298 (2d Cir. 2006).

⁷³ *Standard & Poor's Corp. v. Commodity Exchange, Inc.*, 538 F. Supp. 1063, 1067 (S.D.N.Y. 1982) ("The S&P 500 Stock Price Index is a broad-based, weighted,

from the year 1926 to calculate the market risk premium in the Capital Asset Pricing Model (“CAPM”).⁷⁴

Certain firms in the S&P 500 were excluded from the analysis because the nature of their business causes them to have different capital structures from other firms. In particular, financial services firms and real estate firms were excluded from the comparison group. Railroads were also excluded.

ROI calculation. Two versions of ROIC were calculated for each firm in the comparison group. First, an “STB ROIC” was calculated that reflects the precise methodology that the STB currently uses in its annual determinations. Second, an Adjusted STB ROIC was calculated that makes two corrections to the STB’s methodology designed to enhance comparability. *See supra*, Table 4.

The first correction in Adjusted STB ROIC is to include non-goodwill intangible assets in a company’s investment base. While this adjustment has little impact on railroads (which typically do not have significant non-goodwill intangible assets), it has a significant effect on certain firms that do have such assets in the form of brand names or trademarks. Including these assets in the investment bases of the comparable group improves the comparability of the group by more accurately reflecting the total assets of the comparable firm. The practical effect is to lower the ROIC for companies with those assets.

composite index based on the prices of 500 selected stocks. The index is designed to accurately portray a pattern of common stock price movement. Due to its broad base, the 500 Index is less susceptible to manipulation than an index based on a small number of stocks, and it also provides a more accurate barometer of market performance. Of the broad-based stock indexes, the S&P 500 is the best known, the most widely used, and the most accurate indicator of market conditions. The 500 is the most popular stock price index used by institutional investors and investment advisors.”).

⁷⁴ *See, e.g., Methodology to be Employed in Determining the Railroad Industry’s Cost of Capital*, at 7, 9, 11, Ex Parte No. 664 (served Jan. 17, 2008); *Railroad Cost of Capital – 2006*, at 1, Ex Parte No. 559 (Sub-No. 10) (served Jan. 17, 2008).

The second correction is to remove the distorting impacts of deferred taxes by adopting a “flow-through” approach to deferred taxes. This adjustment both removes the effect of annual deferred taxes from the ROI numerator and removes the effect of accumulated deferred taxes liabilities from the ROI denominator. The adjustment effectively makes the changes proposed in Section III of this Petition.

After these adjustments are made, the comparison analysis still shows that 84% of S&P 500 firms earn Adjusted STB ROICs over their cost of capital, and that the median S&P firm earns an Adjusted STB ROIC 10% over the cost of capital (*i.e.*, if the cost of capital were 10%, the median Adjusted STB ROIC would be 20%).

The conclusions from the data analysis in the Verified Statement are clear. When the median firm in the S&P 500 is earning an accounting return 10% over its cost of capital—and given the well-known measurement errors with its existing calculation and Congressional directive to help carriers earn “a reasonable and economic profit or return,” 49 U.S.C. § 10704(a)(2)—it is indefensible for the Board to declare a railroad has achieved “revenue adequacy” after earning an accounting ROI equal to its cost of capital (and even less defensible for the Board to adopt special regulatory restrictions to prevent that railroad from earning “excess” revenues above its cost of capital). The Board should amend its methodology so that it is incorporating real world information about what typical firms earn above their cost of capital. That information would aid the Board in executing its statutory obligations to monitor and promote revenue adequacy, and create a measuring stick that the Board could use to identify situations where a railroad’s earnings above cost of capital have reached a level warranting further investigation.

iv. The Comparison Proposal is easily implemented and verifiable.

Finally, the comparison approach is feasible and would substantially improve the revenue adequacy evidence the Board considers. While the calculations are

numerous, they are drawn from public sources that are reliable and verifiable. A good analogy is the annual cost of capital calculation by the STB. The methods for determining the cost of capital for the freight rail industry are complex and the details important. But once the agency prescribed in a separate rulemaking with broad public input the methodology it would use, the annual cost-of-capital calculations became a simple, mechanical application of that complex methodology. The same would be true here. Once the STB prescribes how it would compare the performance of the freight railroads against unregulated companies in the S&P 500, the annual revenue adequacy proceeding would remain a mechanical application of that comparison analysis, fully accessible and transparent to the public.

Moreover, the work to gather the data and implement the approach would be borne by the railroad community. Application of the methodology set forth in the Verified Statement would be used on an annual basis to calculate an S&P Differential to be added to the annual revenue adequacy determinations. But we would expect the Board to require the AAR to supply the necessary data analysis with its annual cost of capital submission, and to perform all the necessary calculations, so that it would be readily available for Board staff review and for comments from any interested parties.

Given the measurement errors with its existing calculation and Congressional directive to help carriers earn “a reasonable and economic profit or return,” Petitioners request that the STB initiate a rulemaking proceeding to seek public comment on this proposal, where the agency would re-define “revenue adequacy” in the annual determinations to mean earning a return on investment that exceeds the cost of capital by more than the median S&P 500 company exceeds its cost of capital.

III. The Board Should Also Adopt a Common Sense Approach to the Treatment of Deferred Taxes.

A. The Flow-Through Proposal

The current utility approach inherited from the ICC decades ago is painting a distorted picture of the financial strength of the freight rail industry by artificially reducing the investment base by billions of dollars. Accordingly, Petitioners also urge the STB to institute a rulemaking proceeding to explore the so-called flow-through approach originally advocated by United States Department of Transportation (DOT) in the mid-1980s. At the time, DOT touted the superiority of the flow-through approach for several reasons. First, it would be sensitive to the situation of the individual carriers. Second, DOT observed that this alternative was far superior to the Utility Method because railroads expect a return on all assets, regardless of how they are financed. *See Standards II*, 3 I.C.C.2d at 271. Third, DOT observed that the agency's concern about closely following generally accepted accounting ("GAAP") principles was unfounded, as the ICC was under no obligation to abide by GAAP in all proceedings; and the Net Railway Operating Income ("NROI") is defined by the agency, not GAAP. Fourth, DOT correctly observed that the flow-through approach would require only a simple addition or subtraction of the deferred tax figure from NROI, not a major restructuring of the Uniform System of Accounts. Finally, DOT observed that a flow-through method for railroads would not hinder comparisons with other industries. While the ICC vacillated between the shipper-preferred alternative (the current method) and the railroad-preferred alternative, it never explained why it rejected DOT's alternative proposal.

Under DOT's flow-through approach, annual deferred taxes are not deducted from net operating income in calculating the ROI for a given year. Similarly, accumulated deferred taxes are not deducted from the investment bases. The practical effect is an annual measurement that is on a cash basis, where the impact

of any deferred taxes is captured by the measurement of financial health if and when those taxes come due.

This approach is based on sound economics. As Professors Murphy and Zmijewski explain, eliminating the effect of deferred taxes “is consistent with basic valuation principles, which measures the value of a company as the discounted value of the cash flows the company is expected to generate for its investors. Eliminating the effect of deferred income taxes in the Provision of Income Taxes is one of the required adjustments to measure a company’s cash flows in order to align the company’s operating income with the economic concept used in measuring a company’s economic profit.”⁷⁵ And removing the distorting effect on the net investment base “mitigates—but does not eliminate—the effect of two of the factors that make accounting rates of return inaccurate estimates of the cost of capital: depreciation in excess of economic depreciation and the book value of the assets relative to the market value of the assets.”⁷⁶

The Professors’ recommendation is echoed by virtually every economist to have testified on this issue. *See, e.g.*, Opening Comments of Norfolk Southern Railway Company, EP 722, Verified Statement of Bradford Cornell, at 23 (filed Sep. 5, 2014) (“using an ROI calculation that backs deferred taxes out of invested capital” means that “railroads will not be able to either attract or retain as much equity capital as they otherwise would, leading to the environment of which the ICC spoke wherein ‘there is an incentive to take funds generated within the railroad industry and invest them elsewhere, where market-determined rates of return are available.’” (citations omitted)). Indeed, abandoning the Utility Method was

⁷⁵ Murphy & Zmijewski V.S. at ¶ 57 (citing ROBERT W. HOLTHAUSEN & MARK E. ZMIJEWSKI, CORPORATE VALUATION: THEORY, EVIDENCE AND PRACTICE, Chapters 13 and 14 (2d ed. 2020)).

⁷⁶ *Id.* ¶ 58.

supported by the 1985 joint statement of leading economists, who urged the ICC that: “The appropriate standard for determining the adequacy of railroad revenues is a rate of return equal to the current cost of capital on the replacement value of all rail assets that are required to meet the demands for railroad service, regardless of the source of funds used in investing in those assets.”⁷⁷

Moreover, as discussed below, shifting to DOT’s flow-through approach – as recommended by Professors Murphy and Zmijewski – has many practical benefits. It avoids the absurd result of portraying a railroad with a mountain of deferred debt owed the federal government as financially healthier than an otherwise identical railroad with no deferred taxes. It is plainly better suited for a non-utility industry, like the freight rail industry. And it would prevent future artificial fluctuations in the Board’s regulatory calculations driven by changes in tax policy.

Therefore, even if the Board rejects other aspects of the S&P comparison approach to revenue adequacy, it should adopt DOT’s flow-through approach for deferred taxes—a reasonable proposal that remains well-calibrated to improve the accuracy of the Board’s regulatory calculations.

B. The Flow-Through Treatment of Deferred Taxes Avoids Absurd Results and Is A Better Fit For The Rail Industry.

i. The Current Utility-Based Method for Deferred Taxes Produces Absurd Results.

The Board inherited its current approach to deferred taxes from the ICC, which adopted it in 1986 out of a desire to come closer to “a realistic picture of the current state of the railroad industry.”⁷⁸ In reality, this quarter-century-old approach does not portray a realistic picture. Rather, it portrays a distorted one.

⁷⁷ Opening Comments of Norfolk Southern Railway Company, EP 722, Attachment A, Economists’ Statement in Support of Staggers Act (Feb. 25, 1985).

⁷⁸ *Standards for Railroad Revenue Adequacy*, Decision of May 30, 1986 (served June 5, 1986).

The flaw in the way the Board currently calculates deferred taxes is best described with an illustration. Imagine two railroads. Railroad A has \$2.5 million in annual operating revenues, incurs \$1 million in annual operating expenses, pays \$500,000 in annual taxes, and has an investment base of \$10 million. Railroad B is identical in every respect save one. Railroad B has the same revenues, operating expenses, annual tax expenses, and investment base as Railroad A, but Railroad B also has historical deferred tax liabilities of \$3 million that it must eventually pay to the government.

Which of these two railroads is more financially healthy? The common sense answer is obvious—it's Railroad A. All things being equal, a railroad that does not have deferred tax liabilities is plainly in a superior financial position. But under the Board's current methodologies, *Railroad B* is deemed to have a significantly higher return on investment. Table A illustrates how this happens. Because the Board would subtract Railroad B's deferred tax liability from its investment base before calculating its ROI, its calculations produce a substantially higher ROI for the railroad with a substantial balance of deferred taxes.

Table A

	Railroad A	Railroad B
Revenue	\$2,500,000	\$2,500,000
Operating Expenses	\$1,000,000	\$1,000,000
Taxes	\$500,000	\$500,000
Annual Deferred Taxes	\$0	\$0
Investment Base	\$10,000,000	\$10,000,000
Accumulated Deferred Taxes	\$0	\$3,000,000
ROI Current Methodology	10.0%	14.3%

This result makes no economic sense. It vividly demonstrates that the Board's practice of reducing a railroad's investment base by its accumulated

deferred taxes produces inaccurate measurements of a railroad's financial health. It creates significant regulatory distortions—both in annual revenue adequacy determinations and in important regulatory tools like the RSAM benchmark and URCS costing. Removing deferred taxes from a railroad's investment base before calculating its ROI produces artificially inflated returns, and prevents the Board from accurately measuring actual railroad financial performance.

The Tax Cuts and Jobs Act of 2017 provides an apt example of the distorted results of the current methodology. The Act adopted a lower corporate tax rate, which reduced the value of accumulated deferred taxes. As a result, 2017 deferred taxes for all Class I railroads were substantially negative, amounting to billions of dollars for several railroads. Unless the STB excluded the impacts of these massive negative deferred taxes, under its utility-based methodology the 2017 ROI for all Class I carriers would have skyrocketed. The Board understood that this result was absurd and ultimately decided simply to ignore the impact of the legislation in its calculation of deferred taxes. Yet, ignoring this change in tax law is not a permanent solution. Similar adjustments will be needed in future years if other Congresses change tax policy again.

The Board should adopt a better, permanent solution. At the time that the ICC adopted the approach currently used by the Board, the U.S. Department of Transportation proposed the ICC instead adopt a flow-through approach for deferred taxes.⁷⁹ Under a flow-through approach, annual deferred taxes are not removed from a railroad's net operating income, and accumulated deferred taxes are not subtracted from its investment base. The result is an approach that avoids distortions and is better tailored for the rail industry.

⁷⁹ *Standards II*, 3 I.C.C.2d at 270-71.

The flow-through approach reflects the economic realities of railroad financial health. A simple example set forth in Appendix A illustrates the point. Assume a railroad with \$2.5 million in annual revenue, operating costs of \$500,000 and a book value of investments equal to \$10 million. All this stays constant over time, ignoring the effect of inflation or depreciation, with only the taxes of the company changing. We hold everything constant to pinpoint how the different treatments of deferred taxes affect the annual revenue adequacy (ROI) calculations. In this hypothetical, the railroad would normally pay \$750,000 in taxes a year, but \$250,000 is tax deferred for the first four years, so the railroad only pays \$500,000 in taxes. In years 5 through 8, the tax bill comes due, with the taxes rising to \$1 million a year as \$250,000 in deferred taxes are paid to the government.

This hypothetical railroad is earning more after-tax income in years 1 through 4 (when it is benefiting from deferred taxes) and less after-tax income in years 5 through 8 (when it is paying those taxes). So an accurate measure of its ROI ought to show a higher ROI in years 1 through 4 and a lower measure of its ROI in years 5 through 8. But that is not what the Utility Method produces.

As Appendix A shows, between the Utility Method and the flow-through approach, only the flow-through approach accords with the economic reality that the railroad has a higher return on investment and better overall financial performance when its taxes are lower due to deferred taxes than it does when it is paying those deferred taxes. Under the flow-through approach, in Years 1 through 4, the railroad enjoys higher after-tax cash flows and returns (a 15% return on investment) because of the deferred taxes. When the tax bills come due, the financial performance of the railroad worsens, with lower after-tax cash flows and only a 10% return on investment. This result is just as one would expect.

The Utility Method, by contrast, produces indefensibly arbitrary results, because it both smooths over the timing of returns *and* systemically skews

upwardly the average return on investment over the 8-year tax cycle. As Appendix A shows, the Utility Method would suggest the following distorted pattern of returns over the 8-year cycle: 12.8%, 13.2%, 13.5%, 13.9%, 13.5%, 13.2%, 12.8%, and 12.5%. This pattern of returns is facially flawed. It suggests that the health of the railroad is improving steadily from years 1 through 4, when in the hypothetical nothing has changed. The reported financial health under the Utility Method would peak in year 4, when the deferred taxes are coming due, then fall steadily in years 5 through 8, when again in the hypothetical nothing has changed. And the problem with the Utility Method is not just the bizarre pattern of rising and falling returns, but a systematic bias—as the overall “average” is 13.2%, which is above the real average return of 12.5%. The reason the Utility Method is producing such odd results flows from the removal of accumulated deferred taxes from the investment base when calculating the ROI. Rather than improve precision—as the ICC hoped in the 1980s—shifting to the Utility Method has created more distortions and introduced a new bias in the annual revenue adequacy findings.

ii. The Utility Method Is a Poor Fit for the Railroad Industry.

The Utility Method was not invented by the ICC. It reflects a common way of dealing with deferred taxes in heavily regulated industries (like utilities). But the rationale for this approach only makes sense in public utility markets where the regulator provides guaranteed returns. This is not the case for the railroad industry.

For many public utilities, the government regulators permit the utility to charge customers higher rates *immediately* to cover the future deferred taxes. This is necessary to give the benefit of the deferred taxes to the utility and promote investment. If the regulator forces the utility to charge lower rates because of the lower taxes (thus passing the deferred tax benefit from the utility to the public), it

would strip the utility of all the benefits of the deferred tax program. This, in turn, would defeat the congressional purpose of deferred taxes by destroying the incentive to invest.

As an over-simplified illustration, assume an electric utility had \$500,000 in deferred taxes in Year 1. The regulators, to provide the utility a regulated but guaranteed return, would permit the utility immediately to collect \$500,000 from its customers and place that money into a reserve to pay the future tax liability. But utility regulators would not permit the utility to earn a return on that \$500,000 while it sits in the reserve awaiting payment to the federal government. And so when it calculates the regulated (and guaranteed) ROI for the utility, it backs out \$500,000 from the net investment base (that would otherwise include this cash reserve). The ICC echoed this equitable concern when it adopted the Utility Method, noting that “when we allowed railroads to treat deferred taxes as an expense without a corresponding reduction in the net investment base we allowed the railroads a double benefit: they were allowed to demand rates sufficient to cover tax liabilities not yet paid and also to collect additional profits on the funds held on reserve to pay such deferred taxes.” *Standards II*, 3 I.C.C.2d at 272.

Whether or not that decision makes sense in the utility context, it makes no sense in the railroad context. The railroad industry is fundamentally different from public utilities. There are no guaranteed returns for rail carriers, and revenues are driven by market forces not by regulatory fiat. To use the same simplified example, if a railroad had \$500,000 in deferred taxes in Year 1, even if that figure were used to offset the net income in the annual revenue adequacy findings, it would have virtually no impact on the rates a railroad can or will collect from its customers. Those are driven by market forces, because there are no guaranteed returns in the railroad industry.

Moreover, even if the STB had some residual concerns about the “fairness” of a double-benefit (as it did regarding the hybrid approach), any conceivable double-benefit is removed by shifting to the flow-through approach. Under that approach, annual net income is not offset by future tax liability, so there is no double-benefit. In other words, under the flow-through approach, no carrier could conceivably be “allowed to demand rates sufficient to cover tax liabilities not yet paid” and thus there is no reason to remove accumulated deferred taxes from the investment base. In sum, there is no reason to continue using the Utility Method. That Method is a poor fit for the economics of the rail industry. A superior approach is available.

iii. The Flow-Through Approach Has Many Benefits.

The flow-through approach, where ROI is calculated based simply on real net income and the actual value of railroad assets, is superior to the continued use of the Utility Method for five reasons.

First, as demonstrated above, the flow-through approach better matches the Board’s monitoring tools with railroads’ real-world financial performance. Under the flow-through approach, the Board’s findings would be tied directly to the real financial performance of the industry. As shown in Appendix A, when the industry is enjoying higher real income because of deferred taxes, that return would be captured in the Board’s annual financial snapshot. Similarly, if real income fell when taxes are due, the lower railroad return would be accurately captured in the annual revenue adequacy findings. The discrepancy between changes in real income and the agency’s annual findings – a discrepancy that the ICC claimed justified the adoption of the Utility Model – would vanish and never return.

Second, the sole economic justification for the ICC’s decision to reduce the investment base by accumulated deferred taxes was the perception that deferred taxes reflect an “interest-free” loan from the federal government and that a

regulated entity therefore deserves no return on investments funded with that cash flow. This idea is fundamentally flawed.

No matter the source of internally generated funds, the opportunity costs of making investments with those funds is the same. The number of ways a railroad can generate internal funds to re-invest in the industry is nearly infinite. It could improve productivity, expand into new markets, improve service and take market share from the trucking industry, sell assets, or make investments designed to reduce taxes by taking advantage of deferred tax programs. The source of the internal funds is irrelevant to the economic cost of re-investing that money in the railroad industry. And the opportunity cost of deploying capital internally is the cost of capital.⁸⁰

Third, the flow-through approach provides optimal incentives for capital investment. Providing the optimal incentive for private investment in the railroad industry is a paramount public policy for the STB. The benefits that flow from private capital are numerous. And the Board can only foster private investment by creating a regulatory environment that is hospitable to capital investments, as it has no authority to compel investments in the industry.

⁸⁰ The ICC thus got it right the first time it considered this question. “If we exclude internally generated funds, whether stemming from accelerated depreciation or any other railroad activity, from the investment base, the effect will be to establish a rate of return below the cost of capital. This, in turn, will result in incentives to railroads to invest these funds in nonrail operations.” *Standards I*, 364 I.C.C. at 813; see also *Bessemer*, 691 F.2d at 1116 (explaining the “simple fact” that “for all businesses[,] accelerated depreciation is a source of funds which may be reinvested. If the railroad industry were to be put in the position that unlike unregulated industries it could not earn a rate of return on investment of such funds, it would be at a competitive disadvantage in seeking equity capital, and it would be encouraged to invest the funds generated from accelerated depreciation elsewhere than in the railroad business. . . . It would, moreover, produce a rate of return below the cost of capital, since capital markets act with knowledge of the availability of accelerated depreciation as a source of funds.”).

In the 1980s, the ICC justified its choice to use the Utility Method by reasoning that it would have no impact on the investment incentives of the railroad industry. That was actually true in the 1980s, when the annual revenue adequacy findings had virtually no impact on any important regulatory function because they were used to just monitor the health of the railroad industry.⁸¹ In that case, investors and the railroads base their decisions on the real economics of the industry, not on figures published by the STB. Now, however, the annual revenue adequacy findings are slowly creeping into rate setting, first in the Three-Benchmark test and more recently in the Board's widely-criticized limit-price test for market dominance. But even if the STB only uses the RSAM figure as originally designed (in the Three-Benchmark cases), the Board's refusal to provide the railroad a return on the value of capital investments will create an environment that is hostile to private investment and drive capital to other industries.

Continued use of the Utility Method would have the counter-productive effect of penalizing a railroad that invests in new rail property. The ICC recognized this concern that "the use of the utility method would result in lower allowable rates of return for those railroads that have made the largest investment in new rail property." *Standards II*, 3 I.C.C.2d at 269. This observation is correct, as the more investment a railroad makes in new rail property, the more deferred taxes that will flow from features such as accelerated depreciation, and the lower the allowable

⁸¹ However, the Third Circuit was not impressed with the ICC's argument. It observed that the ICC's argument "ignores the fact, emphasized by the railroads, that they have to compete for capital with unregulated firms which do retain the second benefit of an opportunity to earn a return on those funds." *Consol. Rail Corp.*, 855 F.2d at 90. The Court reasoned that "Given the competition between the railroads and unregulated firms for capital, the railroads are substantially disadvantaged by being deprived of the opportunity to earn a return on the funds in comparison to the unregulated firms, and therefore the incentive to all investors, including the railroads, is to invest in the unregulated firms where the advantage of the 'double benefit' is retained." *Id.*

rate of return under the Utility Method. While the ICC ignored its own reservations, the STB should not follow suit.

Fourth, the flow-through approach would help to prevent future artificial fluctuations in the Board's regulatory calculations driven by changes in tax policy. Under this approach, the annual measurement of the financial health of the industry will be a function of real net operating income and the value of railroad assets. If there is a significant change in tax policy, it will have no impact on the annual revenue adequacy findings until those changes materialize in lower (or higher) taxes and higher (or lower) net operating income. If the Board stays with the Utility Method, in contrast, these issues will resurface time and time again. The flow-through approach would provide welcomed stability to the agency's monitoring responsibility, and promote the comparability of its findings over time. Otherwise, the Board's revenue adequacy findings will have less to do with real economic market conditions facing the industry, and be driven more by accounting treatment of future tax liability that may become increasingly volatile.

Finally, implementing the flow-through approach would be straightforward and eminently reasonable. The Board does not need any new information from the railroads to implement the flow-through approach—it already has all the information it needs. Prospectively, some modest changes to the Schedule 250 form would be needed to reflect the implementation of the flow-through method.⁸² Schedule 210 and 250 could be kept the same, and the Board would not need to delay its monitoring function, or any other regulatory function.⁸³

⁸² Specifically, the calculations in Line 12 and 13 of the Form that subtract accumulated deferred taxes from the net investment base in Line 11 are unnecessary. Going forward, the net investment base before adjustment for deferred taxes in Line 11 would be the final net investment base.

⁸³ Implementing this change through the URCS program is similarly straightforward. No changes to the underlying URCS code are needed. Instead, once

CONCLUSION

As Petitioners stated at the outset, these proposed changes should be made regardless of whatever action the Board takes on revenue adequacy in other dockets. They will improve the accuracy and reliability of the financial health measurements Congress has required the Board to undertake. They will enable the Board to carry out faithfully its statutory responsibility to promote the financial health of the railroad industry.

The Board should emphatically not continue to rely on a fundamentally flawed and misleading measure of revenue adequacy inherited from its predecessor. The Board instead should improve its measurement tool. And then the Board should place its annual findings into real-world financial context: by properly comparing the performance of the freight rail industry to that of other American industries joined in the intense and relentless struggle for scarce capital.

the Board issued a final rule indicating that it will no longer remove accumulated deferred taxes from the investment base (either road property investment or equipment), its staff can quickly implement that decision when releasing the next year's URCS model but zeroing out the deferred tax input into the URCS model.

Respectfully submitted,

/s/ Raymond A. Atkins

Raymond A. Atkins
Matthew J. Warren
Morgan B. Lindsay
SIDLEY AUSTIN LLP
1501 K Street, N.W.
Washington, D.C. 20005

*Counsel for CN, Norfolk Southern
Railway Company, and Union Pacific
Railroad Company*

Sean Finn
Olivier Chouc
CN
935 de La Gauchetière Street West 16th
Floor
Montréal, QC H3B 2M9
CANADA

Kathryn Gainey
CN
Suite 500, North Building
601 Pennsylvania Avenue, N.W.
Washington, DC 20004

Vanessa A. Sutherland
Thomas E. Zoeller
Hanna Chouest
NORFOLK SOUTHERN CORP.
Three Commercial Place
Norfolk, VA 23510

Rhonda S. Ferguson
Craig V. Richardson
James B. Boles
UNION PACIFIC RAILROAD CO.
1400 Douglas Street
Omaha, NE 68179

September 1, 2020

Appendix A

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8
Revenue	\$2,500,000	\$2,500,000	\$2,500,000	\$2,500,000	\$2,500,000	\$2,500,000	\$2,500,000	\$2,500,000
Operating Costs	\$500,000	\$500,000	\$500,000	\$500,000	\$500,000	\$500,000	\$500,000	\$500,000
Taxes	\$500,000	\$500,000	\$500,000	\$500,000	\$1,000,000	\$1,000,000	\$1,000,000	\$1,000,000
Annual Deferred Taxes	\$250,000	\$250,000	\$250,000	\$250,000	(\$250,000)	(\$250,000)	(\$250,000)	(\$250,000)
Investment Base	\$10,000,000	\$10,000,000	\$10,000,000	\$10,000,000	\$10,000,000	\$10,000,000	\$10,000,000	\$10,000,000
Total Deferred Taxes	\$250,000	\$500,000	\$750,000	\$1,000,000	\$750,000	\$500,000	\$250,000	\$0
Utility ROI	12.8%	13.2%	13.5%	13.9%	13.5%	13.2%	12.8%	12.5%
Flow-Through	15.0%	15.0%	15.0%	15.0%	10.0%	10.0%	10.0%	10.0%

**BEFORE THE
SURFACE TRANSPORTATION BOARD**

**JOINT PETITION FOR RULEMAKING
TO MODERNIZE ANNUAL REVENUE ADEQUACY DETERMINATIONS**

VERIFIED STATEMENT OF

PROFESSOR KEVIN M. MURPHY

PROFESSOR MARK E. ZMIJEWSKI

SEPTEMBER 1, 2020

I.	INTRODUCTION	2
A.	Credentials of the Witnesses	2
1.	Professor Kevin M. Murphy.....	2
2.	Professor Mark E. Zmijewski	3
B.	Assignment	5
C.	Summary of Conclusions	6
II.	ECONOMIC PRINCIPLES FOR EVALUATING RAILROADS' ECONOMIC RATE OF RETURN	8
A.	The Goal of the Staggers Act is to Create Conditions for Railroads that Mimic Competitive Markets	9
B.	Forward-Looking Economic Return on Investment is the Relevant Measure of Railroad Revenue Adequacy	14
C.	It is Consistent with Competitive Markets for Firms to Earn an Economic Rate of Return Above Their Cost of Capital.....	17
D.	Even if, Contrary to the Evidence, Railroads' ROIC Exceeded Their COC by an Atypically Large Amount, Rate of Return Regulation is Likely to Worsen Competition and Distort Investment and Operational Decisions.....	20
E.	Revenue Adequacy Determination Will be More Distortionary if Based on Railroad-Specific Evaluation	22
III.	IT IS WELL ESTABLISHED THAT ACCOUNTING RATES OF RETURN ARE POOR MEASURES OF ECONOMIC RATES OF RETURN	24
IV.	MEASURING FINANCIAL PERFORMANCE OF THE RAILROAD INDUSTRY BASED ON THE BENCHMARKING METHODOLOGY PRODUCES MORE INFORMATIVE RESULTS	29
A.	Benchmarking Methodology.....	30
B.	Alternative Specifications of the Return on Invested Capital (ROIC).....	32
C.	Data	35
D.	Railroads' Relative Financial Performance Based on the Board's Definitions of ROIC and Cost of Capital.....	38
E.	Railroads' Relative Financial Performance Based on the Adjusted ROIC and the Board's Definition of the Cost of Capital.....	43
F.	Summary and Conclusions.....	49
V.	SUMMARY AND RECOMMENDATIONS.....	50
APPENDIX A.....		53
A.	Return on Invested Capital (ROIC) – STB definition.....	55
B.	Return on Invested Capital (ROIC) – Adjusted STB ROIC Definition	58
C.	Industry Weighted Average Return on Invested Capital (ROIC)	59
APPENDIX B.....		67
APPENDIX C.....		69

I. INTRODUCTION

A. Credentials of the Witnesses

1. Professor Kevin M. Murphy

1. Professor Murphy is the George J. Stigler Distinguished Service Professor of Economics in the Booth School of Business and the Department of Economics at The University of Chicago, where he has taught since 1983. He earned a doctorate degree in economics from The University of Chicago in 1986 and his bachelor's degree, also in economics, from the University of California, Los Angeles, in 1981.

2. At The University of Chicago, Professor Murphy teaches economics in both the Booth School of Business and the Department of Economics. He teaches graduate level courses in microeconomics, price theory, empirical labor economics, and sports analytics. In these courses, he covers a wide range of topics, including the incentives that motivate firms and individuals, the operation of markets, the determinants of market prices, and the impacts of regulation and the legal system. Most of his teaching focuses on two things: how to use the tools of economics to understand the behavior of individuals, firms and markets; and how to apply economic analysis to data. His focus in both research and teaching has been on integrating economic principles and empirical analysis.

3. Professor Murphy has authored or co-authored more than 65 articles in a variety of areas in economics and co-authored a book titled *Chicago Price Theory*. His articles have been published in leading scholarly and professional journals, including the *American Economic Review*, the *Journal of Law and Economics*, and the *Journal of Political Economy*.

4. Professor Murphy is a Fellow of the Econometric Society and a member of the American Academy of Arts and Sciences. In 1997, he was awarded the John Bates Clark Medal, which the American Economic Association awarded once every two years to an outstanding American

economist under the age of forty. In 2005, he was named a MacArthur Fellow, an award that provides a five-year fellowship to individuals who show exceptional merit and promise for continued and enhanced creative work. Also in 2005, he was elected a Fellow of the Society of Labor Economists.

5. In addition to his positions at The University of Chicago, Professor Murphy also is a Senior Consultant to Charles River Associates (“CRA”), a consulting firm that specializes in the application of economics to law and regulatory matters. He has consulted on a variety of antitrust, intellectual property, fraud, and other matters involving economic and legal issues, such as damages, class certification, mergers, labor practices, joint ventures, and allegations of anticompetitive exclusionary access, tying, price fixing, and price discrimination. He has submitted testimony in Federal Court, the U.S. Senate, and to state regulatory bodies, and has submitted expert reports in numerous cases, testified on behalf of the U.S. Federal Trade Commission, and consulted for the U.S. Department of Justice. Professor Murphy has provided expert testimony to the Surface Transportation Board (“Board”) on behalf of both Union Pacific Railroad and CSXT in the past, including in connection with the Board’s previous consideration of revenue adequacy issues. Professor Murphy’s CV is attached to this Statement.

2. Professor Mark E. Zmijewski

6. Professor Mark E. Zmijewski specializes in the areas of accounting, economics, and finance as they relate to valuation, financial analysis, and security analysis, or more generally, financial economics. Professor Zmijewski is Professor Emeritus at The University of Chicago Booth School of Business (“Chicago Booth”), and previously held the Charles T. Horngren Professorship and the Leon Carroll Marshall Professorship in his 30-year career at Chicago Booth. In addition to his faculty duties, Professor Zmijewski also held the positions of Deputy

Dean, PhD Program faculty director, and the Center for Research in Security Prices faculty director, all at Chicago Booth.

7. Professor Zmijewski earned his BS in 1976, MBA in 1981, and PhD (with major in accounting and minors in economics and finance) in 1983, all from the State University of New York at Buffalo. In addition to The University of Chicago, Professor Zmijewski has taught at the State University of New York at Buffalo and at York University in Toronto, Canada. Professor Zmijewski teaches various courses in accounting (financial accounting, managerial accounting, and advanced accounting/mergers and acquisitions), finance (corporate finance, financial strategy and corporate transactions, financial analysis, and valuation of companies and corporate transactions), and entrepreneurship. His research focuses on firm valuation, the pricing of publicly-traded securities, and the ways in which various capital market participants use information to value securities. He has published articles in academic journals in the areas of accounting and financial economics and also co-authored a textbook (with Professor Robert Holthausen of The Wharton School of the University of Pennsylvania) on how to value companies, parts of companies, and the securities issued by companies, titled, *Corporate Valuation: Theory, Evidence and Practice*. Professor Zmijewski has been an Associate Editor of *The Accounting Review*, and has served on the Editorial Boards of both the *Journal of Accounting Research* and *The Accounting Review*.

8. Professor Zmijewski also is a Senior Consultant to Charles River Associates, a consulting firm that provides economic, financial, and management consulting services. He also is a Senior Advisor to, and a member of, the Investment Committee at Patron Capital Partners (Funds IV and V), a private equity investment company with a focus on real estate related investments. Professor Zmijewski was a founding partner of Chicago Partners, LLC, which was acquired by

Navigant Consulting; a former managing director of Navigant Economics (a subsidiary of Navigant Consulting); and a former member of the corporate executive committee of Navigant Consulting.

9. Professor Zmijewski has worked as a consultant or expert in litigation matters in U.S. state and federal courts, in the Supreme Court of Victoria in Australia, and in U.S. and international arbitrations. He has been engaged by the U.S. Department of Justice, the U.S. Federal Trade Commission, and the U.S. Securities and Exchange Commission, as well as by companies, classes of plaintiffs, and individuals. Professor Zmijewski has consulted on business valuation and securities valuation (valuation of corporate transactions, companies, and parts of companies, intangible assets and intellectual property, and securities); securities litigation (Rule 10b-5, Section 11, Section 12, ERISA, Martin Act, effect of disclosures, analysis of how markets work, and insider trading); mergers and acquisitions (appraisals and price disputes, analyzing merger synergies, material adverse changes, corporate transactions, and the process of purchasing and selling companies); antitrust matters (measuring profitability, measuring and analyzing rates of return, and assessing merger efficiencies), and a variety of other valuation, financial analysis, and accounting related issues. Professor Zmijewski's CV is attached to this Statement.

B. Assignment

10. We have been asked by Canadian National Railway ("CN"), Norfolk Southern Railway ("NS") and Union Pacific Railroad ("UP") to apply economic principles to develop a methodology to modernize how the Surface Transportation Board (the "STB" or "the Board") monitors the financial health of the freight rail industry. Specifically, we propose a refined methodology to assess revenue adequacy that uses the types of accounting-based rates of return

on which the Board historically has relied in its comparison with the railroad industry's cost of capital, but that mitigates some of the limitations and inaccuracies of using accounting-based rates of return in this way. We begin by explaining the economic principles that should guide the assessment of revenue adequacy and use of these principles to minimize the economic harm to both railroads and shippers that could result from misguided rate-of-return regulations based on erroneous and unfounded analyses of the railroads' rates of return. The methodology we then propose is a standard and widely used financial methodology that compares a company's financial performance to that of one or more comparison groups. As applied here, we propose a benchmarking methodology that compares the financial performance of the railroads to the financial performance of companies operating in competitive (unregulated) markets for purposes of assessing revenue adequacy.

C. Summary of Conclusions

11. Based on the analyses that we present in this Statement, we have reached the following conclusions:

- Railroads were deregulated so that they could operate (without financial support from the government) as private firms responsible for purchasing, operating and maintaining the infrastructure and equipment they require. Railroads must compete for the necessary capital with the vast number of other private firms, not just in the United States but worldwide.
- Misguided regulation of railroad rates in response to a conclusion drawn from misleading measurement of railroads' rate of return and misinterpretation of what a measured rate of return implies about a railroad's competitiveness could lead to the classic problems of rate of return regulation and endanger the industry's success. Forces of competition have

motivated railroads to assure a “safe, adequate, economical, efficient, and financially stable rail transportation system.”¹ The potential harm from imposing regulation does not cease once a railroad is profitable.

- Economic efficiency requires that railroads be able to aim for a rate of return greater than their cost of capital. Operational and investment decisions—lowering operating costs, investing in high-return projects, developing new services valued by shippers, changing management—that benefit customers can enable a railroad to earn a rate of return that exceeds its cost of capital for extended periods of time, an outcome that benefits its customers and should be encouraged by the Board.
- Economic research has shown that the limitations and inaccuracies of accounting-based rates of return make it difficult, some say impossible, to infer economic rates of return from accounting rates of return. Fisher and McGowan (1983) expressed one of the strongest conclusions against using accounting rates of return as estimates of economic rates of return: “... there is no way in which one can look at accounting rates of return and infer anything about relative economic profitability ... Economists (and others) who believe that analysis of accounting rates of return will tell them much (if they can only

¹ Staggers Rail Act of 1980. This point was made long ago by two economists at Princeton University: Professors William Baumol and Robert Willig (see Baumol, William J., and Robert D. Willig, “Verified Statement,” EP 347, Coal Rate Guidelines - Nationwide, May 11, 1981). They explained in their Verified Statement in support of the ICC’s proposal to adopt Ramsey pricing and the stand-alone cost standard in regulating rail rates that “Ramsey pricing and stand-alone costs [are] sufficient pricing restraints,” noting that “it is neither necessary nor desirable to adopt any [] additional pricing constraints. The entire purpose of the Staggers Act and the movement toward (partial) deregulation of rail transportation can be frustrated by adoption of such unnecessary restraints” (pp. 77-78). They concluded further that “those same pricing principles continue to apply with equal validity under adequacy of revenues...the regime of financial solvency will therefore require no modification” in the ICC’s pricing principles (p. 85).

overcome the various definitional problems which separate economists and accountants) are deluding themselves.”²

- If it is necessary to compare accounting rates of return to the cost of capital to assess profitability, we propose a widely used benchmarking methodology that compares the railroads’ financial performance to the financial performance of companies operating in competitive (unregulated) markets. This approach provides a more reliable assessment of the financial performance of the railroads relative to their cost of capital.
- Our benchmarking analyses show that the financial performance of the railroad industry and the seven railroads generally was below the financial performance of companies operating in competitive (unregulated) markets. Using two alternative measures of financial performance and three benchmarking groups, we conclude that, over the 2006 through 2019 period, the financial performance of the railroad industry and each of the seven Class I railroads fell well below the median and mostly in the bottom quartile of the financial performance of all three benchmarking groups.

II. ECONOMIC PRINCIPLES FOR EVALUATING RAILROADS’ ECONOMIC RATE OF RETURN

12. Since 1981, the Board or its predecessor agency, the Interstate Commerce Commission (“ICC”), has made an annual determination whether rail carriers are “revenue adequate.” It has done so by comparing each rail carrier’s annual return on the depreciated book value of its assets

² Fisher, Franklin M., and McGowan, John J., “On the Misuse of Accounting Rates of Return to Infer Monopoly Profits,” *American Economic Review*, March 1983, 73, pp. 92 – 93.

(net of “deferred taxes”)³ with the rail industry’s average cost of capital.⁴ Congress mandated an annual evaluation of whether railroads are earning “adequate revenue” when it substantially deregulated the railroad industry in order to “promote a safe and efficient rail transportation system by allowing rail carriers to earn adequate revenues.”⁵

13. We understand some stakeholders are urging the Board to impose additional regulatory constraints on railroads’ pricing and operating flexibility based on a misguided belief that the carriers are earning profits suggestive of noncompetitive pricing. However, fundamental principles of economics counsel caution and careful consideration of how to measure railroad profitability (revenue adequacy), how to interpret a measurement, and whether competition would be enhanced or harmed if the Board mandated additional regulatory action based on inferences drawn from a measure of revenue adequacy.

A. The Goal of the Staggers Act is to Create Conditions for Railroads that Mimic Competitive Markets

14. The fundamental goal in deregulating the railroads was to provide them with incentives and flexibility to undertake necessary investments and operational changes to become profitable and competitive. Congress recognized that this would benefit shippers and consumers.⁶

³ The Board uses historical cost minus accumulated depreciation (net of deferred taxes) as its measure of a railroad’s assets for purposes of calculating revenue adequacy. For ease of exposition, in the rest of our report, we refer to the historical cost minus accumulated depreciation as “book value.”

⁴ See STB Decision EP 679, *Association of American Railroads – Petition Regarding Methodology for Determining Railroads Revenue Adequacy*, decided October 23, 2008, pp. 1-2 (“For a railroad, ROI has traditionally been calculated by dividing net income from railroad operations by the depreciated original cost, or book value, of the railroad’s assets. This is done by dividing net railway operating income (an after-tax, before-interest figure) by an investment base that consists of the firm’s net investment in railroad property, plus working capital, less accumulated deferred income tax credits.”).

⁵ Staggers Rail Act of 1980, Pub. L. No. 96-448, § 3, 94 Stat. 1897, section 3(a).

⁶ The move to deregulate the railroads began with the 1976 Railroad Revitalization and Regulatory Reform Act (“4R Act”), which provided for reduced federal oversight of the railroads. Deregulation was furthered by the 1980 Staggers Rail Act, which gave railroads flexibility to set rates and discontinue unprofitable service.

Railroads had been in extreme financial difficulty for many years. Congress was concerned about their survival as private firms and the risk that taxpayers might have to support the railroads if their financial performance did not improve.⁷ Congress appears to have recognized, and the Board and its predecessor agency acted accordingly, that the prospect of earning higher profits not limited by unnecessary rate of return and operational regulation would create incentives for railroads to undertake operational and capital investments to improve service and win customers. And this turned out to be right—deregulation created incentives for private investment in railroads because investors could expect to make profits by investing in railroads. Railroads then invested available capital to become more efficient and profitable.

15. Outcomes since passage of the Staggers Act demonstrate how competition can work to eliminate inefficiencies created by regulation. When the railroads were first deregulated in 1980, many were inefficiently sized and configured.⁸ This was especially problematic in a network industry such as this, where freight can travel large distances and move on multiple railroads that must coordinate and perform efficiently to serve shippers well. Railroads responded to

⁷ In contrast to the privately financed freight railroads, Congress passed the Rail Passenger Service Act of 1970, establishing the National Railroad Passenger Corporation to “take over the intercity passenger rail service that had been operated by private railroads. Amtrak began service on May 1, 1971 serving 43 states with a total of 21 routes” (see <http://history.amtrak.com/amtraks-history/1970s>). This federally supported rail service recently requested \$1.7 billion in federal grants for its 2019 fiscal year (see <http://www.amtrak.com/ccurl/412/537/Amtrak-FY2015-Federal-Budget-Request-ATK-14-028,0.pdf>). Freight railroads outside North America also are generally government owned or subsidized.

⁸ Committee for a Study of Freight Rail Transportation and Regulation Transportation Research Board, The National Academies of Sciences, Engineering and Medicine, *Modernizing Freight Rail Regulation*, Special Report 318 (2015) at p. 180: “The Staggers Rail Act of 1980 made fundamental changes in the federal railroad regulatory program. When the act was passed, the country’s private freight railroad industry was in financial and physical decline. It had been overregulated and had lost large amounts of traffic to trucks. Some railroads were receiving government subsidies, and the industry’s nationalization was a possibility... The railroads, which had once dominated the transportation of freight and passengers, were left with an asset base that had become oversized and misaligned with demand. They were generating too little revenue to pay for basic upkeep, much less reinvestment. Reducing expansive networks and other legacy capacity that had become uneconomic and making more intensive use of the capacity that remained were critical to the industry’s survival as a private enterprise. The Staggers Rail Act sought to enable such changes, which had been hindered for decades by the federal regulatory regime... The act allowed railroads to shed excess capacity and to concentrate traffic on fewer lines using fewer locomotives and workers.”

deregulation by abandoning many unprofitable operations (that had been sustained only by regulatory requirements or distortions) and integrating many inefficiently sized independent railroads to create strong regional competitors with more efficiently configured networks. The process was not always smooth, but the result has been improved operations on the railroad side (e.g., higher velocity, fewer work events, lower costs, and greater productivity) and better service on the customer side (e.g., faster cycle time, more reliable service, improved car utilization, and single-line service to more markets). The resulting increase in railroads' efficiency and profitability since passage of the Staggers Act is evidence that deregulation enabled railroads to become more financially healthy by improving their service and increasing and diversifying the traffic they carry.

16. The incentive to gain sales and reduce costs in order to increase profitability is the motivation of successful firms in competitive markets free from regulatory restrictions on firms' ability to benefit from their investments and innovation.⁹ Competition motivates firms to become more efficient and improve quality, reduce quality-adjusted price, and innovate. For example, when a railroad faces increased competition from trucks, it will be motivated to reduce rates, increase output (through improved quality of rail service—e.g., better schedules, more rapid delivery, etc.) and other actions likely to benefit shippers on those competitive routes.

⁹ See, e.g., Adam Smith, *An Inquiry into the Nature and Causes of the Wealth of Nations* (1776): "Every individual necessarily labors to render the annual revenue of the society as great as he can ... He intends only his own gain, and he is in this, as in many other cases, led by an invisible hand to promote an end which was no part of his intention ... By pursuing his own interests, he frequently promotes that of the society more effectually than when he really intends to promote it. I have never known much good done by those who affected to trade for the public good."; see also Paul I Joskow and Nancy L. Rose, "The Effects of Economic Regulation," *Handbook of Industrial Organization*, Vol. II (R. Schmalensee and R.D. Willig eds.) 1989 at 1449, 1497: "Economic regulation has important direct and indirect effects on the costs of production and the quality of service. Regulatory influences on input choices, X-inefficiency, and technological change tend to increase costs. Regulation also alters the quality and variety of services, although these effects often are difficult to quantify. It tends to increase service quality through non-price competition when regulated prices in structurally competitive industries are above competitive levels. Regulation may lower service quality when its intention is to keep prices below their market-clearing levels."

Because of the network nature of the rail industry, when a railroad improves service for one group of shippers, other customers often benefit as well, even if competition for those other customers did not increase.

17. Competition motivates firms to become more efficient and thus reduces deadweight loss. Deadweight loss occurs when firms allocate resources inefficiently in response to artificial price constraints, such as those imposed through regulation, that do not reflect demand and supply. It represents a loss to society because it reflects wasted resources and is an unnecessary cost to society when competition is sufficient to discipline firms' conduct.

18. Cost-based regulation that forces rail rates toward marginal costs in an attempt to limit railroads' profitability does not produce the same economic welfare benefits as market competition. The reason is simple—with regulated rates and profits, railroads and their investors do not benefit, or benefit fully, from becoming more efficient and innovative, and thus do not have the same incentives to improve their performance. Many products in the broad economy are sold at prices that exceed marginal cost, yet the short-run gain in reduced deadweight loss from forcing down prices would not improve consumer welfare, but instead would cause substantial (and long-lasting) harm to consumers through distorted producer incentives.

19. For example, the price of an iPhone is substantially higher than its marginal cost (and Apple earns large profits from iPhone sales). Yet, few would argue for regulation to force the price of an iPhone down to marginal cost, and wisely so. While sales of iPhones might increase in the short run as more consumers purchase iPhones at the lower, regulated price, in the longer run consumer welfare and output are likely to fall because the price controls would immediately reduce Apple's incentives to innovate and introduce new products with improved features and

quality. Over the longer run, the harm to consumers from forgoing new improved iPhones is likely to far outweigh any short-run benefits consumers receive from lower prices.

20. The danger of price controls is well-established as a matter of both economic theory and empirical fact.¹⁰ For example, the use of rent controls to reduce property rental rates has been studied extensively to understand whether rent controls are an efficient way to increase consumer welfare. Economists find that they are not—instead, they lead to housing shortages and quality declines. Lower rents might benefit those lucky enough to obtain an apartment at a controlled rate, but harm the many who find such apartments unavailable and that those available are not well maintained or modernized because capital does not flow into rental housing but instead into other investments such as commercial real estate where rates of return are not capped.

21. Thus, the well-established economic principles that motivated the Staggers Act and deregulation of railroads teach that, absent strong evidence of market failure, consumers benefit from allowing competition, not regulation, to determine firms' pricing and operational decisions,

¹⁰ See, e.g., Averch, Harvey, and Leland L. Johnson. "Behavior of the Firm Under Regulatory Constraint," *The American Economic Review* (1962), pp. 1052-69; Baumol, William J., and Alvin K. Klevorick. "Input Choices and Rate-of-Return Regulation: An Overview of the Discussion," *The Bell Journal of Economics and Management Science* (1970), pp. 162-90. There is broad consensus among economists documented in surveys of the literature and of economists' opinions about the inefficiencies created by price controls. For example, a 1992 article reported results of a survey of 1,350 economists (of which 34.4 percent responded) on the question whether "A ceiling on rents reduces the quantity and quality of housing available." About 93.5 percent of respondents agreed – the highest consensus obtained for any of the 40 policy questions asked. See R. M. Alston, J.R. Kearl and M. B. Vaughan, "Is There a Consensus Among Economists in the 1990's?" 82(2) *AEA Papers and Proceedings* 203 (1992), p. 204. A 2012 poll of economists at major U.S. universities (the IGM Economic Experts Panel) found that 95 percent of responses (weighted by each expert's confidence) disagreed with the proposition that "Local ordinances that limit rent increases for some rental housing units... have had a positive impact over the past three decades on the amount and quality of broadly affordable rental housing in cities that have used them." See http://www.igmchicago.org/igmeconomicexpertspanel/pollresults?SurveyID=SV_6upyzeUpI73V5k0. As summarized in a survey article reporting on the near unanimity of opinion on the harmful impact of rent controls, "Economists have shown that rent control diverts new investment, which would otherwise have gone to rental housing, toward greener pastures – greener in terms of consumer need. They have demonstrated that it leads to housing deterioration, fewer repairs, and less maintenance." See Walter Block, "Rent Control," *Concise Encyclopedia of Economics* (<http://www.econlib.org/library/Enc/RentControl.html>). According to a well-regarded textbook, rent control "reduces the incentive to build new rental housing, exacerbating the shortage in the long run. Similarly, owners have less of an incentive to maintain rental housing, so it deteriorates faster than otherwise." See D. W. Carlton and J. M. Perloff, *Modern Industrial Organization* 3rd ed. (1999), p. 769.

subject to the discipline of product and capital markets. The original rationale for deregulation was recognition that, overall, the railroads were not potential beneficiaries of market failures that would allow them to earn excessive profits if not constrained, but instead were the victim of regulation that forced them to abandon competitive market principles and deprived them of capital needed to operate efficiently.

B. Forward-Looking Economic Return on Investment is the Relevant Measure of Railroad Revenue Adequacy

22. As a matter of economics, the proper way to measure whether a railroad is earning a return on investment sufficient to allow it to meet demands for service in the long run is a return on forward-looking investment costs. The same is true for operating costs—one would not conclude based on wage rates set five years ago in a labor union contract expiring today that the firm could operate profitably in the future if the firm would have to pay much higher wages going forward given changes over the five years in market conditions. Expected future returns determine investors' decisions about where to invest their capital and business executives' decisions how to allocate their scarce resources—they look for opportunities that generate the greatest return on incremental investment, and not to average rate of return on all invested capital.

23. For this reason, the return on the historical net investment base that the Board uses to calculate revenue adequacy can be a misleading indicator of whether railroads can attract the needed capital necessary replace their assets as they depreciate or become economically obsolete, or to invest in order to serve new demands for their services. Accounting measures based on backward looking historical purchase prices and depreciation of the railroad's assets often are uninformative about a firm's ability to attract capital in the future.

24. The relevant economic rate of return for purposes of understanding whether railroads are sufficiently revenue adequate to provide efficient and competitive service to shippers is a forward-looking measure of a company's ability to cover future operating expenses, assure repayment of its debt, and attract and retain the necessary capital to maintain, upgrade and replace its assets. Economic profitability is calculated as the rate at which expected *future* cash flows from making an investment today must be discounted to equal the initial investment.¹¹ Investors will be willing to lend to a company if the expected future returns on investment will be as high as the investor can expect (after accounting for risk) from alternative investment opportunities. As explained in a popular corporate finance textbook,

The company's book rate of return may not be a good measure of profitability. It is also an *average* across all of the firm's activities. The average profitability of past investments is not usually the right hurdle for new investments.¹²

25. The proper economic rationale for evaluating whether a railroad is revenue adequate is to determine whether it can raise the funds necessary for financial health and growth in the long term. In order for a railroad to be financially healthy in the long term, it must be able to raise capital in markets where investors have numerous potential investment opportunities, whether such investments would be financed out of retained earnings or financed by attracting new capital. For both sources of capital, the return on reinvesting in the railroad's assets must be compared with the return on alternative investments. Investors are not concerned primarily with how successful firms have been with past investments, but how firms will use capital in the future and thus the investor's expected return if it invests in one firm rather than another.

¹¹ See J. Berk and P. De Marzo, *Corporate Finance*, 2007 ("Berk and DeMarzo"), pp. 156-158.

¹² R. A. Brealey, S. C. Myers, F. Allen, *Principles of Corporate Finance* 8th ed. (2006), p. 89.

26. The methodology used by the Board which relies on book value of assets cannot reveal whether railroads will be able to attract investors in the future. In deciding whether to replace or upgrade track, for example, a railroad does not ask whether the return on book value of existing track exceeds the cost of capital, but whether it can earn an adequate rate of return (above its cost of capital) on the replacement cost of that track. Accounting rates-of-return cannot inform such decision making.

27. Congress and the Board have an interest in monitoring the health of the railroad industry, given the vital importance of the railroad industry in the United States and even world economies for transporting goods to domestic and international markets and avoiding taxpayer subsidization of unprofitable railroads. And because of the importance of having a healthy railroad industry in the United States, it is critical that metrics used and the context in which those metrics are evaluated provide an accurate assessment of the railroads' financial health. If the Board adopts and relies on a metric that systematically under- or overestimates the economic rate of return earned by railroads, then it cannot provide the oversight and monitoring guidance that Congress requires.

28. Congress deregulated the railroads after concluding that the railroad industry could not continue to serve the public well in the long run if the carriers were denied a sufficient economic return on future investments to cover their future cost of capital. But the ICC was unwilling to adopt for its revenue adequacy analysis a measure of a railroad's rate of return based on forward-looking data and evaluations because doing so would be both too costly and too time consuming for such evaluation to be informative and relevant.¹³ Historical costs are easier to measure. And

¹³ See *Standards for Railroad Revenue Adequacy* ("Standards II"), 3 I.C.C.2d 261, 277 (1986) (acknowledging that "current cost accounting is theoretically preferable to original cost valuation"); *Standards for Railroad Revenue Adequacy* ("Standards I"), 364 I.C.C. 803, 818 (1981) (explaining that "the replacement cost method is preferable because it comes closer to the competitive result").

at the time of passage of the Staggers Act, the railroads' poor financial health was evident even using returns on book value. Moreover, a fulsome investigation of a railroad's future investment incentives would require investigation of expected supply and demand conditions facing the railroad industry and an understanding of how best to invest to meet demand. For example, it would require understanding whether a railroad would be willing to incur risks associated with building substantial infrastructure to serve demand arising in new geographic areas and for shipment of new commodities when both demand and the return on investment are uncertain.

29. The advantage of using historical costs is that it permits as easy and mechanical calculation of a rate of return using only publicly available data available either from a railroad's financial submissions to the Board or collected from public third-party sources. We discuss the limitation of this approach further below.

C. It is Consistent with Competitive Markets for Firms to Earn an Economic Rate of Return Above Their Cost of Capital

30. Once the Board settles on a methodology for measuring the two necessary components of a revenue adequacy quantification—the rate of return on invested capital (“ROIC”) and the cost of capital—it faces two further determinations: (1) is a railroad or the railroad industry as a whole excessively revenue adequate in a way that indicates that additional regulation would improve competition and (2) if so, what form should such regulation take? Our analysis in this Statement focuses on the first question—how to evaluate whether railroads' rate of return exceeds their cost of capital by an amount that suggests a failure of competition rather than the normal variation of rates of return expected in a competitive marketplace.

31. The goal of the Staggers Act—to rely on competition to the maximum extent possible to discipline rates and services provided by the railroad industry¹⁴—provides guidance in interpreting a measure of revenue adequacy. The relevant question is what rate of return is consistent with a competitive market and how does the profitability of the railroads compare with competitive market outcomes? Only if that comparison shows that the railroad industry has been unusually profitable *measured against typical, unregulated non-railroad firms* for a sufficiently long period of time is there a reason to investigate whether there might be a market failure that has permitted railroads to charge noncompetitive rates to at least some shippers, and to consider whether the Board’s existing tools to evaluate and constrain unreasonable exercise of a railroad’s market power in the places where it possesses and has exercised such power are not sufficient.

32. In order to understand whether railroads are earning a return on invested capital that is indicative of at least the potential for rates to be unconstrained by competition, it is necessary to benchmark any revenue adequacy measure adopted by the Board against corresponding measures we observe for firms operating under competitive conditions. We propose below in Part IV that the firms included in the S&P 500 stock market index, which are the 500 large companies listed on U.S. stock exchanges designed to represent the U.S. stock market, exclusive of any railroad companies, provide a benchmark for evaluating whether revenue adequacy measures using accounting data indicate that railroads are unusually profitable. The firms whose stock is included in the index are large firms that compete with railroads for capital, including many customers of the railroads. If the railroads earn a rate of return net of cost of capital no higher than the average or median S&P firm, then there would be no presumption that railroads

¹⁴ See 49 U.S.C. §§ 10101(1), 10701(d)(1).

are earning abnormal returns and can set rates without constraint from competition, or that shippers' current protections under the Board's SAC and related proceedings are not sufficient.

33. In a competitive environment, like that in which railroads operate, CN, NS and UP can obtain a competitive rate of return *on average* only if they have the opportunity to earn above its cost of capital for periods of time. It cannot earn the competitive rate of return necessary to compete for capital if it must endure periods where its rate of return falls below the competitive level, yet it would be denied the prospect of earning a return above its cost of capital at other times. Using regulation to reduce rates that are not above the competitive level creates immediate inefficiencies in investment choices and operational decisions that, over the longer run, would reduce the quantity and quality of railroad service, both for shippers whose rates are adjusted downward and for other shippers using the rail network.

34. There are many reasons why a firm can earn an above average rate of return that do not signal market failure but instead more likely reflect the opposite—increased productivity or the firm benefiting from successful, risky investments in new competitive businesses. A railroad that is especially innovative, risk-taking, efficient in making use of its resources, provides high-level service, or otherwise succeeds relative to its peers in returning profits to its stakeholders should not be penalized for its success, because doing so through regulation unrelated to any anticompetitive pricing will deter the type of procompetitive conduct that should be encouraged. Moreover, measuring the industry's return on investment based on accounting data may give a misleading picture of economic rates of return on current and future investments.

D. Even if, Contrary to the Evidence, Railroads' ROIC Exceeded Their COC by an Atypically Large Amount, Rate of Return Regulation is Likely to Worsen Competition and Distort Investment and Operational Decisions

35. A properly calculated measure of economic rate of return could provide information about whether the railroads are earning profits sufficient to achieve and maintain long-run financial solvency. However, there is no economic reason why a finding that a railroad is earning a rate of return at or above its cost of capital or even above that of the average firm in a benchmarking group warrants regulation to force lower rates or cap rate increases across-the-board. Finding that a railroad has achieved or exceeded the profitability of other competitive firms does not tell us that particular rail transportation rates are above or below a competitive level. That determination only can be made after evaluating supply and demand conditions for a particular shipper and shipments (taking into account that a railroad must charge rates above variable cost to some shippers in order to be healthy in the long run). Imposing broad-scale rate regulation when only a fraction of a railroad's services is priced at a level unconstrained by sufficient competition would induce inefficient investment decisions and harm railroads and shippers.

36. A railroad's overall financial condition, even if measured by return on current asset costs, provides no information about whether rates on particular shipments are noncompetitive.

Congress directed that, to the maximum extent possible, railroads should be free to set rates based on competition and the demand for their services, with rates subject to potential regulatory review only if the railroad is "market dominant"—that is, if it faces no effective competition.¹⁵

The Board implemented this directive by regulating rates for traffic over which railroads are

¹⁵ See 49 U.S.C. §§ 10101(1), 10701(d)(1).

found to have market dominance only if it determines that those rates exceed a simulated competitive level.¹⁶ Constraints that would restrict railroad pricing or reduce rates below competitive levels irrespective of whether the rates at issue exceed the competitive level would endanger the ability of the railroads to replace and grow their network over the long term.

37. The railroads' improved financial condition since 1980 is evidence of the benefits created when they have flexibility to set rates to shippers freely except when an individualized investigation indicates that a rate exceeds the competitive level. A finding that the railroad as a whole is revenue adequate provides no information about whether an individual rate for a particular shipment is unreasonable—whether the railroad is market dominant for that shipment and whether the challenged rate is noncompetitive.

38. Allocative efficiency requires that individual prices are set competitively, not that prices generate some overall level of return in total. It is efficient to allocate scarce capacity based on willingness to pay, because this allocates capacity to those shippers that value it most. Rate freezes or caps prevent market signals from allocating scarce capacity to where it is most valuable (e.g., to shippers with time critical needs or with more limited competitive options). When rates cannot respond freely to demand, then the critical signal that there is unmet demand for additional capacity is absent.

¹⁶ Any price that passes the stand-alone cost ('SAC') test is at or below a hypothetical long-run competitive market price in a contestable market where a competing railroad is free to enter (i.e., faces neither entry nor exit costs) by building a railroad network to serve the challenged traffic as well as other traffic that it would be efficient to serve (assuming the other traffic is served at current rates). Rates at or below the SAC level would not induce entry by a competing railroad since such a railroad could not cover its costs even if prices did not fall post entry. Thus, any price consistent with the SAC constraint together with the constraints imposed by alternative modes of shipping (such as truck) is a competitive price.

E. Revenue Adequacy Determination Will be More Distortionary if Based on Railroad-Specific Evaluation

39. Regulation will typically disadvantage a regulated firm relative to its unregulated competitors if it is regulated but its competitors are not. The reason is simple: an unregulated profit-maximizing firm will make optimal choices across all the dimensions on which it can compete—price, quality, product features, product selection etc.—but a regulated company is constrained on one or more of these competitive dimensions. These additional constraints will force the firm to make “conditional” profit-maximizing decisions that are less profitable overall.

40. For example, a firm that is compelled to charge prices lower than it would find optimal if it were unregulated will select the optimal combination of quality, features and supply conditional on that price, but its resulting offering will be less attractive than if it could charge a market-determined price. This is what happens with rent control—“price” is below market levels and quality and availability are reduced as a consequence. While regulation may be intended only to prevent the regulated firm from earning “excessive” profits, the result is to induce sub-optimal decisions regarding all the ways in which the firm can compete. Regulations that govern behavior other than price (such as conditions under which a railroad must interchange with its competitors) similarly will distort a wide range of choices made by the regulated firm.

41. Regulating one firm in an industry because it has been relatively profitable while other firms have been less successful would be especially likely to harm competition. It is likely to hobble a firm that has been especially successful because of its efficiency and success with customers. Regulation that restricts a profitable firm’s flexibility to price and to adapt its services to satisfy changing demands of the marketplace will erode its efficiency, which in turn eventually will deprive its customers of high-quality service. This could induce customers to

switch to the regulated firm's competitors, even though the regulated firm could offer a superior option absent regulation.

42. The harmful impact of regulation of some but not all market participants has been illustrated in a different context. In an article that Professor Murphy co-authored, he explained why partial economic reform in some countries, such as occurred in Russia, can create worse outcomes than if all market participants are subject to the same reform or the same regulations. The reason is that resources (inputs) flow into the unregulated sector even if those inputs would create more value if they were available to the regulated firms. The end result can be lower output than with complete regulation, rather than the increased output and efficiency that was the intended result of the partial deregulation.

43. Regulation of some, but not all, competitors also harms the marketplace because it reduces the competitive constraint on unregulated competitors. An unregulated competitor that knows that regulation limits its rival's ability to respond to changes in consumers' demands will feel less competitive pressure to innovate and price competitively. Because of the additional inefficiency that could result if one or some railroads are found to be sufficiently revenue adequate to warrant additional regulation while other railroads are not constrained by those regulations, economics shows that both evaluation of revenue adequacy and imposition of any regulations as a consequence of such a finding should be made on an industry-wide basis, and not as currently performed for each railroad individually.

III. IT IS WELL ESTABLISHED THAT ACCOUNTING RATES OF RETURN ARE POOR MEASURES OF ECONOMIC RATES OF RETURN

44. The measure of financial performance used in the Board's Annual Revenue Adequacy Determinations¹⁷ compares a railroad's accounting-based (or financial statement-based) rate of return on invested capital ("ROIC") to the railroad industry's cost of capital ("COC"), specifically, ROIC minus COC ("ROIC minus COC").¹⁸ However, as we explain in this section, it is well known that accounting-based rates of return do not accurately measure economic rates of return.¹⁹ The magnitude and direction of the inaccuracy when accounting-based rates of return are used as estimates of economic rates of return can be substantial and depend on the specific characteristics of the companies being analyzed. Below, we summarize the peer-reviewed economic literature from the last 50 years that has identified the well-known limitations and inaccuracies of accounting rates of return as measures of financial performance.

45. Early research showed that accounting-based rates of return are poor measures of economic rates of return. These studies, which include Solomon (1961),²⁰ Harcourt (1965),²¹

¹⁷ See, for example, Surface Transportation Board, Railroad Adequacy – 2018 Determination, Docket No. EP 552 (Sub-No. 23), September 5, 2019 ("STB 2018 Revenue Adequacy Determination").

¹⁸ STB 2018 Revenue Adequacy Determination, Appendices A and B.

¹⁹ The economic cost of capital (or economic rate of return) is equal to the discount rate that equates the sum of the discounted value of the cash flows generated by an investment to the value of the investment. This economic rate of return concept is often called an internal rate of return ("IRR"), which is discussed in corporate finance textbooks; for example, see BREALEY, R. A., MYERS, S. C., & ALLEN, F. (2006). *Principles of corporate finance*. New York, NY, McGraw-Hill/Irwin, pp.111-118; BERK, J. B., & DEMARZO, P. M. (2011). *Corporate finance*. Boston, MA, Prentice Hall, pp.128-131 and 222-227.

²⁰ Solomons, D., "Economic and Accounting Concepts of Income," *The Accounting Review*, 1961 36, pp. 374 – 383.

²¹ Harcourt, G. C., "The Accountant in a Golden Age," *Oxford Economic Papers*, March 1965, pp. 66-80.

Solomon (1966),²² Sarnat and Levy (1969),²³ Livingstone and Solomon (1970),²⁴ Solomon (1970),²⁵ Stauffer (1971),²⁶ Weiss (1974),²⁷ Kay (1976),²⁸ and Wright (1978),²⁹ identified numerous factors that affect the relationship between accounting rates of return and economic rates of return. These include accounting capitalization rules; cash flow patterns; accounting depreciation and amortization rules; economic rate of return of the investment; growth rates (current and past); income tax regulations; market value of the investment relative to the book value of the investment (which implicitly includes the degree of conservativeness of accounting rules); price level changes; and project (investment) length. These studies conclude that any specification that includes all of the factors that affect the ability of ROIC to measure a company's economic rate of return is too complex to model; and that the impacts of various factors that determine the magnitude and direction of the difference between measured accounting rates of return and economic rates of return are interrelated. Depending on the

²² Solomon, E., "Return on Investment: The Relation of Book Yield to True Yield," in *Research in Accounting Measurement*, ed. R. K. Jaedicke, Y. Ijiri, and O. W. Nielsen, American Accounting Association, 1966; later published in J. Leslie Livingstone and Thomas J. Burns, eds., *Income Theory and Rate of Return*, Columbus: Ohio State University Press, 1971, 105-17.

²³ Sarnat, M. and H. Levy, "The Relationship of Rules of Thumb to the Internal Rate of Return: A Restatement and Generalization," *Journal of finance* June 1969, pp. 470 – 490.

²⁴ Livingstone, John, and Gerald Solomon, "Relationship Between the Accounting and the Internal Rate of Return Measures: A Synthesis and an Analysis," *Journal of Accounting Research*, Autumn 1970, pp. 199 – 216.

²⁵ Solomon, Ezra, "Alternative Rate of Return Concepts and Their Implications for Utility Regulation," *Bell Journal of Economics*, Spring 1970, 1, pp. 65 – 81.

²⁶ Stauffer, Thomas R., "The Measurement of Corporate Rates of Return: A Generalized Formulation," *Bell Journal of Economics* Autumn 1971, 2, pp. 434 – 469.

²⁷ Weiss (1974) provides a detailed review of this literature; Weiss, Leonard W., "The Concentration-Profits Relationship and Antitrust," in Harvey J. Goldschmid et al., *Industrial Concentration: The New Learning*, Boston, Little, Brown and Co., 1974.

²⁸ Kay, J. A., "Accountants, Too, Could Be Happy in the Golden Age: The Accountants Rate of Profit and the Internal Rate of Return," 1976, *Oxford Economic Papers* 17 November, pp. 66 – 80.

²⁹ Wright, F. K., "Accounting Rate of Profit and Internal Rate of Return," *Oxford Economic Papers*, November 1978, pp. 464 – 468.

characteristics of a particular firm, the difference between accounting rates of return and its economic rate of return can be very large and can be either positive or negative.

46. A series of subsequent studies focused on the regulatory implications of the limitations and inaccuracies of using accounting-based rates of return as estimates of economic rates of return. These studies include: Benston (1979),³⁰ Fisher and McGowan (1983),³¹ Fisher (1984),³² Benston (1985),³³ Salamon (1985),³⁴ and Salamon (1988).³⁵ These studies, which expanded on earlier research, analyzed how these factors affect the extent to which accounting-based rates of return reasonably approximate economic rates of return. A common finding, as expressed by Fisher and McGowan (1983), is that the difference between accounting rates of return and economic rates of return can be very large: “the theoretical effects are not so small that they can be neglected in practice. Indeed, they are very large”³⁶ They also concluded that the sign of the difference (error) depends on the characteristics of the company: “the accounting rate of return depends *crucially* on the time shape of benefits [cash flows], and the effect of growth on the accounting rate of return also depends on that time shape. In particular, it is not true that

³⁰ Benston, George J., “The FTC’s Line of Business Program: A Benefit-Cost Analysis,” in Harvey Goldschmid, ed., *Business Disclosure. Government’s Need to Know*, New York: McGraw-Hill, 1979, pp. 58 – 118.

Cooper, Joseph D., Proceedings of the Second

³¹ Fisher, Franklin M., and McGowan, John J., “On the Misuse of Accounting Rates of Return to Infer Monopoly Profits,” *American Economic Review*, March 1983, 73, pp. 82 – 97.

³² Fisher, Franklin M., “The Misuse of Accounting Rates of Return: Reply,” *American Economic Review*, June 1984, 74, pp. 509-17.

³³ Benston, George J., “The Validity of Profits- Structure Studies with Particular Reference to the FTC’s Line of Business Data,” *American Economic Review*, March 1985, 75, pp. 37 – 67.

³⁴ Salamon, Gerald L., “Accounting Rates of Return,” *American Economic Review*, June 1985, 75, pp. 495 – 504.

³⁵ Salamon, G. (1988), “On the Validity of Accounting Rate of Return in Cross-sectional Analysis: Theory, Evidence and Implications,” *Journal of Accounting and Public Policy*, 7, 1988, pp. 267 – 292.

³⁶ Fisher and McGowan (1983), p. 83. Fisher (1984) responded to comments on the Fisher and McGowan (1983) paper regarding the magnitude of the difference (error) and did not change their conclusion in Fisher and McGowan (1983) that the difference (error) can be “very large.” See Fisher, Franklin M., “The Misuse of Accounting Rates of Return: Reply,” *American Economic Review*, June 1984, 74, p. 512.

rapidly growing firms tend to understate their profits and slowly growing firms tend to overstate them. The effect can go the other way.”^{37, 38}

47. Recent research has developed more generalized models of accounting rates of return. For example, Rajan, Reichelstein, and Soliman (2007) model the complexity of the interrelation among accounting conservatism, growth in new investments, the useful life of assets, and the internal rate of return of projects available to the firm. The authors illustrate the complexity of using accounting rates of return to measure economic rates of return and show that, for example, accounting conservatism and past growth in investments are interrelated and jointly determine how accounting rates of return compare to economic rates of return: “Given conservative accounting, faster growth tends to depress ROI and this decline will be more pronounced for more conservative accounting rules. Conversely, the impact of higher degree of conservatism on ROI will depend on whether past growth rates are above or below a critical level, given by the internal rate of return of the firm’s projects.”³⁹

³⁷ Fisher and McGowan (1983), p. 84.

³⁸ Some of these studies, for example, McFarland (1990), analyze how accounting rules for depreciation affect the accuracy of accounting rates of return as estimates of economic rates of return. As noted by Fisher and McGowan (1983) and Fisher (1984), the only way to accurately measure depreciation is to use the depreciation method developed by Hotelling (1925), which measures economic depreciation, and which is similar to using replacement cost to value depreciable assets each year. Fisher (1979), however, shows that accounting rates of return are still inaccurate measures of economic rates of return even when a machine has an infinite life. Regardless, accounting rules for depreciation (and amortization) are only one of the factors that drive the inaccuracy of accounting rates of return as estimates of economic rates of return.

Hotelling, Harold, “A General Mathematical Theory of Depreciation,” *Journal of the American Statistical Association*, September 1925, 20, pp. 340 – 353.

Fisher, Franklin M., “Diagnosing Monopoly,” *Quarterly Review of Economics and Business*, Summer 1979, 19, pp. 7-33.

McFarland, Henry, “Alternative Methods of Depreciation and the Reliability of Accounting Measures of Economic Profits,” *The Review of Economics and Statistics*, Vol. 72, No. 3, August 1990, pp. 521-524.

³⁹ Rajan, Reichelstein, and Soliman, “Conservatism, Growth, and Return on Investment,” *Review of Accounting Studies*, Vol 12, No. 2-3, 2007, pp. 325-370 at 355-356.

48. In sum, economic research has identified several factors that determine the accuracy and direction of the error of accounting rates of return as estimates of economic rates of return, but no study has derived a closed-form specification for an accounting rate of return based on all of these factors.⁴⁰ Economic research shows that the complex relationship among these factors makes it difficult, and some say impossible, to draw any conclusions about economic rates of return based on accounting rates of return. Fisher and McGowan (1983) expressed one of the strongest conclusions against using accounting rates of return as estimates of economic rates of return: "... there is no way in which one can look at accounting rates of return and infer anything about relative economic profitability ... Economists (and others) who believe that analysis of accounting rates of return will tell them much (if they can only overcome the various definitional problems which separate economists and accountants) are deluding themselves."⁴¹

49. The Fisher and McGowan (1983) results and conclusions do not imply that accounting rates of return are not informative for other purposes, such as by investors to set security prices. Accounting rates of return are widely used in financial analysis,⁴² and empirical research shows a statistically significant (although weakening) relation (correlation) between accounting rates of

⁴⁰ Rajan, Reichelstein, and Soliman (2007) have the most comprehensive closed-form specification for a steady-state ROIC based on a subset of these factors.

⁴¹ Fisher and McGowan (1983), pp. 90 – 91.

⁴² See Chapters 2 and 4 in Robert W. Holthausen and Mark E. Zmijewski. *Corporate Valuation: Theory, Evidence and Practice*. 2nd edition, Cambridge Business Publishers, 2020 ("Holthausen and Zmijewski").

return and stock price movements (for example, Jacobson (1987)).⁴³ However, that relationship is weak (Lev (1989)⁴⁴) and has weakened over time (Lev and Feng (2016)).⁴⁵

IV. MEASURING FINANCIAL PERFORMANCE OF THE RAILROAD INDUSTRY BASED ON THE BENCHMARKING METHODOLOGY PRODUCES MORE INFORMATIVE RESULTS

50. In this section, we propose and implement an alternative to the current methodology used by the Board in its Annual Revenue Adequacy Determinations. The methodology we propose is more informative than comparing the railroads' accounting-based rates of return to the industry cost of capital in isolation because it mitigates some of the limitations and inaccuracies identified in the previous section of using accounting-based rates as approximation for economic rates of return as implemented by the STB. More specifically, in this section we analyze two measures of the railroads' financial performance (ROIC minus COC and Adjusted ROIC minus COC) and compared them to the financial performance of three benchmarking groups: (a) S&P 500

⁴³ Jacobson, Robert, "The Validity of ROI as a Measure of Business Performance," *American Economic Review*, Vol. 77, No. 3 June 1987, pp. 470-478. Lev, B., "On the Usefulness of Earnings and Earnings Research: Lessons and Directions from Two Decades of Empirical Research," *Journal of Accounting Research* Vol. 27, *Current Studies on The Information Content of Accounting Earnings*, 1989, pp. 153 – 192 and Lev, Baruch and Gu, Feng, *The End of Accounting and the Path Forward for Investors and Managers*, Hoboken, New Jersey: John Wiley & Sons, Inc., 2016. | Series: Wiley finance series; p. xiii ("Based on a comprehensive, large-sample empirical analysis, spanning the past half century, we document a fast and continuous deterioration in the usefulness and relevance of financial information to investors' decisions. Moreover, the pace of this usefulness deterioration has accelerated in the past two decades").

⁴⁴ Lev, B., "On the Usefulness of Earnings and Earnings Research: Lessons and Directions from Two Decades of Empirical Research," *Journal of Accounting Research* Vol. 27, *Current Studies on The Information Content of Accounting Earnings*, 1989, pp. 153 – 192.

⁴⁵ Lev, Baruch and Gu, Feng, *The End of Accounting and the Path Forward for Investors and Managers*, Hoboken, New Jersey: John Wiley & Sons, Inc., 2016. | Series: Wiley finance series; p. xiii, the authors state: ... "we examine in the first part of this book the usefulness of financial (accounting) information to investors and, regrettably, provide an unsatisfactory report, to put it mildly. Based on a comprehensive, large-sample empirical analysis, spanning the past half century, we document a fast and continuous deterioration in the usefulness and relevance of financial information to investors' decisions. Moreover, the pace of this usefulness deterioration has accelerated in the past two decades."

(excluding railroads, financial institutions, and real estate companies); (b) S&P 500 Industrials Sector; and (c) S&P 500 Railroad Customers.

51. All of the analyses show that the relative financial performance of the railroad industry falls within the bottom quartile of the three benchmarking groups. Furthermore, with a single exception (one railroad for one benchmarking group), all of the analyses show that the relative financial performance of all seven railroads also falls within the bottom quartile of the three benchmarking groups.⁴⁶ Thus, the benchmarking analyses we conducted show that financial performance of the railroad industry and the seven railroads was well below the financial performance of companies operating in competitive (unregulated) markets.

A. Benchmarking Methodology

52. Simply stated, we propose a benchmarking methodology that compares the railroads' financial performance (ROIC minus COC) to the financial performance of companies operating in competitive (unregulated) markets over a sufficiently long period of time to reasonably estimate relative financial performance. Benchmarking methodologies are widely used in many fields and for many purposes. The types of benchmarking that are most useful for evaluating revenue adequacy are benchmarking used to evaluate investment portfolio performance, conduct a financial analysis of a company and its competitive position, and value companies.

53. A financial benchmark is a standard (or reference point) by which to evaluate financial performance. For example, when evaluating an investment portfolio's performance, the process involves comparing "the return of a managed portfolio over some evaluation period to the return

⁴⁶ The one exception is UP for the S&P 500 Railroad Customers sample, which has a median across years equal to the 35th percentile for ROIC minus COC and 26th percentile for Adjusted ROIC minus COC; however, UP's median percentile for the S&P 500 and S&P 500 Industrials benchmarking groups are all below the 25th percentile for both financial performance measures. See Table 7, Panel B.

of a benchmark portfolio. The benchmark portfolio should represent a feasible investment alternative to the managed portfolio being evaluated.”⁴⁷ Because accounting-based financial metrics, including accounting rates of return, are inaccurate estimates of the economic concepts of profits, we benchmark a company’s financial metrics against comparable financial metrics of a chosen benchmark group.⁴⁸ In forecasting a company’s future financial performance, benchmarking is used both to determine the drivers (financial metrics) generating the output of the forecasting model and to evaluate the reasonableness of the model’s forecasts.⁴⁹ Benchmarking also is used in several ways when valuing a company, for example, to measure the company’s cost of capital⁵⁰ or to measure the company’s price to earnings, EBITDA to enterprise value, and other market multiples.⁵¹ Establishing the long-run historical performance of a company requires that we analyze time-series of benchmarking results over a sufficiently long period of time to reasonably estimate relative financial performance.

54. Our proposed benchmarking methodology is not innovative or new. It is a standard and well-accepted methodology for analyzing a company’s financial performance. The benchmarking methodology mitigates the erroneous inferences that result from using accounting-based financial rates of return and other financial metrics to estimate the concept of economic profits.

⁴⁷ Argon, G. O. and W. E. Ferson, “Portfolio Performance Evaluation,” *Foundations and Trends in Finance*, Vol. 2, No. 2, 2006, pp. 83–190; see p. 89.

⁴⁸ Holthausen and Zmijewski, Chapter 2.

⁴⁹ Holthausen and Zmijewski, Chapter 4.

⁵⁰ Holthausen and Zmijewski, Chapters 8 and 10.

⁵¹ Holthausen and Zmijewski, Chapters 13 and 14.

B. Alternative Specifications of the Return on Invested Capital (ROIC)

55. In addition to using the Board’s definition of ROIC in our benchmark analysis, we also use an alternative definition of ROIC, Adjusted STB ROIC, which we believe is a more informative measure of financial performance for assessing the financial performance of the railroads. The STB’s Annual Revenue Adequacy Determinations⁵² defines ROIC as follows:⁵³

$$\text{STB ROIC} = \frac{\text{Adjusted Net Railway Operating Income}}{\text{Tax Adjusted Net Investment Base}}$$

56. The Adjusted STB ROIC makes one adjustment to the Board’s definition of Adjusted Net Railway Operating Income (STB ROIC numerator) and two adjustments to the Board’s definition of Tax Adjusted Net Investment Base (STB ROIC denominator). The adjustment to the Board’s definition of Adjusted Net Railway Operating Income (STB ROIC numerator) eliminates the effect of deferred income taxes in the Provision of Income Taxes. The two adjustments to the Board’s definition of Tax Adjusted Net Investment Base (STB ROIC denominator) are: (a) eliminating the effect of Deferred Tax Liabilities in the calculation of the

⁵² See, for example, STB 2018 Revenue Adequacy Determination, Appendix B. For 2017, the STB adjusted this formula because the decrease in the federal income tax rate (2017 Tax Cut and Jobs Creation Act) resulted in a revaluation of deferred income taxes on the balance sheet (companies, like the railroads, with a net deferred tax liability position on their balance sheet recorded a reduction of that liability, which decreased the provision for income taxes and thus, increased income, in that year). The adjustment had the effect of essentially eliminating this reduction in income tax. “By decision served on July 27, 2018, the Board explained that its revenue adequacy determination, among other calculations for 2017, would be affected by the carriers’ revaluation of their deferred tax liabilities as a result of the Tax Cuts and Jobs Act. R.R. Revenue Adequacy—2017 Determination... The Board adopted this proposal in Railroad Revenue Adequacy—2017 Determination, EP 552 (Sub-No. 22) et al., slip op. at 6-9 (STB served Dec. 6, 2018), and, consistent with that decision, the revenue adequacy determination here reflects the adjustments made in the carriers’ Schedule 250 filings,” STB 2017 Revenue Adequacy Determination, December 21, 2018, footnote 2.

⁵³ In Appendix A, we provide a detailed description of this formula and the data sources for every input for the railroads and the S&P 500 companies.

Net Investment Base and (b) including the company's investments in non-goodwill intangible assets. The resulting formula for Adjusted STB ROIC is:⁵⁴

$$\text{Adjusted STB ROIC} = \frac{\text{Adjusted Net Railway Operating Income} + \text{Deferred Tax Expense}}{\text{Tax Adjusted Net Investment Base} + \text{Deferred Tax Liabilities} + \text{Non-Goodwill Intangible Assets}}$$

57. The adjustment to the Board's definition of Adjusted Net Railway Operating Income (STB ROIC numerator) to eliminate the effect of deferred income taxes in the Provision of Income Taxes is consistent with basic valuation principles, which measures the value of a company as the discounted value of the cash flows the company is expected to generate for its investors.⁵⁵ Eliminating the effect of deferred income taxes in the Provision of Income Taxes is one of the required adjustments to measure a company's cash flows in order to align the company's operating income with the economic concept used in measuring a company's economic profit.

58. The first adjustment to the Board's definition of Tax Adjusted Net Investment Base (STB ROIC denominator) is eliminating the effect of Deferred Tax Liabilities in the calculation of the Net Investment Base. IRS rules for depreciation (and other items resulting in deferred tax liabilities) are not intended for, and do not purport to be, better estimates of economic depreciation and other types of expenses. The basic concept of economic depreciation (Hotelling (1925) or replacement cost as proxy) indicates that accelerated IRS depreciation is not a better estimate of economic depreciation. Thus, this adjustment mitigates—but does not eliminate—the effect of two of the factors that make accounting rates of return inaccurate estimates of the

⁵⁴ Adding Deferred Tax Liabilities to the denominator of the Adjusted STB ROIC has the effect of eliminating the deduction of Deferred Tax Liabilities used in the STB definition of ROIC.

⁵⁵ Holthausen and Zmijewski, Chapters 13 and 14.

cost of capital: depreciation in excess of economic depreciation and the book value of the assets relative to the market value of the assets.

59. The second adjustment to the Board's definition of Tax Adjusted Net Investment Base (STB ROIC denominator) is including the company's investments in non-goodwill intangible assets. This adjustment has no meaningful effect on the railroads' ROICs, and thus, no meaningful effect on the ROIC minus COC measure of financial performance used by the Board. However, it can have a meaningful effect on the ROIC of other S&P 500 companies that have substantial investments in non-goodwill intangible assets.⁵⁶

60. As an illustration, consider JM Smucker Company ("Smucker"). In 2016, Smucker's total assets included \$1.6 billion in net property and equipment and \$6.1 billion in non-goodwill intangible assets.⁵⁷ Using the STB definition, Smucker's 2016 Tax Adjusted Net Investment Base is \$171.3 million. The value of Smucker's 2016 Tax Adjusted Net Investment Base is substantially less than the book value of its net property and equipment because the STB calculation subtracts Accumulated Deferred Income Tax Credits, which were \$2.4 billion for Smucker in 2016. Using the STB definition, Smucker's Adjusted Operating Income is \$958.8 million and its 2016 ROIC is over 550% ($5.597 = \$958.8 / \171.3). Including Smucker's non-goodwill intangible assets in the calculation of its 2016 Tax Adjusted Net Investment Base, increases Smucker's 2016 ROIC denominator to \$6,493.5 million, which reduces its 2016 ROIC to 14.8% ($0.1477 = \$958.8 / \$6,493.5$).

⁵⁶ Examples of non-goodwill intangible assets include assets such as patents, copyrights, trademarks, computer software, licenses, films, and import quotas. Accounting rules generally require companies to expense – as opposed to capitalize – expenditures that result in such assets but require companies to record the value of non-goodwill intangible assets when they acquire another company.

⁵⁷ The non-goodwill intangible assets consist of "Customer and contractual relationships, Patents and technology, and Trademarks". See 2016 JM Smucker Annual Report, p. 57.

61. The Smucker’s example illustrates the bias of excluding non-goodwill intangible assets in the ROIC calculation, resulting in overstating a company’s ROIC. Because none of the railroads have meaningful non-goodwill intangible assets, this adjustment has no effect for assessing their financial performance. However, it has a substantial effect for assessing the railroads’ financial performance relative to other companies that may have substantial non-goodwill intangible assets. Generally, excluding non-goodwill intangible assets has the effect of increasing ROIC and thus ROIC minus COC for the benchmark groups.

62. We believe the ROIC measure based on these adjustments are a more useful, albeit still noisy and inaccurate, measure of financial performance to use to compare to a company’s COC.

C. Data

63. Our methodology compares the measure of railroads’ financial performance used by the Board in its Annual Revenue Adequacy Determinations to the financial performance of three benchmarking groups over the 2006–2019 period:⁵⁸ (a) S&P 500 companies excluding railroads, financial institutions, and real estate companies (“S&P 500” benchmarking group);⁵⁹ (b) S&P 500 Industrials Sector excluding railroads, the industry sector to which railroads belong (“S&P 500 Industrials Sector” benchmarking group);⁶⁰ and (c) customers (shippers) of CN, NS, and/or

⁵⁸ We use this time period as illustration to show the analysis over a sufficiently long period of time to reasonably estimate relative financial performance.

⁵⁹ The S&P 500 is “is widely regarded as the best single gauge of large-cap U.S. equities... The index includes 500 leading companies and covers approximately 80% of available market capitalization.” See, <http://us.spindices.com/indices/equity/sp-500>. We exclude financial institutions and real estate companies because they have substantially different capital structures and business operations; however, none of the conclusions in our analyses change if we include financial institutions and real estate companies.

⁶⁰ Industry Sectors are based on the Global Industry Classification Standard (“GICS”).

The GICS methodology aims to enhance the investment research and asset management process for financial professionals worldwide. It is the result of numerous discussions with asset owners, portfolio managers and investment analysts around the world. It was designed in response to the global financial community’s need for accurate, complete and standard industry definitions.

UP in the S&P 500 that accounted for at least \$1.0 million of combined revenues to those railroads during 2018 (“S&P 500 Railroad Customers” benchmarking group). All three alternative benchmarking groups include a broad selection of companies that compete with railroads to raise capital. In our analyses, we evaluate each railroad’s relative financial performance by determining the percentile of the distribution of the financial performance of the members of a benchmarking group into which that railroad falls. In addition, we calculate the financial performance of the railroad industry (“Industry Weighted Average”) and benchmark the relative financial performance of the railroad industry as a whole in the same way.⁶¹

64. Naturally, a company’s ROIC minus COC requires the calculation of that company’s ROIC and industry cost of capital. ROIC does not have a single generally accepted or standard definition. The Board uses a specific definition for ROIC (“STB ROIC”), and we use that definition as one alternative for our analysis. We also use an alternative definition of ROIC (“Adjusted STB ROIC”), which we believe is a more informative measure of accounting-based financial performance for assessing the financial performance of the railroads based on ROIC minus COC. Although we do not agree with the Board’s definition and implementation of the cost of capital, we do not adjust it and instead use the Board’s definition and implementation to measure the cost of capital for the railroads and the companies within the S&P 500 benchmarking groups.

The GICS structure consists of 11 Sectors, 24 Industry groups, 69 Industries and 158 sub-industries. The railroads are included in the Industrial Sector 20. GICS® Global Industry Classification Standard accessed on August 14, 2020 at https://www.spglobal.com/marketintelligence/en/documents/112727-gics-mapbook_2018_v3_letter_digitalspreads.pdf

⁶¹ The Industry Weighted Average is equal to the weighted average of the ROICs of the seven railroads minus the industry cost of capital. See Appendix A for detailed description of the Industry Weighted Average calculation.

65. In Appendix A, we provide a detailed description of the formulas used and the data sources for all of the inputs in our analysis.⁶² As explained in detail in Appendix A, we use the same data sources and measurement of inputs in calculating railroads' ROIC as those used in the Board's Revenue Adequacy Determinations.⁶³ Compustat, a publicly available database widely used in peer reviewed academic studies, is our source of data for measuring ROIC for the S&P 500 benchmarking groups. As also explained in detail in Appendix A, the data sources and measurement of the inputs for the railroads cost of capital are the same as those used in the STB's Annual Cost of Capital Decisions.⁶⁴ The data sources used to measure the industry cost of capital for the S&P 500 benchmarking groups are Ibbotson⁶⁵ and Duff & Phelps,⁶⁶ which are publicly available and widely used in peer reviewed academic studies. In Exhibit A1 of Appendix A, we present a list of the S&P 500 benchmarking group for each year in the analysis.⁶⁷

⁶² As explained in detail in Appendix A, for ROIC and the cost of capital for the railroads, we use the same data sources and measurement of the inputs for the calculation of railroads' ROIC as those in the STB Revenue Adequacy Determinations; the data source used to measure ROIC for the S&P 500 companies is Compustat, which is publicly available and widely used in such analyses and in peer reviewed academic studies.

⁶³ For example, see STB 2018 Revenue Adequacy Determination. See Appendix A for citations to each of these data sources. Appendix B presents the ROIC minus COC for the railroads for each year.

⁶⁴ For example, see Surface Transportation Board Decision, Railroad Cost of Capital – 2018, Docket No. EP 558 (Sub-No. 22), August 6, 2019 (“STB 2018 Cost of Capital Decision”). See Appendix A for citations to each of these data sources.

⁶⁵ The Ibbotson Cost of Capital Yearbook, originally published by Ibbotson and Associates, had been subsequently published by Morningstar, Inc. through 2014 when it was discontinued. According to Morningstar, the “Cost of Capital Yearbook... includes five separate measures of cost of equity, weighted average cost of capital, detailed statistics for sales and profitability, capitalization, beta, equity valuation multiples,... The publication is considered an invaluable independent resource to a large number of financial professionals.” See, Ibbotson Cost of Capital 2012 Yearbook, p. 1.

⁶⁶ Duff and Phelps acquired the cost of capital publication business from Morningstar and replaced the discontinued Cost of Capital Yearbook with the Duff & Phelps Valuation Handbook – U.S. Industry Cost of Capital.

⁶⁷ As shown in this exhibit, because the S&P 500 has turnover in its membership, the S&P 500 includes 795 companies during 2006 – 2019 period. Only 273 companies (34%) were members of the S&P 500 in every year from 2006 – 2019. 162 companies (21%) were members of the S&P 500 for nine to thirteen years, 135 companies (17%) were members of the S&P 500 for five to eight years, and with 225 companies (28%) members of the S&P 500 for one to four years. The companies marked with an asterisk next to a company's ticker are financial

D. Railroads' Relative Financial Performance Based on the Board's Definitions of ROIC and Cost of Capital

66. In this section, we present the results of our comparison of the relative financial performance of seven railroads based on the Board's definitions of ROIC and industry COC: BNSF Railway; CSX Corporation; Grand Trunk Corporation; Kansas City Southern; Norfolk Southern Corporation; Soo Line Corporation; and Union Pacific Corporation. Table 1 below compares the financial performance of the railroads to the S&P 500 excluding railroads, financial institutions, and real estate companies (see Appendix Exhibit A1 for list of companies in the S&P 500 each year).⁶⁸ This table has two panels. In the top panel, we present descriptive statistics about the S&P 500 benchmarking group and in the bottom panel, we present the minimum, maximum, median,⁶⁹ and average percentile of ROIC minus COC within the distribution of the S&P 500 benchmarking group for the railroad industry and for each of the seven railroads.

institutions or real estate companies, which we exclude from our analyses because financial institutions and real estate companies have substantially different capital structures, assets, and business models than other companies in the S&P 500. The number of S&P 500 Companies excluding financial institutions and real estate companies is shown at the top of the exhibit and range from 396 to 414 over this period.

⁶⁸ See Exhibit 1 for the year-by-year results for the Industry Weighted Average and the seven railroads summarized in Table 1.

⁶⁹ We use medians and 25th percentiles in our analyses to mitigate the effect of outliers. See Chapter 2 in Holthausen and Zmijewski for a discussion of mitigating the effect of outliers when conducting a financial analysis.

Table 1
S&P 500 Companies Excluding Railroads, Financial Institutions and Real Estate Companies

Number of Observations, Median, 25th Percentile, and % Positive ROIC minus COC Over 2006-2019 Period				
	Minimum	Maximum	Median	Average
Number of Observations in Sample	368	405	395	391
Median ROIC minus COC	13%	29%	19%	20%
25th Percentile ROIC minus COC	-1%	6%	5%	4%
% with ROIC minus COC > 0.0%	73%	91%	89%	88%
<u>Railroad Percentile in the Distribution of ROIC minus COC</u>				
Industry Weighted Average ROIC	9	22	13	14
BNSF Railway	9	23	15	15
CSX Corporation	6	23	10	12
Grand Trunk Corporation	3	16	10	10
Kansas City Southern	4	18	8	9
Norfolk Southern Corporation	10	24	13	15
Soo Line Corporation	2	26	13	13
Union Pacific Corporation	8	30	22	20

Sources: Bloomberg; Compustat; Ibbotson Yearbook (2006-2019); STB Revenue Adequacy Determination Report (2006-2018); RevAd 2019 AAR workpaper1.pdf, titled "AAR Duplication of STB Workpapers."

67. As shown in the top panel of Table 1, the number of companies in the S&P 500 benchmarking group varies from 368 to 405 across years (2006 through 2019). The number of observations differs from the possible number of observations because some companies in the S&P 500 benchmarking group have negative denominators based on the Board definition of Tax Adjusted Net Investment Base, so we exclude them from the S&P 500 benchmarking group because their ROIC is not meaningful. The median ROIC minus COC for the S&P 500 benchmarking group ranges from 13% to 29% over the 2006 – 2019 period, and the median of the annual medians is 19% (average 20%). The 25th percentile ROIC minus COC for the S&P 500 benchmarking group range from -1% to 6% over the 2006 – 2019 period, and the median of the annual 25th percentile is 5% (average 4%). The ROIC minus COC is positive in every year for most companies in the S&P benchmarking group. The percentage of companies in the S&P

500 benchmarking group annually that have a positive ROIC minus COC ranges from 73% to 91% over the 2006 – 2019 period.

68. As shown in the bottom panel of Table 1, the Industry Weighted Average ROIC minus COC percentile for the railroad companies in the S&P as a whole within the S&P 500 benchmarking group over this period ranges from the 9th percentile to the 22nd percentile. The median of the annual medians of the over this period for the Industry Weighted Average is the 13th percentile, and the average of the annual medians over this period is the 14th percentile. For the seven railroads, the median of the annual medians over this period range from the 8th percentile to the 22nd percentile, and the average of the annual medians over this period range from the 9th percentile to the 20th percentile.

69. Table 2 below presents the same type of analysis as that presented in Table 1 but for the S&P 500 Industrials Sector benchmarking group.⁷⁰ As shown in the top panel of Table 2, the number of observations annually in the S&P 500 Industrials Sector benchmarking group varies from 48 to 63. The median ROIC minus COC for the S&P 500 Industrials Sector ranges from 14% to 31% over the 2006 – 2019 period, and the median of the annual medians is 23% (average 23%). The 25th percentile ROIC minus COC for the S&P 500 Industrial Sector ranges from 4% to 14% over the 2006 – 2019 period, and the median of the annual 25th percentile is 13% (average 12%). The percentage of companies in the S&P 500 Industrial Sector benchmarking group that have a positive ROIC minus COC range from 83% to 100% over the 2006 – 2019 period.

⁷⁰ See Exhibit 1 for the year-by-year results for the Industry Weighted Average and the seven railroads summarized in Table 2.

Table 2
S&P 500 Companies in the Industrials Sector Excluding Railroads

Number of Observations, Median, 25th Percentile, and % Positive ROIC minus COC Over 2006-2019 Period				
	Minimum	Maximum	Median	Average
Number of Observations in Sample	48	63	56	57
Median ROIC minus COC	14%	31%	23%	23%
25th Percentile ROIC minus COC	4%	14%	13%	12%
% with ROIC minus COC > 0.0%	83%	100%	96%	95%
<u>Railroad Percentile in the Distribution of ROIC minus COC</u>				
Industry Weighted Average ROIC	2	12	7	7
BNSF Railway	2	13	7	7
CSX Corporation	2	9	5	6
Grand Trunk Corporation	2	9	5	5
Kansas City Southern	2	9	4	5
Norfolk Southern Corporation	2	14	8	7
Soo Line Corporation	2	15	6	6
Union Pacific Corporation	4	21	9	10

Sources: Bloomberg; Compustat; Ibbotson Yearbook (2006-2019); STB Revenue Adequacy Determination Report (2006-2018); RevAd 2019 AAR workpaper1.pdf, titled "AAR Duplication of STB Workpapers."

70. As shown in the bottom panel of Table 2, the Industry Weighted Average ROIC minus COC percentile within the S&P 500 Industrials Sector benchmarking group over this period ranges from the 2nd percentile to the 12th percentile. The median of the annual medians over this period for the Industry Weighted Average is the 7th percentile, and the average of the annual medians over this period also is the 7th percentile. For the seven railroads, the median of the annual medians over this period range from the 4th percentile to the 9th percentile, and the average of the annual medians over this period range from the 5th percentile to the 10th percentile.

71. Table 3 below presents the same type of analysis as that presented in Tables 1 and 2 for the S&P 500 Railroad Customers benchmarking group.⁷¹ As shown in the top panel of Table 3,

⁷¹ See Exhibit 1 for the year-by-year results for the Industry Weighted Average and the seven railroads summarized in Table 3.

the number of observations in the S&P 500 Railroad Customers companies varies from 80 to 86. The median ROIC minus COC for the S&P 500 Railroad Customers companies ranges from 3% to 13% over the 2006 – 2019 period, and the median of the annual medians is 9% (average 9%). The 25th percentile ROIC minus COC for the S&P 500 companies ranges from -4% to 4% over the 2006 – 2019 period, and the median of the annual 25th percentile is 2% (average 2%). The ROIC minus COC is positive for most companies in the S&P companies. The percentage of the S&P 500 companies with a positive ROIC minus COC ranges from 61% to 88% over the 2006 – 2019 period.

Table 3
Railroad Customer Sample of S&P 500 Companies

Number of Observations, Median, 25th Percentile, and % Positive ROIC minus COC Over 2006-2019 Period				
	Minimum	Maximum	Median	Average
Number of Observations in Sample	80	86	84	83
Median ROIC minus COC	3%	13%	9%	9%
25th Percentile ROIC minus COC	-4%	4%	2%	2%
% with ROIC minus COC > 0.0%	61%	88%	83%	81%
<u>Railroad Percentile in the Distribution of ROIC minus COC:</u>				
Industry Weighted Average ROIC	7	36	22	23
BNSF Railway	7	36	24	24
CSX Corporation	5	36	16	18
Grand Trunk Corporation	5	29	14	16
Kansas City Southern	5	28	13	13
Norfolk Southern Corporation	15	31	20	23
Soo Line Corporation	6	43	19	19
Union Pacific Corporation	6	49	35	31

Sources: Bloomberg; Compustat; Ibbotson Yearbook (2006-2019); STB Revenue Adequacy Determination Report (2006-2018); RevAd 2019 AAR workpaper1.pdf, titled "AAR Duplication of STB Workpapers."

72. As shown in the bottom panel of Table 3, the Industry Weighted Average ROIC minus COC percentile within the sample over this period ranges from the 7th percentile to the 36th percentile. The median of the annual medians over this period for the Industry Weighted

Average is the 22nd percentile, and the average of the annual medians over this period is the 23rd percentile. The median of the annual medians over this period for the seven railroads range from the 13th percentile to the 35th percentile and the average of the annual medians over this period for the seven railroads range from the 13th percentile to the 31st percentile.

E. Railroads' Relative Financial Performance Based on the Adjusted ROIC and the Board's Definition of the Cost of Capital

73. In this section, we discuss the relative financial performance of the railroads based on the Adjusted STB ROIC and the industry cost of capital (COC). Recall that the difference between the STB ROIC and the Adjusted STB ROIC is (a) eliminating the effect of deferred income taxes in the Provision of Income Taxes in the Adjusted Net Railway Operating Income (STB ROIC numerator) and (b) eliminating the effect of Deferred Tax Liabilities and including the company's investments in non-goodwill intangible assets in the Tax Adjusted Net Investment Base (STB ROIC denominator). The results in Tables 4 through 6 in this section correspond to the results in Tables 1 through 3 in the preceding section except that the measure of financial performance is Adjusted STB ROIC minus the industry cost of capital (COC), i.e. Adjusted ROIC minus COC.

74. Table 4 below presents the results of this analysis comparing the financial performance of the railroads to the S&P 500 benchmarking group.⁷² As shown in the top panel of Table 4, the number of companies in the S&P 500 benchmarking group varies from 393 to 415. The median Adjusted ROIC minus COC for the S&P 500 benchmarking group range from 5% to 12% over the 2006 – 2019 period, and the median of the annual medians is 10% (average 9%). The 25th percentile of Adjusted ROIC minus COC for the S&P 500 benchmarking group ranges from -2%

⁷² See Exhibit 2 for the year-by-year results for the Industry Weighted Average and the seven railroads summarized in Table 4.

to 3% over the 2006 – 2019 period, and the median of the annual 25th percentile is 2% (average 2%). The percentage of companies in the S&P 500 benchmarking group that have a positive Adjusted ROIC minus COC ranges from 68% to 87% over the 2006 – 2019 period.

Table 4
S&P 500 Companies Excluding Railroads, Financial Institutions and Real Estate Companies

Number of Observations, Median, 25th Percentile, and % Positive ROIC minus COC Over 2006-2019 Period				
	Minimum	Maximum	Median	Average
Number of Observations in Sample	393	415	409	406
Median Adjusted ROIC minus COC	5%	12%	10%	9%
25th Percentile Adjusted ROIC minus COC	-2%	3%	2%	2%
% with ROIC minus COC > 0.0%	68%	87%	84%	83%
<u>Railroad Percentile in the Distribution of Adjusted ROIC minus COC</u>				
Industry Weighted Average ROIC	9	23	13	14
BNSF Railway	8	24	14	15
CSX Corporation	6	25	10	12
Grand Trunk Corporation	4	15	9	10
Kansas City Southern	5	20	10	11
Norfolk Southern Corporation	7	21	11	13
Soo Line Corporation	1	34	13	14
Union Pacific Corporation	8	34	17	19

Sources: Bloomberg; Compustat; Ibbotson Yearbook (2006-2019); STB Revenue Adequacy Determination Report (2006-2018); RevAd 2019 AAR workpaper1.pdf, titled "AAR Duplication of STB Workpapers."

75. As shown in the bottom panel of Table 4, the Industry Weighted Average Adjusted ROIC minus COC percentile within the S&P 500 benchmarking group over this period ranges from the 9th percentile to the 23rd percentile. The median of the annual medians of the over this period for the Industry Weighted Average is the 13th percentile, and the average of the annual medians over this period is the 14th percentile. For the seven railroads, the median of the annual medians over this period range from the 9th percentile to the 17th percentile, and the average of the annual medians over this period range from the 10th percentile to the 19th percentile.

76. Table 5 below presents the same type of analysis as that presented in Table 4 but for the S&P 500 Industrials Sector benchmarking group.⁷³ As shown in the top panel of Table 5, the number of observations in the S&P 500 Industrials Sector benchmarking group varies from 48 to 66. The median Adjusted ROIC minus COC for the S&P 500 Industrials Sector ranges from 5% to 15% over the 2006 – 2019 period, and the median of the annual medians is 13% (average 13%). The 25th percentile Adjusted ROIC minus COC for the S&P 500 Industrial Sector ranges from 1% to 9% over the 2006 – 2019 period, and the median of the annual 25th percentile is 7% (average 6%). The percentage of companies in the S&P 500 Industrial Sector benchmarking group that have a positive Adjusted ROIC minus COC ranges from 80% to 97% over the 2006 – 2019 period.

⁷³ See Exhibit 2 for the year-by-year results for the Industry Weighted Average and the seven railroads summarized in Table 5.

Table 5
S&P 500 Companies in the Industrials Sector Excluding Railroads

Number of Observations, Median, 25th Percentile, and % Positive ROIC minus COC Over 2006-2019 Period				
	Minimum	Maximum	Median	Average
Number of Observations in Sample	48	66	59	59
Median Adjusted ROIC minus COC	5%	15%	13%	13%
25th Percentile Adjusted ROIC minus COC	1%	9%	7%	6%
% with ROIC minus COC > 0.0%	80%	97%	93%	92%
<u>Railroad Percentile in the Distribution of Adjusted ROIC minus COC</u>				
Industry Weighted Average ROIC	2	13	7	7
BNSF Railway	2	16	6	7
CSX Corporation	2	13	5	6
Grand Trunk Corporation	2	11	4	5
Kansas City Southern	2	11	5	5
Norfolk Southern Corporation	2	13	5	6
Soo Line Corporation	2	19	6	7
Union Pacific Corporation	3	23	7	9

Sources: Bloomberg; Compustat; Ibbotson Yearbook (2006-2019); STB Revenue Adequacy Determination Report (2006-2018); RevAd 2019 AAR workpaper1.pdf, titled "AAR Duplication of STB Workpapers."

77. As shown in the bottom panel of Table 5, the Industry Weighted Average Adjusted ROIC minus COC percentile within the S&P 500 Industrials Sector benchmarking group over this period ranges from the 2nd percentile to the 13th percentile. The median of the annual medians of the over this period for the Industry Weighted Average is the 7th percentile, and the average of the annual medians over this period is the 7th percentile. For the seven railroads, the median of the annual medians over this period range from the 4th percentile to the 7th percentile, and the average of the annual medians over this period range from the 5th percentile to the 9th percentile.

78. Finally, Table 6 below presents the same type of analysis as presented in Tables 4 and 5 but for the S&P 500 Railroad Customers benchmarking group.⁷⁴ As shown in the top panel of Table 6, the number of observations in the S&P 500 Railroad Customers companies varies from 80 to 87. The median Adjusted ROIC minus COC for the S&P 500 Railroad Customers companies ranges from 0% to 9% over the 2006 – 2019 period, and the median of the annual medians is 5% (average 5%). The 25th percentile Adjusted ROIC minus COC for the S&P 500 Railroad Customers companies ranges from -5% to 2% over the 2006 – 2019 period, and the median of the annual 25th percentile is 0% (average 0%). The percentage of the S&P 500 Railroad Customers companies that have a positive Adjusted ROIC minus COC ranges from 52% to 84% over the 2006 – 2019 period.

⁷⁴ See Exhibit 2 for the year-by-year results for the Industry Weighted Average and the seven railroads summarized in Table 6.

Table 6
Railroad Customer Sample of S&P 500 Companies

Number of Observations, Median, 25th Percentile, and % Positive ROIC minus COC Over 2006-2019 Period				
	Minimum	Maximum	Median	Average
Number of Observations in Sample	80	87	84	83
Median Adjusted ROIC minus COC	0%	9%	5%	5%
25th Percentile Adjusted ROIC minus COC	-5%	2%	0%	0%
% with ROIC minus COC > 0.0%	52%	84%	78%	76%
Railroad Percentile in the Distribution of Adjusted ROIC minus COC				
Industry Weighted Average ROIC	7	39	18	21
BNSF Railway	7	36	20	22
CSX Corporation	6	39	16	18
Grand Trunk Corporation	5	29	14	15
Kansas City Southern	6	31	15	16
Norfolk Southern Corporation	11	33	16	18
Soo Line Corporation	6	39	19	21
Union Pacific Corporation	7	49	26	29

Sources: Bloomberg; Compustat; Ibbotson Yearbook (2006-2019); STB Revenue Adequacy Determination Report (2006-2018); RevAd 2019 AAR workpaper1.pdf, titled "AAR Duplication of STB Workpapers."

79. As shown in the bottom panel of Table 6, the Industry Weighted Average Adjusted ROIC minus COC percentile within the sample over this period ranges from the 7th percentile to the 39th percentile. The median of the annual medians over this period for the Industry Weighted Average is the 18th percentile, and the average of the annual medians over this period is the 21st percentile. The median of the annual medians over this period for the seven railroads range from the 14th percentile to the 26th percentile and the average of the annual medians over this period for the seven railroads range from the 15th percentile to the 29th percentile.

F. Summary and Conclusions

80. In this section, we analyzed the two measures of the railroads' financial performance (ROIC minus COC and Adjusted ROIC minus COC) and compared them to the financial performance of three benchmarking groups. We summarize these results in Table 7.⁷⁵

Table 7
Summary of the Analysis of the Railroads' Relative Financial Performance

Panel A: Benchmarking Groups' Median Statistics Across Years (2006 through 2019)						
	STB ROIC minus STB COC			Adjusted STB ROIC minus STB COC		
	S&P 500¹	Industrials²	Customers³	S&P 500¹	Industrials²	Customers³
Number of Observations in Sample	395	56	84	409	59	84
Median ROIC minus COC	19%	23%	9%	10%	13%	5%
25th Percentile ROIC minus COC	5%	13%	2%	2%	7%	0%
% with ROIC minus COC > 0.0%	89%	96%	83%	84%	93%	78%
Panel B: Railroads' Median of the Annual Percentiles Across Years (2006 through 2019)						
	STB ROIC minus STB COC			Adjusted STB ROIC minus STB COC		
	S&P 500¹	Industrials²	Customers³	S&P 500¹	Industrials²	Customers³
Industry Weighted Average ROIC	13	7	22	13	7	18
BNSF Railway	15	7	24	14	6	20
CSX Corporation	10	5	16	10	5	16
Grand Trunk Corporation	10	5	14	9	4	14
Kansas City Southern	8	4	13	10	5	15
Norfolk Southern Corporation	13	8	20	11	5	16
Soo Line Corporation	13	6	19	13	6	19
Union Pacific Corporation	22	9	35	17	7	26

Notes:

1 S&P 500 companies excluding Railroads, Financial Institutions and Real Estate Companies

2 S&P 500 companies in the Industrials Sector excluding Railroads

3 Railroad customer sample of S&P 500 companies

Sources: Bloomberg; Compustat; Ibbotson Yearbook (2006-2019); STB Revenue Adequacy Determination Report (2006-2018); RevAd 2019 AAR workpaper1 pdf, titled "AAR Duplication of STB Workpapers "

81. All of the analyses show that the relative financial performance of the railroad industry falls within the bottom quartile of the three benchmarking groups. Thus, the benchmarking analyses we conducted show that financial performance of the railroad industry and the seven

⁷⁵ Table 7 summarizes the result shown in Tables 1 through 6 for the median ROIC minus COC and median Adjusted ROIC minus COC.

railroads was well below the financial performance of companies operating in competitive (unregulated) markets.

V. SUMMARY AND RECOMMENDATIONS

82. Economic research has shown that the limitations and inaccuracies of accounting-based rates of return make it difficult, and some say impossible, to draw any inferences about economic rates of return based on accounting rates of return. To the extent it is necessary to use accounting rates of return in comparison to the cost of capital to assess financial performance, using the proposed benchmarking methodology mitigates the limitations and inaccuracies of accounting rates of return as estimates of the cost of capital.

83. Our benchmarking analyses show that the financial performance of the railroad industry as a whole and each of the seven railroads was well below the financial performance of companies operating in competitive (unregulated) markets over the 2006-2019 period. Specifically, using two alternative measures of financial performance and three benchmarking groups, we find that, over this period, the financial performance of the railroad industry and the seven railroads fell well below the median and mostly in the bottom quartile of the financial performance of all three benchmarking groups.

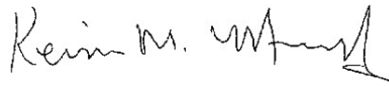
84. If in the future ROIC minus COC exceeds the median for the benchmarking group, then we recommend that the Board should first investigate whether the railroads are above the median for procompetitive reasons – greater efficiency, benefits from risky investments, increases in demand that exceeded expected etc. If, after such investigation, the Board can rule out such procompetitive reasons, and the Board concludes that there is a basis for concern that there is a lack of competition in serving some shippers or some geographic areas, the Board should look to

use its existing tools more effectively and perhaps to make it easier for shippers to challenge specific rates where there may be noncompetitive pricing.

85. In order to avoid penalizing especially efficient railroads and introducing distortions in competition among railroads that would occur if one railroad were subject to additional regulation not imposed on others, the Board should look at the railroad industry as a whole in evaluating whether there is a basis for considering additional regulation in response to potential lack of competition. If the Board determines that such regulation is warranted, it should be imposed on the entire industry, and not just on individual railroads.

VERIFICATION

I, Kevin M. Murphy, declare under penalty of perjury that the foregoing is true and correct. Further, I certify that I am qualified and authorized to file this Verified Statement.

A handwritten signature in black ink that reads "Kevin M. Murphy". The signature is written in a cursive style with a large, stylized 'K' and 'M'.

Kevin M. Murphy

I, Mark E. Zmijewski, declare under penalty of perjury that the foregoing is true and correct. Further, I certify that I am qualified and authorized to file this Verified Statement.

A handwritten signature in black ink that reads "Mark E. Zmijewski". The signature is written in a cursive style with a large, stylized 'M' and 'Z'.

Mark E. Zmijewski

APPENDIX A

SAMPLES, DEFINITIONS, AND DATA SOURCES

A-1. In this Appendix, we describe the calculation methodology and data sources used in the analysis of railroads' financial performance and the railroads' financial performance relative to the financial performance of three benchmarking samples: (a) S&P 500 companies excluding railroads, financial institutions, and real estate companies;⁷⁶ (b) S&P 500 Industrials Sector excluding railroads, the industry sector to which railroads belong;⁷⁷ and (c) customers of CN, NS, and/or UP in the S&P 500 that account for at least \$1 million of combined revenue in 2018.⁷⁸ We analyze the period from 2006 through 2019. Exhibit A1 presents a list of the S&P 500 companies for each year in the analysis. As shown in this exhibit, because the S&P 500 has turnover in its membership, the S&P 500 includes 795 companies during 2006 through 2019 period.⁷⁹ If a company is a member of the S&P 500 on December 31 in a given year, that year is marked with 1 and is 0 otherwise. The companies marked with an asterisk next right to the company's ticker are financial institutions or real estate companies, which we exclude from our

⁷⁶ The S&P 500 stock market index, maintained by S&P Dow Jones Indices, comprises 505 common stocks issued by 500 large-cap companies and traded on American stock exchanges. S&P U.S. Indices Methodology Update, January 21, 2015.

⁷⁷ Industry Sectors are based on the Global Industry Classification Standard ("GICS"). GICS "was developed by S&P Dow Jones Indices, ..., and MSCI. ... The GICS structure consists of 11 Sectors, 24 Industry groups, 69 Industries and 158 sub-industries." The railroads are included in the Industrial Sector 20. GICS® Global Industry Classification Standard accessed on November 10, 2019 at https://www.spglobal.com/marketintelligence/en/documents/112727-gics-mapbook_2018_v3_letter_digitalspreads.pdf

⁷⁸ We were provided with a list of S&P 500 customers from CN, NS, and UP. The customer companies with a combined 2018 revenue greater than \$1 million are selected as S&P 500 customers for ranking.

⁷⁹ Only 273 companies (34%) were members of the S&P 500 in every year from 2006 through 2019. 162 companies (34%) were members of the S&P 500 for nine to thirteen years, 135 companies (17%) were members of the S&P 500 for five to eight years, and 225 companies (28%) were members of the S&P 500 for one to four years.

analyses because financial institutions and real estate companies have substantially different capital structures, assets, and business models than other companies in the S&P 500.

A-2. The Surface Transportation Board's (STB) measure of financial performance used in the STB's Annual Revenue Adequacy Determinations⁸⁰ compares a company's accounting-based (or financial statement-based) rate of return on invested capital (ROIC) to that company's industry economic cost of capital (COC);⁸¹ more specifically, it determines whether ROIC minus COC is negative or positive. In our analyses, we calculate each railroad's financial performance (measured by ROIC minus COC) relative to the financial performance (measured by ROIC minus COC) of the benchmarking samples by calculating each railroad's percentile in the distribution of the benchmarking samples. In addition, we calculate the financial performance of the railroad industry, using weighted average ROIC minus COC (Industry Weighted Average), and calculate the relative financial performance of the railroad industry as a whole in the same manner.

A-3. Naturally, a company's ROIC minus COC requires the calculation of that company's ROIC and industry cost of capital. ROIC does not have a single generally accepted or standard definition. The STB has developed a specific definition for ROIC to calculate the financial performance of the railroads; thus, we adopt the STB definition for ROIC ("STB ROIC"). We also use an alternative definition of ROIC ("Adjusted STB ROIC"), which we believe is a more

⁸⁰ See, for example, Surface Transportation Board, Railroad Adequacy – 2018 Determination, Docket No. EP 552 (Sub-No. 23), September 5, 2019 ("STB 2018 Revenue Adequacy Determination").

⁸¹ "Pursuant to those procedures, which are essentially mechanical, a railroad is considered revenue adequate under 49 U.S.C. § 10704(a) if it achieves a rate of return on net investment (ROI) equal to at least the current cost of capital for the railroad industry." Surface Transportation Board, Railroad Revenue Adequacy – 2018 Determination, September 5, 2019.

useful measure of accounting-based financial performance for assessing the financial performance of the railroads based on ROIC minus COC.

A. Return on Invested Capital (ROIC) – STB definition

A-4. The STB’s Annual Revenue Adequacy Determinations⁸² define ROIC as follows:⁸³

$$\text{STB ROIC} = \frac{\text{Adjusted Net Railway Operating Income}}{\text{Tax Adjusted Net Investment Base}}$$

where adjusted Net Railway Operating Income is defined as:

$$\begin{aligned} & \text{Consolidated Net Railway Operating Income} \\ & + \text{Interest Income from Working Capital Allowance – Cash Portion} \\ & + \text{Income Taxes Associated with Non-Rail Income and Deductions} \\ & + \text{Gain or (Loss) from Transfer/Reclassification to Nonrail-Status (Net of Income Taxes)} \\ & = \text{Adjusted Net Railway Operating Income} \end{aligned}$$

⁸² See, for example, STB 2018 Revenue Adequacy Determination, Appendix B.

⁸³ For 2017, the STB adjusted this formula because the decrease in the federal income tax rate (2017 Tax Cut and Jobs Creation Act) resulted in a revaluation of deferred income taxes on the balance sheet (companies, like the railroads, with a net deferred tax liability position on their balance sheet recorded a reduction of that liability, which decreased the provision for income taxes and thus, increased income, in that year). The adjustment had the effect of essentially eliminating this reduction in income tax. “By decision served on July 27, 2018, the Board explained that its revenue adequacy determination, among other calculations for 2017, would be affected by the carriers’ revaluation of their deferred tax liabilities as a result of the Tax Cuts and Jobs Act. R.R. Revenue Adequacy—2017 Determination... The Board adopted this proposal in Railroad Revenue Adequacy—2017 Determination, EP 552 (Sub-No. 22) et al., slip op. at 6-9 (STB served Dec. 6, 2018), and, consistent with that decision, the revenue adequacy determination here reflects the adjustments made in the carriers’ Schedule 250 filings,” STB 2017 Revenue Adequacy Determination, December 21, 2018, footnote 2.

and where Tax Adjusted Net Investment Base is defined as:⁸⁴

$$\begin{aligned} & \text{Combined Investment in Railroad Property Used in Transportation Service} \\ & - \text{Interest During Construction} \\ & - \text{Other Elements of Investment} \\ & + \text{Net Rail Assets of Rail Related Affiliates} \\ & + \text{Working Capital Allowance}^{85} \\ & - \text{Accumulated Deferred Income Tax Credits} \\ \hline & = \text{Tax Adjusted Net Investment Base} \end{aligned}$$

A-5. For the railroads, we use the same data sources and measurement of the inputs for the calculation of railroads' ROIC as those in the STB's Revenue Adequacy Determinations; thus, our railroad ROICs are numerically identical to those reported in the STB Revenue Adequacy Determinations for all years in the analysis from 2006 through 2019.⁸⁶ The data source used to measure ROIC for the S&P 500 companies is Compustat,⁸⁷ which is publicly available and widely used in peer reviewed academic studies. For S&P 500 companies, Adjusted Net Railway Operating Income is equal to operating income ("Earnings Before Interest and Taxes" ("EBIT")) minus income taxes ("Income Tax Provision") plus marginal income tax on non-operating

⁸⁴ The Tax Adjusted Net Investment Base is calculated using the average of the beginning (end of prior year) and ending (end of current year) balances for each year.

⁸⁵ The STB defines the Working Capital Allowance as the lesser Cash Working Capital Required and Cash and Temporary Cash Balance. Cash Working Capital Required is defined as Days of Working Capital Required (Days of Operating Revenue in Current Operating Assets + 15 days - Days of Operating Expenses in Current Operating Liabilities) multiplied by Average Daily Expenditures.

⁸⁶ STB 2006 Revenue Adequacy Determination, May 6, 2008; STB 2007 Revenue Adequacy Determination, September 26, 2008; STB 2008 Revenue Adequacy Determination, October 26, 2009; STB 2009 Revenue Adequacy Determination, November 10, 2010; STB 2010 Revenue Adequacy Determination, January 2, 2014; STB 2011 Revenue Adequacy Determination, January 2, 2014; STB 2012 Revenue Adequacy Determination, January 2, 2014; STB 2013 Revenue Adequacy Determination, September 2, 2014; STB 2014 Revenue Adequacy Determination, September 8, 2015; STB 2015 Revenue Adequacy Determination, September 8, 2016; STB 2016 Revenue Adequacy Determination, September 6, 2017; STB 2017 Revenue Adequacy Determination, December 21, 2018; STB 2018 Revenue Adequacy Determination, September 5, 2019; 2019 Revenue Adequacy Workpapers, May 1, 2020 (document titled "AAR Duplication of STB Workpapers," RevAd 2019 AAR workpaper1.pdf).

⁸⁷ Compustat is a "comprehensive database with standardized, historical and point-in-time data, with flexible delivery options to power your quantitative research and analysis... [with] history back to the 1950s, and extended interim history back to 1962." Source: https://www.spglobal.com/marketintelligence/en/documents/compustat-brochure_digital.pdf.

income (expense). Tax Adjusted Net Investment Base for the S&P 500 companies is equal to Net Property, Plant & Equipment (“PPE”) plus Inventory plus Working Capital Allowance⁸⁸ minus Accumulated Deferred Income Tax Credits.⁸⁹ The formula for measuring ROIC using Compustat data is as follows:⁹⁰

$$ROIC = \frac{ebit - txt + \tau * nopi}{Average(ppent + invt + Min(Max(\frac{rectr}{revt} * 360 + 15) - \frac{ap}{xopr - dp} * 360, 0) * \frac{xopr - dp}{360}, che) - txndbl)}$$

where:

- Compustat mnemonic (ebit) = Earnings Before Interest and Taxes
- Compustat mnemonic (txt) = Income Taxes – Total
- Compustat mnemonic (nopi) = Non-Operating Income (Expense)
- τ = Marginal Tax Rate; 37.5% (2006-2017) and 24% (2018-2019)
- Compustat mnemonic (ppent) = Property, Plant and Equipment - Total (Net)⁹¹
- Compustat mnemonic (invt) = Inventories – Total⁹²
- Compustat mnemonic (rectr) = Receivables – Trade
- Compustat mnemonic (revt) = Revenue – Total
- Compustat mnemonic (ap) = Accounts Payable – Trade
- Compustat mnemonic (xopr) = Operating Expenses – Total
- Compustat mnemonic (dp) = Depreciation and Amortization, and
- Compustat mnemonic (che) = Cash and Short-Term Investments
- Compustat mnemonic (txndbl) = Net Deferred Tax Liability.⁹³

⁸⁸ To calculate Working Capital Allowance, we followed the methodology outlined in Schedule 245 to the railroads’ Class I Railroad Annual Report R-1.

⁸⁹ We calculated Tax Adjusted Net Investment Base using the average of the beginning (end of prior year) and ending (end of current year) balances for each year.

⁹⁰ If the average Tax Adjusted Net Investment Base is non-positive, STB ROIC is set to be empty for that observation. If Earnings Before Interest and Taxes (EBIT) is missing from Compustat’s data pull, STB ROIC is set to be empty. For example, EBITs are missing for Commerce Bancorp (ticker: CBH.1) in 2006 and 2007, so the STB ROICs are set to empty for Commerce Bancorp for both years.

⁹¹ If the data point is missing from Compustat’s data pull, it is set to zero.

⁹² If the data point is missing from Compustat’s data pull, it is set to zero.

⁹³ If the data point is missing from Compustat’s data pull, it is set to zero.

B. Return on Invested Capital (ROIC) – Adjusted STB ROIC Definition

A-6. Also, we propose and analyze an adjusted STB definition of ROIC, which we believe is a more appropriate ROIC measure to use when comparing a company's accounting-based ROIC to its economic cost of capital. The definition of Adjusted STB ROIC makes one adjustment to the STB definition of Adjusted Net Railway Operating Income (i.e. to the STB ROIC numerator) and two adjustments to the STB definition of Tax Adjusted Net Investment Base (i.e. to the STB ROIC denominator). The adjustment to the STB definition of Adjusted Net Railway Operating Income (STB ROIC numerator) is eliminating the effect of deferred income taxes in the Provision of Income Taxes. The two adjustments to the STB definition of Tax Adjusted Net Investment Base (STB ROIC denominator) are: (a) eliminating the effect of Deferred Tax Liabilities in the calculation of the Net Investment Base; and (b) including the company's investments in non-goodwill intangible assets. The resulting formula for Adjusted STB ROIC is:⁹⁴

$$\text{Adjusted STB ROIC} = \frac{\text{Adjusted Net Railway Operating Income} + \text{Deferred Tax Expense}}{\text{Tax Adjusted Net Investment Base} + \text{Deferred Tax Liabilities} + \text{Non-Goodwill Intangible Assets}}$$

Stated in terms of Compustat data items, the resulting formula for Adjusted STB ROIC is:⁹⁵

$$\text{Adjusted STB ROIC} = \frac{ebit - txt + \tau * nopi + txdi}{\text{Average} \left(ppent + invt + \text{Min} \left(\text{Max} \left(\left(\frac{rectr}{revt} * 360 + 15 \right) - \frac{ap}{xopr - dp} * 360, 0 \right) * \frac{xopr - dp}{360}, che \right) - txndbl + txndbl + intano \right)}$$

where:

⁹⁴ Adding Deferred Tax Liabilities to the denominator of the Adjusted STB ROIC has the effect of eliminating the deduction of Deferred Tax Liabilities used in the STB definition of ROIC.

⁹⁵ If the average denominator for Adjusted STB ROIC is non-positive, Adjusted STB ROIC is set to be empty for that observation. If Earnings Before Interest and Taxes (EBIT) is missing from Compustat's data pull, Adjusted STB ROIC is set to be empty.

Compustat mnemonic (txdi) = Income Taxes - Deferred⁹⁶

Compustat mnemonic (intano) = Other Intangibles⁹⁷

All other Compustat data items are as defined previously.

A-7. One of these adjustments, i.e. adding the company's investments in non-goodwill intangible assets in the calculation of the STB definition of Tax Adjusted Net Investment Base, has no meaningful effect on the railroads' ROICs, and thus, no meaningful effect on the ROIC minus COC measure of financial performance used by the STB. This adjustment has no meaningful effect on railroads' ROICs because railroads do not have substantial investments in non-goodwill intangible assets. However, this adjustment can have a meaningful effect on the ROIC of other S&P 500 companies who have substantial investments in non-goodwill intangible assets.⁹⁸

A-8. Because none of the railroads have meaningful non-goodwill intangible assets, this adjustment has no effect for assessing the financial performance of the railroads, but it has a substantial effect for assessing the financial performance of the railroads relative to other companies that may have substantial non-goodwill intangible assets.

C. Industry Weighted Average Return on Invested Capital (ROIC)

A-9. In addition to analyzing the ROIC minus COC for each of the railroads, we also analyze ROIC minus COC based on an Industry Weighted Average ROIC. We calculate the Industry

⁹⁶ If Income Taxes – Deferred is missing from Compustat's data pull, Income Taxes – Deferred is calculated as Income Taxes – Total minus Income Taxes – Current. However, if either Income Taxes – Total or Income Taxes – Current is also missing, Income Taxes – Deferred is set to zero.

⁹⁷ If the data point is missing from Compustat's data pull, it is set to zero.

⁹⁸ Examples of non-goodwill intangible assets include assets such as patents, copyrights, trademarks, computer software, licenses, films, and import quotas. Accounting rules generally require companies to expense – as opposed to capitalize – expenditures that result in such assets but require companies to record the value of non-goodwill intangible assets when they acquire another company.

Weighted Average ROIC as the weighted average ROIC of the seven railroads listed in the STB Revenue Adequacy Determinations.⁹⁹

A-10. We use the STB definition of the cost of capital to measure the cost of capital for the railroads and companies in the S&P 500. The STB outlines its cost of capital methodology in the STB's Railroad Cost of Capital Decisions:¹⁰⁰

$$\begin{aligned} & \text{Industry Cost of Debt} \quad \quad \quad \times \text{Industry Debt Weight} \\ & + \text{Industry Cost of Preferred Equity} \times \text{Industry Preferred Equity Weight} \\ & + \text{Industry Cost of Common Equity} \times \text{Industry Common Equity Weight} \\ & = \text{Industry Cost of Capital} \end{aligned}$$

where Industry Cost of Debt, Industry Cost of Preferred Equity, and Industry Cost of Common Equity, as well as their respective weights, are determined based on individual railroads' accounting and market data. In the following paragraphs, we provide further details on how STB measures each component of the Industry Cost of Capital.

⁹⁹ In mathematical terms, we define the Industry Weighted Average ROIC in each year equal to the sum of the seven railroads' STB ROIC numerators divided by the sum of the seven railroads' STB ROIC denominators using the reported ROIC components in the STB Revenue Adequacy Determinations. For example, based on the STB 2018 Revenue Adequacy Determination, Appendix B, the 2018 Industry Weighted Average ROIC is 12.70% = $(5,859,642 + 3,124,995 + 820,915 + 364,179 + 2,774,609 + 472,522 + 6,383,168) / (49,292,436 + 23,714,297 + 10,668,213 + 4,535,569 + 23,850,288 + 3,503,522 + 40,396,642)$, where \$5,859,642, \$3,124,995, \$820,915, \$364,179, \$2,774,609, \$472,522, and \$6,383,168 refer to the 2018 Adjusted Net Railway Operating Income (in USD thousand) for BNSF Railway, CSX Corporation, Grand Trunk Corporation, Kansas City Southern, Norfolk Southern Corporation, Soo Line Corporation, and Union Pacific Corporation, respectively; and where \$49,292,436, \$23,714,297, \$10,668,213, \$4,535,569, \$23,850,288, \$3,503,522, and \$40,396,642 refer to the 2018 Tax Adjusted Net Investment Base (in USD thousand) for BNSF Railway, CSX Corporation, Grand Trunk Corporation, Kansas City Southern, Norfolk Southern Corporation, Soo Line Corporation, and Union Pacific Corporation, respectively.

¹⁰⁰ See, for example, Surface Transportation Board Decision, Railroad Cost of Capital – 2018, Docket No. EP 558 (Sub-No. 22), August 6, 2019 (“STB 2018 Cost of Capital Decision”). To estimate the railroad cost of capital, STB relies on inputs from the Association of American Railroads (“AAR”) who “calculated the cost of capital for a ‘composite railroad’ based on criteria developed in the Railroad Cost of Capital – 1984, 1 I.C.C.2d 989 (1985),” STB 2008 Cost of Capital Decision, p. 2.

A-11. The STB measures the Industry Cost of Debt based on individual railroads' cost of bonds and cost of equipment trust certificates ("ETCs").¹⁰¹ The cost of bonds is the market value weighted average yield of the publicly traded bonds of all railroads. The cost of ETCs is the market value weighted average yield of the railroads ETCs.¹⁰² In calculating the cost of bonds and cost of ETCs, the STB also considers the flotation cost¹⁰³ associated with the issuance of such securities and adds the flotation costs to the respective estimates of the costs of bonds and ETCs. The market value weighted average of cost of bonds and cost of ETC is the Industry Cost of Debt. The STB measures Debt Weight based on railroads' combined market values of debt, common equity, and preferred equity.

A-12. The STB measures the Cost of Preferred Equity as the market value weighted average of the dividend yields (dividend divided by market price of preferred stock) for the preferred stock of the individual railroads.¹⁰⁴ The STB measures the Preferred Equity Weight based on railroads' combined market values of debt, common equity, and preferred equity.

¹⁰¹ ETC is "a debt instrument that allows a company to take possession of and enjoy the use of an asset while paying for it over time. The debt issue is secured by the equipment or physical asset. During this time, the title for the equipment is held in trust for the holders of the issue." See, <https://www.investopedia.com/terms/e/equipmenttrustcertificate.asp>. In addition to the cost of bonds and cost of ETCs, the STB also considers the cost of (i) conditional sales agreements and (ii) capitalized leases and miscellaneous debt, however, these debt instruments either have minimal value or are not publicly traded, so they have insignificant effect on the Industry Cost of Debt calculations.

¹⁰² ETCs are not actively traded on the secondary markets and their yield and market values are estimated by adding a spread to the yield of other securities that are actively traded such as government securities with similar maturity.

¹⁰³ "Flotation costs are incurred by a publicly traded company when it issues new securities, and includes expenses such as underwriting fees, legal fees and registration fees." See, <https://www.investopedia.com/terms/f/flotationcost.asp>. The calculation of flotation cost is based on the difference in yields between a new issue with flotation cost and an issues without flotation cost. For more details see, for example, STB 2018 Cost of Capital Decision, p. 6 and Table 7.

¹⁰⁴ See, for example, STB 2018 Cost of Capital Decision, p. 11 and Table 13.

A-13. The STB measures the Cost of Common Equity by equally weighting a Capital Asset Pricing Model-based (“CAPM”) and a Multi-Stage Discounted Cash Flow Model-based (“MSDCF”) equity cost of capital. The STB measures the Common Equity Weight based on railroads’ combined market values of debt, common equity, and preferred equity.

A-14. The CAPM has three inputs: beta, risk-free rate, and market risk premium. The STB measures an industry beta by regressing five years of merger-adjusted weekly returns of the portfolio of all publicly traded railroads over the weekly returns of the S&P 500 Index.¹⁰⁵ The STB measures the risk-free rate based on the average yield to maturity for a 20-year U.S. Treasury Bond.¹⁰⁶ The STB measures the market risk premium based on the Ibbotson/Duff & Phelps Cost of Capital Valuation Handbook.¹⁰⁷ The CAPM equity cost of capital for the railroad industry is calculated as the risk-free rate plus the industry beta times the market risk premium.

A-15. The STB measures the MSDCF equity cost of capital using accounting and market data for the publicly traded railroads and the following methodology. Step one – create a cash flow

¹⁰⁵ See, for example, STB 2018 Cost of Capital Decision, p.8 and Table 9.

¹⁰⁶ See, for example, STB 2018 Cost of Capital Decision, p.7.

¹⁰⁷ See, for example, STB 2018 Cost of Capital Decision, pp. 7-8, “The Ibbotson SBBI Classic Yearbook, published by Morningstar, which was previously used as the source of the market risk premium for 2013 and 2014, has been discontinued. AAR replaced the former source with the Duff & Phelps’ Valuation Handbook—U.S. Guide to Cost of Capital, as the source of the market risk premium for 2015 and 2016. However, in 2018, Duff & Phelps discontinued the publication of that book in hardcover form and replaced it with an online tool called the Cost of Capital Navigator. According to AAR, the Cost of Capital Navigator uses the same method as Ibbotson and provides the same data reflecting the market-risk premium.”

forecast for each railroad using historical accounting data¹⁰⁸ and expected growth rates.¹⁰⁹ Step two – calculate each railroad’s discount rate by equating that railroad’s observed market value with the present value of its future cash flows from step one. Step three – calculate a market value weighted average of the discount rates determined in step two. The resulting estimate is the MSDCF equity cost of capital for the railroad industry.

A-16. Our data sources and measurement of the inputs for the cost of capital of the railroads are the same as those in the STB’s Cost of Capital Decisions.¹¹⁰ Thus, our cost of capital estimates

¹⁰⁸ See, for example, STB 2018 Cost of Capital Decision, pp. 9-10 and Table 11. The cash flow (“CF”) is defined as income before extraordinary items (“IBEI”), minus capital expenditures (“CAPEX”), plus depreciation (“DEP”) and deferred taxes (“DT”). That is, $CF = IBEI - CAPEX + DEP + DT$. The MSDCF model assumes three stages. Cash flows are projected using different growth rates in each stage, however, all cash flows are derived starting with a base cash flow (“Base CF”) in the current year. The Base CF is the product of the CF ratio and the revenue for the current year, i.e. year zero. The CF ratio is measured by the ratio of the last five years of historical CF divided by the last five years of historical revenue. The cash flow projections are constructed as follows. In the first stage, years 1 to 5, the cash flows are calculated using Base CF and stage-one growth rate (“g-rate_1”). The estimated cash flows for years 1 to 5 are $Base\ CF \cdot (1+g\text{-}rate_1)$, $Base\ CF \cdot (1+g\text{-}rate_1)^2$, $Base\ CF \cdot (1+g\text{-}rate_1)^3$, $Base\ CF \cdot (1+g\text{-}rate_1)^4$, and $Base\ CF \cdot (1+g\text{-}rate_1)^5$, respectively. In the second stage, years 6 to 10, the cash flows are assumed to continue to grow at stage-two growth rate (“g-rate_2”). The estimated cash flows for years 6 to 10 are $Base\ CF \cdot (1+g\text{-}rate_1)^5 \cdot (1+g\text{-}rate_2)$, $Base\ CF \cdot (1+g\text{-}rate_1)^5 \cdot (1+g\text{-}rate_2)^2$, $Base\ CF \cdot (1+g\text{-}rate_1)^5 \cdot (1+g\text{-}rate_2)^3$, $Base\ CF \cdot (1+g\text{-}rate_1)^5 \cdot (1+g\text{-}rate_2)^4$, and $Base\ CF \cdot (1+g\text{-}rate_1)^5 \cdot (1+g\text{-}rate_2)^5$, respectively. Finally, in the third stage, years 11 and beyond, the cash flows are assumed to grow indefinitely at a constant rate (“g-rate_3”). The cash flow for year 11 is $Base\ CF \cdot (1+g\text{-}rate_1)^5 \cdot (1+g\text{-}rate_2)^5 \cdot (1+g\text{-}rate_3)$. The cash flow in year 11 is used to calculate the terminal value for each railroad.

¹⁰⁹ See, for example, STB 2018 Cost of Capital Decision, pp. 9-10 and Table 11. The MSDCF model assumes three stages with a different growth rate in each stage. The stage-one growth rate, g-rate_1, is railroad-specific and is based on earnings per share (“EPS”) forecasts. G-rate_1 is measured using the median of the long-term (three- to five-year) EPS growth rate forecasts published by the financial analysts following each publicly traded railroad. The source for g-rate_1 is the Institutional Brokers Estimate System (“I/B/E/S”). The stage-two growth rate, g-rate_2, is the same for all railroads and is calculated as the average of the individual stage-one growth rates. The stage-three growth rate, g-rate_3, is estimated based on the sum of the long-run historical growth in real Gross Domestic Product (“GDP”) and the long-run expected inflation.

¹¹⁰ STB 2006 Cost of Capital Decision, STB 2007 Cost of Capital Decision, STB 2008 Cost of Capital Decision, STB 2009 Cost of Capital Decision, STB 2010 Cost of Capital Decision, STB 2011 Cost of Capital Decision, STB 2012 Cost of Capital Decision, STB 2013 Cost of Capital Decision, STB 2014 Cost of Capital Decision, STB 2015 Cost of Capital Decision, STB 2016 Cost of Capital Decision, STB 2017 Cost of Capital Decision, and STB 2018 Cost of Capital Decision.

for the railroad industry are numerically identical to those reported by STB in all years from 2006 to 2019.¹¹¹

A-17. We measure the industry cost of capital for the S&P 500 companies for each two-digit Standard Industry Classification (“SIC”) code.¹¹² The data source used to measure the industry cost of capital for the S&P 500 companies is Ibbotson/Duff & Phelps Cost of Capital yearbooks,¹¹³ all of which are publicly available and widely used in such analyses and in peer reviewed academic studies.

A-18. The Industry Cost of Debt for the S&P 500 companies is measured using the cost of debt as reported in the Ibbotson/Duff & Phelps Cost of Capital yearbooks.¹¹⁴ The Debt Weight is measured by the Debt to Total Capital ratio as reported in the Ibbotson/Duff & Phelps Cost of

¹¹¹ 2019 STB Cost of Capital is used from 2019 Revenue Adequacy Workpapers, May 1, 2020 (document titled “AAR Duplication of STB Workpapers,” RevAd 2019 AAR workpaper1.pdf), which is based on the R1 submissions by the carriers and the AAR cost-of-capital submission.

¹¹² “The Standard Industrial Classification Codes that appear in a company’s disseminated EDGAR filings indicate the company’s type of business. These codes are also used in the Division of Corporation Finance as a basis for assigning review responsibility for the company’s filings.” U.S. Security and Exchange Commission website, accessed on November 16, 2019 at <https://www.sec.gov/info/edgar/siccodes.htm>.

¹¹³ Ibbotson Cost of Capital 2006 Yearbook, Ibbotson Cost of Capital 2007 Yearbook, Ibbotson Cost of Capital 2008 Yearbook, Ibbotson Cost of Capital 2009 Yearbook, Ibbotson Cost of Capital 2010 Yearbook, Ibbotson Cost of Capital 2011 Yearbook, Ibbotson Cost of Capital 2012 Yearbook, Ibbotson Cost of Capital 2013 Yearbook, Duff & Phelps 2014 Valuation Handbook – U.S. Industry Cost of Capital, Duff & Phelps 2015 Valuation Handbook – U.S. Industry Cost of Capital, Duff & Phelps 2016 Valuation Handbook – U.S. Industry Cost of Capital, Duff & Phelps 2017 Valuation Handbook – U.S. Industry Cost of Capital, and Duff & Phelps 2018 Valuation Handbook – U.S. Industry Cost of Capital, Duff & Phelps Cost of Capital Navigator, U.S. Industry Benchmarking Module, costofcapital.duffandphelps.com, collectively (“Ibbotson/Duff & Phelps Cost of Capital”) yearbooks. The industry data in the cost of capital yearbooks are reported at different levels of aggregation for an industry (one-, two-, three-, and four-digit SIC code levels) and within that industry (median, SIC composite, large composite, and small composite). All inputs from the cost of capital yearbooks we use in our analyses are based on two-digit SIC code industry level and SIC composite data aggregation level.

¹¹⁴ The Industry Cost of Debt was first published as a standalone reported item in 2011. For years 2006-2010, we calculate the Industry Cost of Debt in a year by adding the 2011 figure to the difference in the spread of a 10-year BBB corporate bond between 2011 and that year. For example, Ibbotson Cost of Capital 2011 Yearbook reports cost of debt of 4.63% for the two-digit SIC code 27. The average spread over the risk-free rate of a 10-year BBB corporate bond, as reported by Bloomberg, was 2.07% in 2011 and 3.27% in 2008. Thus, for 2008, we estimate the cost of debt for SIC code 27 at 5.83% (= 4.63% + 3.27% - 2.07%).

Capital yearbooks. Both the Industry Cost of Debt and Debt Weight are measured at the two-digit SIC code level.¹¹⁵

A-19. The Industry Cost of Common Equity for the S&P 500 companies is calculated by equally weighing the common equity cost estimates based on the CAPM and MSDCF methods¹¹⁶ as reported in the Ibbotson/Duff & Phelps Cost of Capital yearbooks. We calculate the Common Equity Weight as one minus Debt Weight.¹¹⁷ Both Industry Cost of Common Equity and Common Equity Weight are calculated at the two-digit SIC code level.¹¹⁸

A-20. As discussed earlier, the CAPM has three inputs: risk-free rate; market risk premium; and beta. The risk-free rate and the market risk premium are economy-wide estimates. The risk-free rate and the market risk premium for the S&P 500 companies are the annual figures reported in the STB Cost of Capital Decisions. Industry beta for the S&P 500 companies is the levered raw beta reported in the Ibbotson/Duff & Phelps Industry Cost of Capital books at the two-digit SIC code level.¹¹⁹

A-21. The MSDCF cost of equity for each company is the 3-Stage Discounted Cash Flow cost of equity reported in Ibbotson/Duff & Phelps Cost of Capital yearbooks at the two-digit SIC

¹¹⁵ We used the reported “SIC Composite” definition.

¹¹⁶ Note that prior to 2008, STB calculated Cost of Common Equity based on CAPM alone. Respectively, for the two years prior to 2008 in my sample, 2006 and 2007, we used only CAPM to estimate the Cost of Common Equity.

¹¹⁷ This calculation of the Common Equity Weights assumes that the companies in our sample finance their operations with debt and common equity only. In reality, companies use other equity securities, such as preferred equity. Thus, we effectively assume that costs of common and preferred equity are the same. We expect the impact of this assumption on our cost of capital calculations to be *de minimis* due to the usually small proportion of preferred equity to total capital. For example, over the last 13 years, STB determined that the preferred equity accounted for less than 0.005% of the publicly traded railroads’ total capital in 5 of the 13 years and zero % in the other 8 years.

¹¹⁸ We used the reported “SIC Composite” definition.

¹¹⁹ We use the reported “SIC Composite” definition.

code level.¹²⁰ The methodology of the 3-Stage Discounted Cash Flow Model¹²¹ forms the foundation of STB's MSDCF Model.¹²² Thus the 3-Stage Discounted Cash Flow cost of equity and the MSDCF cost of equity are calculated based on the same methodology.

A-22. The Industry Cost of Capital for the S&P 500 companies is equal to the weighted averages of the Industry Cost of Debt and Industry Cost of Equity. The data to measure the industry cost of capital is not available for all years for all two-digit SIC codes because these codes were not available in some of the Ibbotson/Duff & Phelps Cost of Capital yearbooks.¹²³ When the industry cost of capital was not available for a two-digit SIC code in a year, we estimate the cost of capital for that two-digit SIC code based on the average cost of capital across all two-digit SIC codes in that year.¹²⁴

¹²⁰ We use the reported "SIC Composite" definition.

¹²¹ See, for example, Ibbotson Cost of Capital 2013 Yearbook, p. 13, "The three-stage model identifies three separate growth rates: a growth rate applicable to cash flows during the first five years of future performance, a growth rate applicable to cash flows over the sixth through tenth years, and a growth rate applicable to earnings for all future years following the first ten years... Cash flow is defined as income before extraordinary items plus depreciation less capital expenditures plus deferred taxes. Normal cash flows and income before extraordinary items are used because of the potential for anomalous years. 'Normal' cash flows and income before extraordinary items are estimated by multiplying the last five years average cash flow and earnings rates, both as a percent of sales, by the most recent year's sales... Earnings are used in place of cash flows in the third term, because over extended periods of time it is assumed that capital expenditures and depreciation will be equal... In those instances where companies in the composite do not have a Thomson Reuters earnings growth estimate, the industry average is substituted."

¹²² See paragraph A-16 and the footnotes thereto.

¹²³ The methodology underlying the analyses in the yearbooks require a minimum of 5 companies per industry.

¹²⁴ More specifically, if the cost of capital is not available for a given two-digit SIC code in a year, we add the average cost of capital calculated across all two-digit SIC codes ("sample average") in that year to the mean deviation from the sample average across all other years in which there is a cost of capital figure available for the two-digit SIC code with missing cost of capital in the current year. The industry cost of capital was not available for any year for two-digit SIC code 99, Nonclassifiable Establishments. For industries with SIC code 99, we use the sample average cost of capital. The issue of missing industry cost of capital affects less than 3% of our sample.

APPENDIX B

RAILROAD'S FINANCIAL PERFORMANCE BASED ON STB DEFINITIONS OF RETURN ON INVESTED CAPITAL (STB ROIC) AND COST OF CAPITAL (STB COC)

(STB ROIC MINUS STB COC, 2006 – 2019)

B-1. In Appendix B, we present the STB data for the seven railroads overseen by Board and the Industry Weighted Average over the 2006 - 2019 period; specifically, we present the STB's railroad industry cost of capital, the STB's financial performance metric used in its Annual Revenue Adequacy Determinations (ROIC minus COC), and our alternative measure of financial performance (Adjusted ROIC minus COC).

B-2. In Panel A of Exhibit B1, we present the STB's railroad cost of capital over this period. The range of the STB's railroad cost of capital over this period is from 8.9% to 12.2%. The median cost of capital over this period is 10.8% (average 10.7%).

B-3. In Panel B of Exhibit B1, we present ROIC minus COC for the Industry Weighted Average and for the seven railroads. The range of the ROIC minus COC over this period for the industry is from -2.5% to 3.1%, and the median ROIC minus COC over this period for the industry is 0.7% (average 0.7%). The ROIC minus COC for the seven railroads varies across years and across the railroads in any one year. The median ROIC minus COC over this period across the seven railroads varies from -2.6% to 3.6% and the average varies from -2.5% to 2.4%.

B-4. In Panel C of Exhibit B1, we present Adjusted ROIC minus COC for the Industry Weighted Average and for the seven railroads. The range of the Adjusted ROIC minus COC over this period for the industry is from -3.5% to 1.4%, and the median Adjusted ROIC minus COC over this period for the industry is -1.2% (average -1.3%). The Adjusted ROIC minus COC for the seven railroads also varies across years and across the railroads in any one year.

The median Adjusted ROIC minus COC over this period across the seven railroads varies from -3.0% to 0.3% and the average varies from -3.1% to 0.1%.

APPENDIX C

RAILROAD'S (ROIC MINUS COC) PERCENTILES WITHIN S&P 500 SAMPLES

(RAILROADS' RETURN ON INVESTED CAPITAL AND COST OF CAPITAL MEASURED USING NON-STB PUBLIC DATA)

C-1. In Appendix C, we present the Industry Weighted Average and each railroad's ROIC minus COC percentile within the distribution of all companies in three benchmarking samples: (a) S&P 500 excluding railroads, financial institutions, and real estate companies ("S&P 500" benchmarking group)); (b) S&P 500 Industrials Sector excluding railroads (industry sector to which railroads belong, "S&P 500 Industrials Sector" benchmarking group); and (c) customers (shippers) of CN, NS, and/or UP in the S&P 500 that accounted for at least \$1.0 million of combined revenues to those railroads during the last year ("S&P 500 Railroad Customers" benchmarking group).

C-2. The analyses we present in Appendix C, Exhibits C1 and C2 are the same as those in Exhibits 1 and 2 except the inputs for the ROIC and cost of capital for the railroads are based on the Compustat data (and not the STB data). That is, we use the same Compustat data for both the railroads and the companies in the S&P 500 benchmarking samples. The percentile numbers of only four (out of seven) railroad companies are presented because only four of the seven railroad companies are publicly traded and, thus, have Compustat financial data.¹²⁵ The results for the railroads reported in Exhibits 1 and 2 differ from the results reported in Appendix C, Exhibits C1 and C2 due to differences in data sources. The Compustat data used for the calculation of ROIC are for the consolidated company rather than the U.S. railroad operations

¹²⁵ The four companies are: CSX Corporation, Kansas City Southern, Norfolk Southern Corporation, and Union Pacific Corporation.

only as in the STB filings. The costs of capital also differ because of differences in the STB and the non-STB publicly available databases.¹²⁶

C-3. The results in Exhibit C1 are analogous to the results presented in Exhibit 1. The top section of each panel presents the descriptive statistics about the S&P 500 benchmarking group and the bottom section of each panel presents the railroads' percentile within the distribution of all companies in that benchmarking group; however, as stated above, the inputs for measuring ROIC and the cost of capital for the railroads are based on the Compustat (not STB) data that is also used for the companies in the S&P 500 benchmarking groups.

C-4. Panel A of Exhibit C1 presents the railroads' percentile in the distribution of ROIC minus COC of the S&P 500 benchmarking group. The range of the ROIC minus COC percentile over this period for the industry is from 12th to 27th, and the median ROIC minus COC percentile over this period for the industry is 19th (average 20th). The ROIC minus COC percentile for the four publicly traded railroads varies across years and across the railroads in any one year. The median ROIC minus COC percentile over this period across the four railroads varies from 11th to 24th and the average varies from 11th to 21st.

C-5. Panel B of Exhibit C1 presents the railroads' percentile in the distribution of ROIC minus COC of the S&P 500 Industrials Sector benchmarking group. The range of the ROIC minus COC percentile over this period for the industry is from 4th to 17th, and the median ROIC minus COC percentile over this period for the industry is 10th (average 10th). The ROIC minus COC percentile for the four publicly traded railroads varies across years and across the railroads in any

¹²⁶ One such example is difference in beta, an input for calculating the CAPM equity cost of capital.

one year. The median ROIC minus COC percentile over this period across the four railroads varies from 5th to 10th and the average varies from 6th to 10th.

C-6. Panel C of Exhibit C1 presents the railroads' percentile in the distribution of ROIC minus COC of the S&P 500 Railroad Customers benchmarking group. The range of the ROIC minus COC percentile over this period for the industry is from 17th to 44th, and the median ROIC minus COC percentile over this period for the industry is 31st (average 31st). The ROIC minus COC percentile for the seven railroads varies across years and across the railroads in any one year. The median ROIC minus COC percentile over this period across the seven railroads varies from 17th to 37th and the average varies from 18th to 32nd. In sum, the results shown in Exhibit C1 are qualitatively similar to the results shown in Exhibit 1.

C-7. The results in Exhibit C2 are analogous to the results presented in Exhibit C1, however, the results in Exhibit C2 are for the Adjusted ROIC minus COC whereby the results in Exhibit C1 are for the ROIC minus COC. The top section of each panel in Exhibit C2 presents the descriptive statistics about the S&P 500 benchmarking group and the bottom section of each panel in Exhibit C2 presents the railroads' percentile within the distribution of all companies in that benchmarking group. As stated previously, the inputs for measuring Adjusted ROIC and the cost of capital for the railroads are based on the Compustat (not STB) data that is also used for the companies in the S&P 500 benchmarking groups.

C-8. Panel A of Exhibit C2 presents the railroads' percentile in the distribution of ROIC minus COC of the S&P 500 benchmarking group. The range of the ROIC minus COC percentile over this period for the industry is from 11th to 31st, and the median ROIC minus COC percentile over this period for the industry is 18st (average 19th). The ROIC minus COC percentile for the four

publicly traded railroads varies across years and across the railroads in any one year. The median ROIC minus COC percentile over this period across the four railroads varies from 15th to 20th and the average varies from 15th to 22nd.

C-9. Panel B of Exhibit C2 presents the railroads' percentile in the distribution of ROIC minus COC of the sample of S&P 500 Industrials Sector companies. The range of the ROIC minus COC percentile over this period for the industry is from 5th to 18th, and the median ROIC minus COC percentile over this period for the industry is 9th (average 9th). The ROIC minus COC percentile for the four publicly traded railroads varies across years and across the railroads in any one year. The median ROIC minus COC percentile over this period across the four railroads varies from 7th to 11th and the average varies from 7th to 11th.

C-10. Panel C of Exhibit C2 presents the railroads' percentile in the distribution of ROIC minus COC of the sample customers of CN, NS, and UP in the S&P 500. The range of the ROIC minus COC percentile over this period for the industry is from 12th to 45th, and the median ROIC minus COC percentile over this period for the industry is 26th (average 27th). The ROIC minus COC percentile for the four publicly traded railroads varies across years and across the railroads in any one year. The median ROIC minus COC percentile over this period across the four railroads varies from 20th to 32nd and the average varies from 21st to 33rd. In sum, the results shown in Exhibit C2 are qualitatively similar to the results shown in Exhibit 2.

C-11. Overall, while the results shown in Appendix C, Exhibits C1 and C2 are naturally not identical to the results shown in Exhibits 1 and 2, on the balance, they are qualitatively similar.

Curriculum Vitae
of
Professor Kevin M. Murphy

Curriculum Vitae

Kevin M. Murphy

August 2020

Business Address:

The University of Chicago
Booth School of Business
5807 South Woodlawn Avenue
Chicago, Illinois 60637
email: kevin.murphy@chicagobooth.edu

Home Address:

1810 Pennington Court
New Lenox, Illinois 60451
Phone: (815)463-4756
Fax: (815)463-4758

Current Positions

July 2005-Present: George J. Stigler Distinguished Service Professor of Economics,
Department of Economics and Booth School of Business, The University of Chicago

Faculty Research Associate, National Bureau of Economic Research

Co-Director, Health and Human Capital Program, Health Economics Initiative, Becker
Friedman Institute

Education

University of California, Los Angeles, A.B., Economics, 1981

The University of Chicago, Ph.D., 1986

Thesis Topic: *Specialization and Human Capital*

Previous Research and Academic Positions

2002-2005: George J. Stigler Professor of Economics, Department of Economics and
Booth School of Business, The University of Chicago

1993 – 2002: George Pratt Shultz Professor of Business Economics and Industrial
Relations, The University of Chicago

1989 – 1993: Professor of Business Economics and Industrial Relations, The University
of Chicago

1988 – 1989: Associate Professor of Business Economics and Industrial Relations, The University of Chicago

1986 – 1988: Assistant Professor of Business Economics and Industrial Relations, The University of Chicago

1983 – 1986: Lecturer, Booth School of Business, The University of Chicago

1982 – 1983: Teaching Associate, Department of Economics, The University of Chicago

1979 – 1981: Research Assistant, Unicon Research Corporation, Santa Monica, California

Honors and Awards

2008: John von Neumann Lecture Award, Rajk College, Corvinus University, Budapest

2007: Kenneth J. Arrow Award (with Robert H. Topel)

October 2005: Garfield Research Prize (with Robert H. Topel)

September 2005: MacArthur Foundation Fellow

1998: Elected to the American Academy of Arts & Sciences

1997: John Bates Clark Medalist

1993: Fellow of The Econometric Society

1989 – 1991: Sloan Foundation Fellowship, The University of Chicago

1983 – 1984: Earhart Foundation Fellowship, The University of Chicago

1981 – 1983: Fellowship, Friedman Fund, The University of Chicago

1980 – 1981: Phi Beta Kappa, University of California, Los Angeles

1980 – 1981: Earhart Foundation Fellowship, University of California, Los Angeles

1979 – 1981: Department Scholar, Department of Economics, University of California, Los Angeles

Publications

Books

Social Economics: Market Behavior in a Social Environment with Gary S. Becker, Cambridge, MA: Harvard University Press (2000).

Measuring the Gains from Medical Research: An Economic Approach, edited volume with Robert H. Topel, Chicago: The University of Chicago Press (2003).

Chicago Price Theory, by Sonia Jaffe, Robert Minton, Casey B. Mulligan, and Kevin M. Murphy, Princeton University Press (2019).

Chapters in Books

“Income and Wealth in America,” with Emmanuel Saez, in Inequality and Economic Policy, ed. Tom Church, Christopher Miller, John B. Taylor, Stanford, CA: Hoover Press (2015)

Articles

“Government Regulation of Cigarette Health Information,” with Benjamin Klein and Lynne Schneider, 24 *Journal of Law and Economics* 575 (1981).

“Estimation and Inference in Two-Step Econometric Models,” with Robert H. Topel, 3 *Journal of Business and Economic Statistics* 370 (1985).

“Unemployment, Risk, and Earnings: Testing for Equalizing Wage Differences in the Labor Market,” with Robert H. Topel, in Unemployment and the Structure of Labor Markets, pp. 103-139, ed. Kevin Lang and Jonathan S. Leonard. London: Basil Blackwell (1987).

“The Evolution of Unemployment in the United States: 1968-1985,” with Robert H. Topel, in NBER Macroeconomics Annual, pp. 11-58, ed. Stanley Fischer. Cambridge, MA: MIT Press (1987).

“Cohort Size and Earnings in the United States,” with Mark Plant and Finis Welch, in Economics of Changing Age Distributions in Developed Countries, pp. 39-58, ed. Ronald D. Lee, W. Brian Arthur, and Gerry Rodgers. Oxford: Clarendon Press (1988).

“The Family and the State,” with Gary S. Becker, 31 *Journal of Law and Economics* 1 (1988).

“A Theory of Rational Addiction,” with Gary S. Becker, 96 *Journal of Political Economy* 675 (1988).

“Vertical Restraints and Contract Enforcement,” with Benjamin Klein, 31 *Journal of Law and Economics* 265 (1988).

“Income Distribution, Market Size, and Industrialization,” with Andrei Shleifer and Robert W. Vishny, 104 *Quarterly Journal of Economics* 537 (1989).

“Wage Premiums for College Graduates: Recent Growth and Possible Explanations,” with Finis Welch, 18 *Educational Researcher* 17 (1989).

“Industrialization and the Big Push,” with Andrei Shleifer and Robert W. Vishny, 97 *Journal of Political Economy* 1003 (1989).

“Building Blocks of Market Clearing Business Cycle Models,” with Andrei Shleifer and Robert W. Vishny, in NBER Macroeconomic Annual, pp. 247-87, ed. Olivier Jean Blanchard and Stanley Fischer. Cambridge, MA: MIT Press (1989).

“Efficiency Wages Reconsidered: Theory and Evidence,” with Robert H. Topel, in Advances in the Theory and Measurement of Unemployment, pp. 204-240. ed. Yoram Weiss and Gideon Fishelson. London: Macmillan (1990).

“Empirical Age-Earnings Profiles,” with Finis Welch, 8 *Journal of Labor Economics* 202 (1990).

“Human Capital, Fertility, and Economic Growth,” with Gary S. Becker and Robert F. Tamura, 98 *Journal of Political Economy*, S12 (1990).

“Accounting for the Slowdown in Black-White Wage Convergence,” with Chinhui Juhn and Brooks Pierce, in Workers and Their Wages: Changing Patterns in the United States, pp. 107-143, ed. Marvin Kesters. Washington, D.C.: American Enterprise Institute (1991).

“The Role of International Trade in Wage Differentials,” with Finis Welch, in Workers and Their Wages: Changing Patterns in the United States, pp. 39- 69, ed. Marvin Kesters. Washington, D.C.: American Enterprise Institute (1991).

“Why Has the Natural Rate of Unemployment Increased over Time?” with Robert H. Topel and Chinhui Juhn, 2 *Brookings Papers on Economic Activity* 75 (1991).

“The Allocation of Talent: Implications for Growth,” with Andrei Shleifer and Robert W. Vishny, 106 *Quarterly Journal of Economics* 503 (1991).

“Rational Addiction and the Effect of Price on Consumption,” with Gary S. Becker and Michael Grossman, 81 *American Economic Review* 237 (1991).

“Wages of College Graduates,” in The Economics of American Higher Education, pp. 121-40, ed. William E. Becker and Darrell R. Lewis. Boston: Kluwer Academic Publishers (1992).

“Changes in Relative Wages, 1963-1987: Supply and Demand Factors,” with Lawrence F. Katz, 107 *Quarterly Journal of Economics* 35 (1992).

“The Structure of Wages,” with Finis Welch, 107 *Quarterly Journal of Economics* 285 (1992).

“The Transition to a Market Economy: Pitfalls of Partial Planning Reform,” with Andrei Shleifer and Robert W. Vishny, 107 *Quarterly Journal of Economics* 889 (1992).

“The Division of Labor, Coordination Costs, and Knowledge,” with Gary S. Becker, 107 *Quarterly Journal of Economics* 1137 (1992).

“Industrial Change and the Rising Importance of Skill” with Finis Welch, in Uneven Tides: Rising Inequality in America, pp. 101-132, ed. Peter Gottschalk and Sheldon Danziger. New York: Russell Sage Foundation Publications (1993).

“Wage Inequality and the Rise in Returns to Skill,” with Chinhui Juhn and Brooks Pierce, 101 *Journal of Political Economy* 410 (1993).

“Occupational Change and the Demand for Skill, 1940-1990,” with Finis Welch, 83 *American Economic Review* 122 (1993).

“Inequality and Relative Wages,” with Finis Welch, 83 *American Economic Review* 104 (1993).

“Why Is Rent-Seeking So Costly to Growth?” with Andrei Shleifer and Robert W. Vishny, 83 *American Economic Review* 409 (1993).

“A Simple Theory of Advertising as a Good or Bad,” with Gary S. Becker, 108 *Quarterly Journal of Economics* 941 (1993).

“Relative Wages and Skill Demand, 1940-1990,” with Chinhui Juhn, in Labor Markets, Employment Policy, and Job Creation, pp. 343-60, ed. Lewis C. Solmon and Alec R. Levenson. The Milken Institute Series in Economics and Education. Boulder, CO: Westview Press (1994).

“Cattle Cycles,” with Sherwin Rosen and Jose A. Scheinkman, 102 *Journal of Political Economy* 468 (1994).

“An Empirical Analysis of Cigarette Addiction,” with Gary S. Becker and Michael Grossman, 84 *American Economic Review* 396 (1994).

“Inequality in Labor Market Outcomes: Contrasting the 1980s and Earlier Decades,” with Chinhui Juhn, 1 *Economic Policy Review* 26 (1995).

“Employment and the 1990-91 Minimum Wage Hike,” with Donald R. Deere and Finis Welch, 85 *American Economic Review* 232 (1995).

“Examining the Evidence on Minimum Wages and Employment,” with Donald R. Deere and Finis Welch, in The Effects of the Minimum Wage on Employment, pp. 26-54, ed. Marvin H. Koster. Washington, D.C.: The AEI Press (1996).

“Social Status, Education, and Growth,” with Chaim Fershtman and Yoram Weiss, 104 *Journal of Political Economy* 108 (1996).

“Wage Inequality and Family Labor Supply,” with Chinhui Juhn, 15 *Journal of Labor Economics* 72 (1997).

“Quality and Trade,” with Andrei Shleifer, 53 *Journal of Development Economics* 1 (1997).

“Vertical Integration as a Self-Enforcing Contractual Arrangement,” with Benjamin Klein, 87 *American Economic Review* 415 (1997).

“Unemployment and Nonemployment,” with Robert H. Topel, 87 *American Economic Review* 295 (1997).

“Wages, Skills, and Technology in the United States and Canada,” with W. Craig Riddell and Paul M. Romen, in General Purpose Technologies and Economic Growth, pp. 283-309, ed. Elhanan Helpman. Cambridge, MA: M.I.T. Press (1998).

“Perspectives on the Social Security Crisis and Proposed Solutions,” with Finis Welch, 88 *American Economic Review* 142 (1998).

“Population and Economic Growth,” with Gary S. Becker and Edward Glaeser, 89 *American Economic Review* 145 (1999).

“A Competitive Perspective on Internet Explorer,” with Steven J. Davis, 90 *American Economic Review* 184 (2000).

“Industrial Change and the Demand for Skill,” with Finis Welch, in The Causes and Consequences of Increasing Inequality, pp. 263-84, ed. Finis Welch. Volume II in the Bush School Series in the Economics of Public Policy. Chicago: The University of Chicago Press (2001).

“Wage Differentials in the 1990s: Is the Glass Half Full or Half Empty?” with Finis Welch, in The Causes and Consequences of Increasing Inequality, pp. 341-64, ed. Finis Welch. Volume II in the Bush School Series in the Economics of Public Policy. Chicago: The University of Chicago Press (2001).

“Economic Perspectives on Software Design: PC Operating Systems and Platforms,” with Steven J. Davis and Jack MacCracken, in Microsoft, Antitrust, and the New Economy: Selected Essays, pp. 361-420, ed. Davis S. Evans. Boston, MA: Kluwer (2001).

“Current Unemployment, Historically Contemplated,” with Robert H. Topel and Chinhui Juhn, 1 *Brookings Papers on Economic Activity* 79 (2002).

“The Economics of Copyright ‘Fair Use’ in A Networked World,” with Andres Lerner and Benjamin Klein, 92 *American Economic Review* 205 (2002).

“The Economic Value of Medical Research,” with Robert H. Topel, in Measuring the Gains from Medical Research: An Economic Approach, pp. 41-73, ed. Robert H. Topel and Kevin M. Murphy. Chicago: The University of Chicago Press (2003).

“School Performance and the Youth Labor Market,” with Sam Peltzman, 22 *Journal of Labor Economics* 299 (2003).

“Entrepreneurial ability and market selection in an infant industry: evidence from the Japanese cotton spinning industry,” with Atsushi Ohyama and Serguey Braguinsky, 7 *Review of Economic Dynamics* 354 (2004).

“Entry, Pricing, and Product Design in an Initially Monopolized Market,” with Steven J. Davis and Robert H. Topel, 112 *Journal of Political Economy* S188 (2004).

“Diminishing Returns: The Costs and Benefits of Increased Longevity,” with Robert H. Topel, 46 *Perspectives in Biology and Medicine* S108 (2004).

“Persuasion in Politics,” with Andrei Shleifer, 94 *American Economic Review* 435 (May 2004).

“Black-White Differences in the Economic Value of Improving Health,” with Robert H. Topel, 48 *Perspectives in Biology and Medicine* S176 (2005).

“The Equilibrium Distribution of Income and the Market for Status,” with Gary S. Becker and Iván Werning, 113 *Journal of Political Economy* 282 (2005).

“The Market for Illegal Goods: The Case of Drugs,” with Gary S. Becker and Michael Grossman, 114 *Journal of Political Economy* 38 (2006).

“Competition in Two-Sided Markets: The Antitrust Economics of Payment Card Interchange Fees,” with Benjamin Klein, Kevin Green, and Lacey Place, 73 *Antitrust Law Journal* 571 (2006).

“The Value of Health and Longevity,” with Robert H. Topel, 114 *Journal of Political Economy* 871 (2006).

“Social Value and the Speed of Innovation,” with Robert H. Topel, 97 *American Economic Review* 433 (2007).

“Education and Consumption: The Effects of Education in the Household Compared to the Marketplace,” with Gary S. Becker, 1 *The Journal of Human Capital* 9 (Winter 2007).

“Why Does Human Capital Need a Journal?” with Isaac Ehrlich, 1 *The Journal of Human Capital* 1 (Winter 2007).

“Critical Loss Analysis in the Whole Foods Case,” with Robert H. Topel, 3 (2) *GCP Magazine* (March 2008).

“Exclusive Dealing Intensifies Competition for Distribution,” with Benjamin Klein, 75 *Antitrust Law Journal* (October 2008).

“Fertility Decline, the Baby Boom and Economic Growth,” with Curtis Simon and Robert Tamura, 2 *The Journal of Human Capital* 3 (Fall 2008).

“The Market for College Graduates and the Worldwide Boom in Higher Education of Women,” with Gary S. Becker and William H. J. Hubbard, 100 *American Economic Review: Papers & Proceedings* 229 (May 2010).

“Explaining the Worldwide Boom in Higher Education of Women,” with Gary S. Becker and William H. J. Hubbard, 4 *Journal of Human Capital* No. 3 (2010).

“How Exclusivity is Used to Intensify Competition for Distribution-Reply to Zenger,” with Benjamin Klein, 77 *Antitrust Law Journal* No. 2 (2011).

“Achieving Maximum Long-Run Growth,” *Federal Reserve Bank of Kansas City Proceedings of the Annual Jackson Hole Conference 2011*.

“On the Economics of Climate Policy,” with Gary S. Becker and Robert H. Topel, 10 *B.E. Journal of Economic Analysis and Policy* No. 2 (2011).

“Measuring Crack Cocaine and its Impact,” with Roland G. Fryer, Jr., Paul S. Heaton, and Steven D. Levitt, 51 *Economic Inquiry* No. 3 (July 2013).

“Some Basic Economics of National Security,” with Robert H. Topel, 103 *American Economic Review* No. 3 (2013).

“Activating *Actavis*: A More Complete Story,” with Barry C. Harris, Robert D. Willig, and Matthew B. Wright, 28 *Antitrust* No. 2 (Spring 2014).

“Competitive Discounts and Antitrust Policy,” with Edward A. Snyder and Robert H. Topel, Chapter 5 of *The Oxford Handbook of International Antitrust Economics*, Volume 2 (2014).

“Gary Becker as Teacher,” 105 *American Economic Review* No. 5 (2015).

“Black and White Fertility, Differential Baby Booms: The Value of Equal Education Opportunity,” with Robert Tamura and Curtis Simon, 82 *Journal of Demographic Economics*, Issue 1 (2016).

“Human Capital Investment, Inequality, and Economic Growth,” with Robert H. Topel, 34 *Journal of Labor Economics*, No. S2/Part 2 (2016).

“A Theory of Intergenerational Mobility,” with Gary S. Becker, Scott Duke Kominers, and Jörg L. Spenkuch, *Journal of Political Economy* 126, no. S1 (October 2018): S7-S25.

“Gary Becker Remembered,” with James J. Heckman and Edward P. Lazear, *Journal of Political Economy* 126, no. S1 (October 2018): S1-S6.

Sample of “The Power of the Economic Approach: Unpublished Manuscripts of Gary S. Becker,” Edited by Julio J. Elías, Casey B. Mulligan, and Kevin M. Murphy, University of Chicago Press (Forthcoming). *Journal of Human Capital* 2019 13:2, 140-141.

Selected Working Papers

“Gauging the Economic Impact of September 11th,” with Gary S. Becker, Unpublished Working Paper (October 2001).

“War In Iraq Versus Containment: Weighing the Costs,” with Steven J. Davis and Robert H. Topel, NBER Working Paper No.12092 (March 2006).

“The Interaction of Growth in Population and Income,” with Gary S. Becker, Unpublished Working Paper (2006).

“Persuasion and Indoctrination,” with Gary Becker (2007).

“The Value of Life Near Its End and Terminal Care,” with Gary S. Becker and Tomas Philipson (2007).

“On the Economics of Climate Policy,” with Gary S. Becker and Robert H. Topel, Working Paper No. 234 (January 2010, Revised September 2010).

“The Manipulation of Children’s Preferences, Old Age Support, and Investment in Children’s Human Capital,” with Gary S. Becker and Jörg L. Spenkuch, Unpublished Working Paper (February 2012).

“The Collective Licensing of Music Performance Rights: Market Power, Competition and Direct Licensing” (March 2013).

“Activating *Actavis* with A More Complete Model,” with Michael G. Baumann, John P. Bigelow, Barry C. Harris, Janusz A. Ordovery, Robert D. Willig, and Matthew B. Wright, (January 2014).

“A Theory of Bundling Advertisements in Media Markets,” with Ignacio Palacios-Huerta, NBER Working Paper No. 229994 (December 2016).

Selected Comments

Comment on “Causes of Changing Earnings Equality” by Robert Z. Lawrence. Federal Reserve Bank of Kansas City (1998).

“Comment: Asking the Right Questions in the Medicare Reform Debate,” Medicare Reform: Issues and Answers, pp. 175-81, ed. Andrew J. Rettenmaier and Thomas R. Saving. Chicago: The University of Chicago Press (2000).

Comment on “Social Security and Demographic Uncertainty” by Henning Bohn, in Risk Aspects of Investment-Based Social Security Reform, ed. John Y. Campbell and Martin Feldstein. Chicago: The University of Chicago Press (2001).

Comment on “High Technology Industries and Market Structure” by Hal R. Varian. Federal Reserve Bank of Kansas City (2001).

Popular Press Articles

“The Education Gap Rap,” *The American Enterprise* (March-April 1990), pp. 62.

“Rethinking Antitrust,” with Gary S. Becker, *Wall Street Journal* (February 26, 2001), A22.

“Prosperity Will Rise Out of the Ashes,” with Gary S. Becker, *Wall Street Journal* (October 29, 2001), A22.

“The Economics of NFL Team Ownership,” with Robert H. Topel, report prepared at the request of the National Football League Players’ Association (January 2009).

Articles About Murphy

“Higher Learning Clearly Means Higher Earning,” by Carol Kleiman. *Chicago Tribune*, March 12, 1989, Jobs Section pp. 1. Long article about “The Structure of Wages” with picture of Murphy.

“Why the Middle Class Is Anxious,” by Louis S. Richman. *Fortune*, May 21, 1990, pp. 106. Extensive reference to Murphy's work on returns to education.

“Unequal Pay Widespread in U.S.,” by Louis Uchitelle, *New York Times*, August 14, 1990, Business Day section pp. 1. Long piece on income inequality.

“One Study’s Rags to Riches Is Another’s Rut of Poverty,” by Sylvia Nasar, *New York Times*, June 17, 1992, Business Section pp. 1. Long piece on the income inequality research.

“Nobels Pile Up for Chicago, but Is the Glory Gone?” by Sylvia Nasar, *New York Times* November 4, 1993, Business Section pp. 1. Long piece on Chicago School of economics. Featured a photo of five of the “brightest stars on the economics faculty” (including Murphy) and a paragraph about Murphy’s research.

“This Sin Tax is Win-Win,” by Christopher Farrell. *Business Week*, April 11, 1994, pp. 30. Commentary section refers to Murphy, Becker, and Grossman’s work on rational addiction.

“Growing inequality and the economics of fragmentation,” by David Warsh, *Boston Sunday Globe*, August 21, 1994, pp. A1. Two-page article with picture and biographical details about Murphy and his research; part of a series about “how the new generation replaced the old in economics.”

“A Pay Raise’s Impact,” by Louis Uchitelle. *New York Times*, January 12, 1995, Business Section pp. 1. Article about consequences of proposed increase in the minimum wage. Articles featuring Murphy's comments on the minimum wage appeared in numerous

other publications, including the *Chicago Tribune*; in addition, Murphy was interviewed on CNN (January 26, 1995).

“The Undereducated American,” *Wall Street Journal*, August 19, 1996, A12. Changes in the rate of returns to education.

“In Honor of Kevin M. Murphy: Winner of the John Bates Clark Medal,” by Finis Welch, 14 *Journal of Economic Perspectives* 193 (2000).

Testimony, Reports, and Depositions (Last 4 Years)

Deposition of Kevin M. Murphy, January 5, 2016, in the Matter of ABS Global, Inc. v. Inguran, LLC d/b/a Sexing Technologies and XY, LLC v Genus PLC, The United States District Court for the Western District of Wisconsin. Case No. 14-cv-503.

Supplemental Expert Report of Kevin M. Murphy, January 13, 2016, in the Matter of The Dial Corporation, Henkel Consumer Goods, Inc., H.J. Heinz Company, H.J. Heinz Company, L.P., Foster Poultry Farms, Smithfield Foods, Inc., HP Hood LLC, BEF Foods, Inc. and Spectrum Brands, Inc. v. News Corporation, News America Inc., News America Marketing FSI L.L.C., News America Marketing In-Store Services L.L.C., The United States District Court for the Southern District of New York. Case No. 13-cv-06802 (WHP).

Declaration of Kevin M. Murphy, January 26, 2016, in the Matter of ABS Global, Inc. v. Inguran, LLC d/b/a Sexing Technologies and XY, LLC v Genus PLC, The United States District Court for the Western District of Wisconsin. Case No. 14-cv-503.

Expert Report of Kevin M. Murphy, February 5, 2016, in the Matter of Moldex Metric, Inc. v. 3M Company and 3M Innovative Properties Company, The United States District Court for the District of Minnesota. Case No. 2014-cv-01821 (JNE/FLN).

Confidential Submission on Fractional Licensing to the U.S. Department of Justice in Connection with Modification of the ASCAP Consent Decree, February 12, 2016.

Deposition of Kevin M. Murphy, February 16, 2016, in the Matter of Moldex Metric, Inc. v. 3M Company and 3M Innovative Properties Company, The United States District Court for the District of Minnesota. Case No. 2014-cv-01821 (JNE/FLN).

Verified Statement of Kevin M. Murphy, March 7, 2016, Exhibit II-B-2 to CSXT Reply Evidence, In Re: STB Docket No. NOR 42142.

Expert Report of Kevin M. Murphy, March 8, 2016, in the Matter of ABS Global, Inc. v. Inguran, LLC d/b/a Sexing Technologies and XY, LLC v Genus PLC, The United States District Court for the Western District of Wisconsin. Case No. 14-cv-503.

Expert Report of Kevin M. Murphy, March 9, 2016, in the Matter of Lisa Watson, Wayne Miner, and James Easley, Individually and on Behalf of All Others Similarly Situated v. Philip Morris Companies, Inc. a corporation, and Philip Morris Incorporated, a corporation, in the Circuit Court of Pulaski County, Arkansas. Case No. CV03-4661.

Trial Testimony of Kevin M. Murphy, April 4, 2016, in the Matter of Dayna Craft (Withdrawn), Deborah Larsen, individually and on behalf of all others similarly situated v. Philip Morris USA Inc., a corporation, Missouri Circuit Court for the Twenty-Second Judicial District (City of St. Louis). Case No. 002-00406-02.

Reply Expert Report of Kevin M. Murphy, April 11, 2016, in the Matter of Kleen Products LLC, et al. v. International Paper, et al., The United States District Court for the Northern District of Illinois Eastern Division. Case No. 1:10-cv-05711.

Responsive Damages Report of Kevin M. Murphy, April 12, 2016, in the Matter of ABS Global, Inc. v. Inguran, LLC d/b/a Sexing Technologies and XY, LLC v. Genus PLC, The United States District Court for the Western District of Wisconsin. Case No. 14-cv-503.

Deposition of Kevin M. Murphy, May 2, 2016, in the Matter of ABS Global, Inc. v. Inguran, LLC d/b/a Sexing Technologies and XY, LLC v. Genus PLC, The United States District Court for the Western District of Wisconsin. Case No. 14-cv-503.

Verified Statement of Kevin M. Murphy, July 26, 2016, In Re: STB Docket No. 704 (Sub-No. 1), Review of Commodity, Boxcar, and TOFC/COFC Exemptions.

Expert Report of Kevin M. Murphy, July 29, 2016, In Re Biogen '755 Patent Litigation, The United States District Court for the District of New Jersey. Civil Action No. 10-2734 (CCC/JAD).

Trial Testimony of Kevin M. Murphy, August 3, 2016 and August 12, 2016, in the Matter of ABS Global, Inc. v. Inguran, LLC d/b/a Sexing Technologies and XY, LLC v. Genus PLC, The United States District Court for the Western District of Wisconsin. Case No. 14-cv-503.

Expert Report of Kevin M. Murphy, September 23, 2016, in the Matter of First Impressions Salon, Inc., Roy Mattson, Belle Foods Trust, Bankruptcy Estate of Yarnell's Ice Cream Company, Inc., Piggly Wiggly Midwest LLC and KPH Healthcare Services, Inc., aka Kinney Drugs, Inc. et.al. v. National Milk Producers Federation, Cooperatives Working Together, Dairy Farmers of America, Inc., Land O'Lakes, Inc., Dairy Lea Cooperative Inc., Agri-Mark, Inc. d/b/a Cabot Creamery Cooperative, Inc., The United States District Court for the Southern District of Illinois. Case No. 3:13-cv-00454-NJR-SCW.

Verified Statement of Kevin M. Murphy, October 26, 2016, In Re: STB Docket EP 711 (Sub-No. 1), Reciprocal Switching.

Expert Report of Kevin M. Murphy, November 21, 2016, in the Matter of Valassis Communications, Inc. v. News America Inc., a/k/a News America Marketing Group, News America Marketing FSI, Inc., a/k/a News America Marketing FSI LLC, and News America Marketing In-Store Services, Inc. a/k/a News America Marketing In-Store Services, LLC, The United States District Court for the Eastern District of Michigan, Southern Division. Case No. 2-06-cv-10240-AJT-MJH.

Deposition of Kevin M. Murphy, December 2, 2016 and December 3, 2016, In Re Biogen '755 Patent Litigation, The United States District Court for the District of New Jersey. Civil Action No. 10-2734 (CCC/JAD).

Trial Testimony of Kevin M. Murphy, December 7, 2016 and December 8, 2016, in the Matter of US Airways, Inc. v. Sabre Holdings Corp., Sabre, Inc., and Sabre Travel International Ltd., The United States District Court for the Southern District of New York. Case No. 1:11-cv-02725-MGC.

Expert Report of Kevin M. Murphy, February 23, 2017, in the Matter of 1-800 Contacts, Inc., Before the Federal Trade Commission, Office of Administrative Law Judges, United States of America. Docket No. 9372.

Expert Report of Kevin M. Murphy, March 1, 2017, in the Matter of Gene R. Romero, et al. v. Allstate Insurance, et al., The United States District Court for the Eastern District of Pennsylvania. Case No. 01-3894 (consolidated with other matters) (E.D. Pa.).

Deposition of Kevin M. Murphy, March 16, 2017, in the Matter of 1-800 Contacts, Inc., Before the Federal Trade Commission, Office of Administrative Law Judges, United States of America. Docket No. 9372.

Deposition of Kevin M. Murphy, March 27, 2017, in the Matter of Gene R. Romero, et al. v. Allstate Insurance, et al., The United States District Court for the Eastern District of Pennsylvania. Case No. 01-3894 (consolidated with other matters) (E.D. Pa.).

Supplemental Expert Report of Kevin M. Murphy, April 3, 2017, in the Matter of Parallel Networks Licensing, LLC v. Microsoft Corporation, The United States District Court for the District of Delaware. Case No. 13-2073-SLR.

Expert Report of Kevin M. Murphy, April 3, 2017, in the Matter of Optical Disc Drive Products Litigation (Acer America Corp., et al. v. Lite-On Corporation, et al.), The United States District Court for the Northern District of California, San Francisco Division. No. 3:10-md-2143, RS 5:13-cv-04991.

Expert Report of Kevin M. Murphy, April 3, 2017, in the Matter of Optical Disc Drive Products Litigation (Dell Inc. and Dell Products L.P., v. Hitachi, Ltd., et al.), The United States District Court for the Northern District of California, San Francisco Division. No. 3:10-md-2143 RS.

Expert Report of Kevin M. Murphy, April 3, 2017, in the Matter of Optical Disc Drive Products Litigation (Hewlett-Packard Company v. Toshiba Corporation, et al.), The United States District Court for the Northern District of California, San Francisco Division. MDL No. 2143, No. 3:13-cv-05370 RS.

Expert Report of Kevin M. Murphy, April 3, 2017, in the Matter of Optical Disc Drive Products Litigation (Ingram Micro Inc., et al. v. LG Electronics, Inc., et al.), The United States District Court for the Northern District of California, San Francisco Division. No. 3:10-md-2143 RS.

Expert Report of Kevin M. Murphy, April 3, 2017, in the Matter of Optical Disc Drive Products Litigation (All Indirect Purchaser Actions), The United States District Court for the Northern District of California, San Francisco Division. No. 3:10-md-2143 RS.

Expert Report of Kevin M. Murphy, April 3, 2017, in the Matter of Optical Disc Drive Products Litigation (Alfred H. Siegel v. Sony Corporation, et al. and Peter Kravitz v. Sony Corporation, et al.), The United States District Court for the Northern District of California, San Francisco Division. No. 3:10-md-2143 RS.

Deposition of Kevin M. Murphy, April 30, 2017 and May 1, 2017, in the Matter of Optical Disc Drive Products Litigation, The United States District Court for the Northern District of California, San Francisco Division. No. 3:10-md-2143 RS.

Trial Testimony of Kevin M. Murphy, May 10, 2017 and May 11, 2017, in the Matter of 1-800 Contacts, Inc., Before the Federal Trade Commission, Office of Administrative Law Judges, United States of America. Docket No. 9372.

Expert Report of Kevin M. Murphy, July 3, 2017, in the Matter of Blue Cross Blue Shield Antitrust Litigation (MDL No.: 2406), The United States District Court for the Northern District of Alabama Southern Division. Master File No. 2:13-CV-20000-RDP.

Deposition of Kevin M. Murphy, July 22, 2017, in the Matter of Blue Cross Blue Shield Antitrust Litigation (MDL No.: 2406), The United States District Court for the Northern District of Alabama Southern Division. Master File No. 2:13-CV-20000-RDP.

Expert Report of Kevin M. Murphy, August 25, 2017, in the Matter of Gene R. Romero, et al. v. Allstate Insurance, et al., The United States District Court for the Eastern District of Pennsylvania. Case No. 01-3894 (consolidated with other matters) (E.D. Pa.).

Expert Rebuttal Report of Kevin M. Murphy, September 18, 2017, in the Matter of Gene R. Romero, et al. v. Allstate Insurance, et al., The United States District Court for the Eastern District of Pennsylvania. Case No. 01-3894 (consolidated with other matters) (E.D. Pa.).

Expert Report of Kevin M. Murphy, November 3, 2017, in the Matter of Valassis Communications, Inc. v. News Corporation, News America Marketing, a/k/a News America Incorporated, a/k/a News America Marketing Group, a/k/a News America Marketing FSI L.L.C., a/k/a News America Marketing FSI, Inc.; and News America

Marketing In-Store Services L.L.C., a/k/a News America Marketing In-Store Services, Inc., The United States District Court for the Southern District of New York. Case No. 1:17-cv-07378-PKC.

Deposition of Kevin M. Murphy, January 17, 2018, in the Matter of Valassis Communications, Inc. v. News Corporation, News America Marketing, a/k/a News America Incorporated, a/k/a News America Marketing Group, a/k/a News America Marketing FSI L.L.C., a/k/a News America Marketing FSI, Inc.; and News America Marketing In-Store Services L.L.C., a/k/a News America Marketing In-Store Services, Inc., The United States District Court for the Southern District of New York. Case No. 1:17-cv-07378-PKC.

Verified Statement of Kevin M. Murphy, January 19, 2018, In Re Biogen '755 Patent Litigation, The United States District Court for the District of New Jersey. Civil Action No. 10-2734 (CCC/JAD).

Trial Testimony of Kevin M. Murphy, February 1, 2018, In Re Biogen '755 Patent Litigation, The United States District Court for the District of New Jersey. Civil Action No. 10-cv-2734 (CCC/JBC).

Expert Report and Testimony of Kevin M. Murphy, February 28, 2018 in the Matter of Washington Metropolitan Area Transit Authority and Amalgamated Transit Union Local 689, Interest Arbitration Under Sections 66(C) Of the WMATA Compact, The United States District Court for the District of Columbia.

Expert Report of Kevin M. Murphy, June 29, 2018, in the Matter of Gene R. Romero, et al. v. Allstate Insurance, et al., The United States District Court for the Eastern District of Pennsylvania. Case No. 01-3894 (consolidated with other matters) (E.D. Pa.).

Expert Report of Kevin M. Murphy, July 30, 2018, in the Matter of Daniel Gordon, et al. v. Amadeus IT Group, S.A. et al. The United States District Court for the Southern District of New York. Civ. A. No. 1:15-cv-05457-KPF.

Declaration of Kevin M. Murphy, August 16, 2018, in the Matter of Genentech, Inc., Biogen, Inc., Hoffmann-La Roche Inc., and City of Hope v. Celltrion, Inc., Celltrion Healthcare Co., Ltd., Teva Pharmaceuticals USA, Inc., and Teva Pharmaceuticals International GmbH, The United States District Court for the District of New Jersey. Civ. A. No. 18-cv-00574 (RMB) (KMW).

Expert Report of Kevin M. Murphy, September 21, 2018, in the Matter of Certain Memory Modules and Components Thereof, International Trade Commission, Washington, DC 20436. No. 337-TA-1089.

Reply Declaration of Kevin M. Murphy, September 26, 2018, in the Matter of Genentech, Inc., Biogen, Inc., Hoffmann-La Roche Inc., and City of Hope v. Celltrion, Inc., Celltrion Healthcare Co., Ltd., Teva Pharmaceuticals USA, Inc., and Teva Pharmaceuticals International GmbH, The United States District Court for the District of New Jersey. Civ. A. No. 18-cv-00574 (RMB) (KMW).

Expert Rebuttal Report of Kevin M. Murphy, October 9, 2018, in the Matter of Certain Memory Modules and Components Thereof, International Trade Commission, Washington, DC 20436. No. 337-TA-1089.

Deposition of Kevin M. Murphy, October 29, 2018, in the Matter of Certain Memory Modules and Components Thereof, International Trade Commission, Washington, DC 20436. No. 337-TA-1089.

Confidential Submission to the U.S. Department of Justice, Economic Considerations for Modification and Termination of the ASCAP Consent Decree, October 30, 2018.

Expert Report of Kevin M. Murphy, March 1, 2019, in the Matter of First Impressions Salon, Inc., Roy Mattson, KPH Healthcare Services, Inc., d/b/a Kinney Drugs, Inc. and Piggly Wiggly Midwest, LLC. v. National Milk Producers Federation, Cooperatives Working Together, Dairy Farmers of America, Inc., Land O'Lakes, Inc., Dairy Lea Cooperative Inc., Agri-Mark, Inc. d/b/a Cabot Creamery Cooperative, Inc., The United States District Court for the Southern District of Illinois. Case No. 3:13-cv-00454-SCW.

Expert Report of Kevin M. Murphy, March 15, 2019, in the Matter of Robert Binz V, Michael Binz, Leslie Clemenson, William Clynes, Andrew Margolick, Gregory Melita, and Nili Sinai-Nathan v. Amadeus IT Group, S.A., Amadeus North America, Inc., Amadeus Americas, Inc., Sabre Corporation f/k/a Holdings Corporation, Sabre Holdings Corporation, Sabre GLBL Inc., Sabre Travel International Limited, Travelport Worldwide Limited, and Travelport LP d/b/a Travelport, The United States District Court for the Southern District of New York. Civ A. No. 1:15-cv-05457-KPF.

Verified Statement of Kevin M. Murphy, April 25, 2019, On Behalf of Union Pacific Railroad Company in NAFCA vs. Union Pacific Railroad Company, Before the Surface Transportation Board. STB Docket No. NOR 42144.

Deposition of Kevin M. Murphy, May 9, 2019, in the Matter of Robert Binz V, Michael Binz, Leslie Clemenson, William Clynes, Andrew Margolick, Gregory Melita, and Nili Sinai-Nathan v. Amadeus IT Group, S.A., Amadeus North America, Inc., Amadeus Americas, Inc., Sabre Corporation f/k/a Holdings Corporation, Sabre Holdings Corporation, Sabre GLBL Inc., Sabre Travel International Limited, Travelport Worldwide Limited, and Travelport LP d/b/a Travelport, The United States District Court for the Southern District of New York. Civ A. No. 1:15-cv-05457-KPF.

Expert Report of Kevin M. Murphy, May 10, 2019, in the Matter of National Prescription Opiate Litigation (MDL No. 2804), The United States District Court for the Northern District of Ohio Eastern Division. Case No. 17-op-5004 and Case No. 18-op-45090. (Corrected and Restated Expert Report filed June 21, 2019).

Expert Report of Kevin M. Murphy, May 10, 2019, In Re Packaged Seafood Products Antitrust Litigation (Associated Wholesale Grocers, Inc. v. Bumble Bee Foods, LLC et al.), In the United States District Court of the Southern District of California. No. 15-md-2670.

Expert Report of Kevin M. Murphy, May 10, 2019, In Re Packaged Seafood Products Antitrust Litigation (W. Lee Flowers & Co., Inc. v. Bumble Bee Foods LLC, et al.), In the United States District Court of the Southern District of California. No. 15-md-2670.

Expert Report of Kevin M. Murphy, May 10, 2019, In Re Packaged Seafood Products Antitrust Litigation (Winn-Dixie Stores, Inc. and Bi-Lo Holding, LLC. v. Bumble Bee Foods, LLC et al.), In the United States District Court of the Southern District of California. No. 15-md-2670.

Expert Addendum Report of Kevin M. Murphy, May 24, 2019, In Re Packaged Seafood Products Antitrust Litigation (Affiliated Foods Midwest Cooperative, Inc. v. Bumble Bee Foods LLC, et al.), In the United States District Court of the Southern District of California. No. 15-md-2670.

Deposition of Kevin M. Murphy, June 6, 2019, in the Matter of National Prescription Opiate Litigation (MDL No. 2804), The United States District Court for the Northern District of Ohio Eastern Division. Case No. 17-op-5004 and Case No. 18-op-45090.

Expert Report of Kevin M. Murphy, June 10, 2019, In Re Payment Card Interchange Fee and Merchant Discount Antitrust Litigation, In the United States District Court for the Eastern District of New York. No. 05-md-1720 (MKB) (JO).

Deposition of Kevin M. Murphy, June 25, 2019, In Re Packaged Seafood Products Antitrust Litigation, In the United States District Court of the Southern District of California. No. 15-md-2670.

Expert Report of Kevin M. Murphy, July 15, 2019, in the Matter of Blue Cross Blue Shield Antitrust Litigation (MDL No.: 2406), The United States District Court for the Northern District of Alabama Southern Division. Master File No. 2:13-CV-20000-RDP.

Submission to the U.S. Department of Justice, Economic Considerations for Modification and Termination of the ASCAP Consent Decree, August 9, 2019.

Expert Report of Kevin M. Murphy, November 15, 2019, In Re Dealer Management Systems Antitrust Litigation, MDL 2817, The United States District Court for the Northern District of Illinois Eastern Division. No. 1:18-CV-00864. (Corrected and Restated Expert Report filed January 15, 2020).

Expert Report of Kevin M. Murphy, December 6, 2019, in the Matter of North American Soccer League, LLC v. United States Soccer Federation, Inc., and Major League Soccer, LLC, In the United States District Court for The Eastern District of New York. No. 1:17-cv-05495-MKB-ST.

Expert Report of Kevin M. Murphy, December 20, 2019, in the Matter of The United States of America v. Sabre Corporation, Sabre GLBL Inc., Farelogix, Inc., and Sandler Capital Partners V, L.P., In the United States District Court for The District of Delaware. No: 1:19-cv-01548-LPS.

Expert Rebuttal Report of Kevin M. Murphy, January 3, 2020, in the Matter of The United States of America v. Sabre Corporation, Sabre GBL Inc., Farelogix, Inc., and Sandler Capital Partners V, L.P., In the United States District Court for The District of Delaware. No: 1:19-cv-01548-LPS.

Expert Rebuttal Report of Kevin M. Murphy, January 10, 2020, in the Matter of The United States of America v. Novelis Inc. and Aleris Corporation, In the United States District Court for the Northern District of Ohio. No.: 1:19-cv-02033-CAB.

Expert Reply Report of Kevin M. Murphy, January 15, 2020, in the Matter of The United States of America v. Sabre Corporation, Sabre GBL Inc., Farelogix, Inc., and Sandler Capital Partners V, L.P., In the United States District Court for The District of Delaware. No: 1:19-cv-01548-LPS.

Deposition of Kevin M. Murphy, January 18, 2020, in the Matter of The United States of America v. Sabre Corporation, Sabre GBL Inc., Farelogix, Inc., and Sandler Capital Partners V, L.P., In the United States District Court for The District of Delaware. No: 1:19-cv-01548-LPS.

Deposition of Kevin M. Murphy, January 21, 2020, and January 22, 2020, In Re Payment Card Interchange Fee and Merchant Discount Antitrust Litigation, In the United States District Court for the Eastern District of New York. No. 05-md-1720 (MKB) (JO).

Deposition of Kevin M. Murphy, January 24, 2020, In Re Dealer Management Systems Antitrust Litigation, MDL 2817, The United States District Court for the Northern District of Illinois Eastern Division. No. 1:18-CV-00864.

Deposition of Kevin M. Murphy, January 27, 2020, in the Matter of The United States of America v. Novelis Inc. and Aleris Corporation, In the United States District Court for the Northern District of Ohio. No.: 1:19-cv-02033-CAB.

Expert Report of Kevin M. Murphy, February 3, 2020, In Re Opioid Litigation, In the Supreme Court of the State of New York County of Suffolk. Index No.:400001/2017, Index No.: 400008/2017, and Index No.: 400016/2018.

Trial Testimony of Kevin M. Murphy, February 3, 2020, in the Matter of The United States of America v. Sabre Corporation, Sabre GBL Inc., Farelogix, Inc., and Sandler Capital Partners V, L.P., In the United States District Court for The District of Delaware. No: 1:19-cv-01548-LPS.

Deposition of Kevin M. Murphy, February 13, 2020, in the Matter of North American Soccer League, LLC v. United States Soccer Federation, Inc., and Major League Soccer, LLC, In the United States District Court for The Eastern District of New York. No. 1:17-cv-05495-MKB-ST.

Deposition of Kevin M. Murphy, February 19, 2020, In Re Opioid Litigation, In the Supreme Court of the State of New York County of Suffolk. Index No.:400001/2017, Index No.: 400008/2017, and Index No.: 400016/2018.

Arbitration Testimony of Kevin M. Murphy, February 25, 2020, in the Matter of The United States of America v. Novelis Inc. and Aleris Corporation, In the United States District Court for the Northern District of Ohio. No.: 1:19-cv-02033-CAB.

Expert Report of Kevin M. Murphy, May 30, 2020, in the Matter of an Independent Review Process, Afiliis Domains No. 3 Limited v. Internet Corporation for Assigned Names and Numbers, before The International Centre for Dispute Resolution.

Expert Report of Kevin M. Murphy, July 24, 2020, in the Matter of The State of Ohio v. McKesson Corporation, Cardinal Health, Inc., AmerisourceBergen Drug Corporation, and Miami-Luken, Inc., In the Court of Common Pleas for Madison County, Ohio. Case No. CVH20180055.

Expert Report of Kevin M. Murphy, August 27, 2020, in the Matters of The City of Huntington v. AmerisourceBergen Drug Corporation, et al., and Cabell County Commission v. AmerisourceBergen Drug Corporation, et al., In the United States District Court for the Southern District of West Virginia. Civil Action Nos. 3:17-01362 and 3:17-01665.

Curriculum Vitae
of
Professor Mark E. Zmijewski

Mark E. Zmijewski (Zme – yev’ -ski) Bio

Professor Zmijewski specializes in the areas of accounting, economics, and finance as they relate to valuation, financial analysis, and security analysis, or more generally, financial economics. He is Professor Emeritus at The University of Chicago Booth School of Business, and previously held the Charles T. Horngren Professorship and the Leon Carroll Marshall Professorship in his 30-year career at the Booth. In addition to his research and teaching activities, Professor Zmijewski also held the positions of Deputy Dean, Associate Dean for PhD Studies, and the Faculty Director of the Center for Research in Security Prices (CRSP), all at the Booth School of Business. Professor Zmijewski is a Senior Consultant to Charles River Associates, a consulting firm that provides economic, financial, and management consulting services. He is also a Senior Advisor to, and a member of, the Investment Committee at Patron Capital Partners (Funds IV and V), a private equity investment company with a focus on real estate related investments. Professor Zmijewski was a Founding Partner of Chicago Partners, LLC, which was acquired by Navigant Consulting. He is the former Managing Director of Navigant Economics (a subsidiary of Navigant Consulting) and a former member of the Corporate Executive Committee of Navigant Consulting.

Professor Zmijewski earned his BS in 1976, MBA in 1981, and PhD with a major in accounting and minors in economics and finance in 1983, all from the State University of New York at Buffalo. In addition to The University of Chicago, he has taught at the State University of New York at Buffalo and at York University in Toronto, Canada. He has taught various courses in accounting (financial accounting, managerial accounting, and advanced accounting/mergers and acquisitions), finance (corporate finance, financial strategy and corporate transactions, financial analysis, and valuation of companies and corporate transactions), and entrepreneurship. Professor Zmijewski's research has focused on firm valuation and the ways in which various capital market participants use information to value securities. He has published articles in academic journals in the areas of accounting and financial economics and has co-authored a textbook (with Professor Robert Holthausen of The Wharton School of the University of Pennsylvania) on how to value companies, parts of companies, and the securities issued by companies, titled "Corporate Valuation: Theory, Evidence and Practice." He has been an Associate Editor of *The Accounting Review*, and has been on the Editorial Boards of both the *Journal of Accounting Research* and *The Accounting Review*.

Professor Zmijewski has worked as a consultant or expert in litigation matters in US state and federal courts, in the Supreme Court of Victoria in Australia, and in US and international arbitrations. The issues on which he has consulted include: business valuation and securities valuation (valuation of corporate transactions, companies, and parts of companies, intangible assets and intellectual property, and securities); securities litigation (10b-5, section 11, section 12, ERISA, Martin Act, and insider trading); mergers and acquisitions (appraisals and price disputes, analyzing merger synergies, material adverse changes, corporate transactions, and the process of purchasing and selling companies); solvency and ability to pay (fraudulent conveyance, solvency assessment, and ability to pay government fines); antitrust litigation (analysis of merger efficiencies, failing firm defense, and financial analyses of alleged anticompetitive behavior); commercial and stockholder disputes (measurement of damages, accounting analyses, and economic assessment of transactions); accounting issues (measuring and analyzing revenue, cost structures, profitability, rates of return, interest rates, and other financial metrics and concepts); and creating and evaluating business plans.

The frameworks and tools used in his work are generally applicable to all industries, and he has applied his expertise in a broad range of sectors, including the airline, auto, chemical, computer hardware and software, credit card, energy, entertainment, financial services, for-profit education, health care, insurance, heavy and light manufacturing, pharmaceutical, retail, real estate investment fund, technology, telecommunications, and transportation industries, among others.

Mark E. Zmijewski
(Zme-yev'-ski)
Senior Consultant

PhD, Accounting
State University of New York
at Buffalo

MBA, Accounting
State University of New York
at Buffalo

BA, Accounting
State University of New York
at Buffalo

Academic employment

1984–Present	The University of Chicago Booth School of Business <i>Professor Emeritus</i> (2018–Present) <i>Charles T. Horngren Professor of Accounting</i> (2015–2018) <i>Leon Carroll Marshall Professor of Accounting</i> (1999–2015) <i>Deputy Dean</i> (1996–2011) <i>Professor of Accounting</i> (1992–1999) <i>Associate Dean for PhD Studies</i> (1995–1996) <i>Executive Director, Center for Research in Securities Prices (CRSP)</i> (1992–1998) <i>Associate Professor of Accounting</i> (1988–1992) <i>Assistant Professor of Accounting</i> (1984–1988)
1980–1984	<i>Assistant Professor of Accounting</i> , State University of New York at Buffalo
1979–1982	<i>Course Director</i> , York University, Toronto Canada
1977–1980	<i>Teaching Assistant</i> , State University of New York at Buffalo

Honors and awards

Business Information Professional of the Year—Education, Beta Alpha Psi, 2007.

Hillel J. Einhorn Excellence in Teaching Award, The Executive MBA Program, The University of Chicago Graduate School of Business, 1999.

Emory Williams Award for Excellence in Teaching, The University of Chicago, 1988

Competitive Manuscript Award, American Accounting Association, 1984.

Beta Alpha Psi, Honorary Accounting Society, 1981.

Beta Gamma Sigma, Honorary Business Society, 1980.

Grants

Research Grant, SEC and Financial Reporting Institute, 1985.

University Fellowship, State University of New York at Buffalo, 1979.

Graduate Fellowship, State University of New York at Buffalo, 1976–1978.

Publications

Corporate Valuation: Theory, Evidence and Practice (textbook). With Robert W. Holthausen, Cambridge Business Publishers, LLC, 1st Edition, 2014; 2nd edition, 2020.

“Valuation with Market Multiples: How to Avoid Pitfalls When Identifying and Using Comparable Companies.” With R. Holthausen. *Journal of Applied Corporate Finance*, Summer 2012.

“Pitfalls in Levering and Unlevering Beta and Cost of Capital Estimates in DCF Valuations.” With R. Holthausen. *Journal of Applied Corporate Finance*, Summer 2012.

“Accounting and Disclosure Issues in Structured Finance.” With Keith Bockus and W. Dana Northcut. In *Corporate Aftershock: The Public Policy Lessons from the Collapse of Enron and Other Major Corporations*, C.L. Culp and W.A. Niskanen, eds., Wiley, 2003.

“Discovery and the Financial Analyst.” With Roger Hickey. *Litigation Services Handbook*, January 1995.

“How Useful Are Wall Street Week Stock Recommendations?” With P. Griffin and J. Jones. *Journal of Financial Statement Analysis*, Fall 1995.

“Contemporaneous Announcements of Dividends and Earnings.” With R. Leftwich. *Journal of Accounting, Auditing, and Finance*, Autumn 1994.

“The Relative Informativeness of Accounting Disclosures in Different Countries.” With A. Alford, J. Jones, and R. Leftwich. *Journal of Accounting Research*, Supplement, 1993.

“Extensions and Violations of the Statutory SEC Form 10-K Filing Requirements.” With A. Alford and J. Jones. *Journal of Accounting and Economics*, 1993.

“SEC Form 10-K/10-Q Reports and Annual Reports to Shareholders: Reporting Lags and Squared Market Model Prediction Errors.” With P. Easton. *Journal of Accounting Research*, Winter 1993.

The Phish Corporation: A Practice Case in Managerial Accounting, With R. Derstine, R. Huefner, and S. Gunn. McGraw-Hill, 1991.

“Cross-Sectional Variation in the Stock Market Response to the Announcement of Accounting Earnings.” With P. Easton. *Journal of Accounting and Economics*, 1989.

“An Evaluation of Alternative Proxies for the Market’s Expectation of Earnings.” With L. Brown, P. Griffin, and R.L. Hagerman. *Journal of Accounting and Economics*, 1987.

"Predictive Value of Accounting Information." With P. Griffin. In *Usefulness to Investors and Creditors of Information Provided by Financial Reporting*, 2nd Edition, P. Griffin, ed. Financial Accounting Standards Board, 1987.

"Security Analyst Superiority Relative to Univariate Time-Series Models in Forecasting Quarterly Earnings." With L. Brown, P. Griffin, and R. Hagerman. *Journal of Accounting and Economics*, 1987.

"The Effect of Labor Strikes on Security Analysts' Forecast Superiority and on the Association between Risk-Adjusted Stock Returns and Unexpected Earnings." With L. Brown. *Contemporary Accounting Research*, 1987.

"Estimating Models with Binary Dependent Variables: Some Theoretical and Empirical Observations." With G. Gessner, W. Kamakura, and N. Malhotra. *Journal of Business Research*, 1987.

"Methodological Issues Related to the Estimation of Financial Distress Prediction Models." *Journal of Accounting Research*, 1984.

"The Association Between the Magnitude of Quarterly Earnings Forecast Errors and Risk-Adjusted Stock Returns." With R.L. Hagerman and P. Shah. *Journal of Accounting Research*, 1984.

"An Income Strategy Approach to the Positive Theory of Accounting Policy Setting/Choice." With R.L. Hagerman. *Journal of Accounting and Economics*, 1981. Reprinted in *The Economics of Accounting Policy Choice*, Ray Ball and Clifford Smith, Jr., eds. McGraw-Hill, 1992.

"A Test of Accounting Bias and Market Structure: Some Additional Evidence." With R.L. Hagerman. *Review of Business and Economic Research*, 1981.

"Some Economic Determinants of Accounting Policy Choice." With R.L. Hagerman. *Journal of Accounting and Economics*, 1979.

Comments on "Earnings Forecasting Research: Its Implications for Capital Markets Research." *International Journal of Forecasting*.

Dissertation committees

Sandip Madan, The University of Chicago, 1999, Member

Keith Bockus, The University of Chicago, 1998, Co-Chairperson

Beverly Walther, The University of Chicago, 1995, Member

Howard Bunsis, The University of Chicago, 1993, Co-Chairperson

Phillip Berger, The University of Chicago, 1992, Member

Stuart Essig, The University of Chicago, 1991, Member

Sherri Jarrell, The University of Chicago, 1991, Member

Andrew Alford, The University of Chicago, 1990, Chairperson

Mark Lang, The University of Chicago, 1990, Member

Laureen Maines, The University of Chicago, 1990, Member

Walter Teets, The University of Chicago, 1988, Member

Siew Teoh, The University of Chicago, 1988, Member

Kirsten Ely, The University of Chicago, 1988, Member

M. Daniel Beneish, The University of Chicago, 1987, Member

Pat O'Brien, The University of Chicago, 1986, Member

W. Forbes Cavanagh, State University of New York at Buffalo, 1985, Member

University activities

Accounting Advisory Counsel, State University of New York at Buffalo, 1993–1995.

Faculty Facilitator, Leadership, Education, and Development (LEAD) Program, The University of Chicago, Graduate School of Business, 1989, 1991.

Dean's Advisory Committee on MBA Students and Curriculum, The University of Chicago, 1988.

Executive Director, Management Development Council, State University of New York at Buffalo, 1981–1984.

Advisor, Center for Management Development, State University of New York at Buffalo, 1979–1980.

Editorial service and boards

Associate Editor, *The Accounting Review*, 1993–1997.

Editorial Board, *Journal of Accounting Research*, 1988–1993.

Editorial Board, *The Accounting Review*, 1985–1987.

Ad hoc referee

Journal of Accounting, Auditing, and Finance

The Accounting Review

Contemporary Accounting Research

The Financial Review

Journal of Accounting and Economics

Journal of Accounting Research

Journal of Banking and Finance

Journal of Business

Journal of Forecasting

International Journal of Forecasting

Management Science

Professional organizations

American Accounting Association

The American Finance Association

Testimony, declarations, and other court filings and submissions in the past five years

Federal Trade Commission v. Peabody Energy Corporation and Arch Coal, Inc. In the United States District Court for the Eastern District of Missouri, C.A. No 4:20-cv-00317-SEP. Deposition testimony June 26, 2020. Trial testimony July 24, 2020.

Zantran Pty Limited, Applicant vs. Crown Resorts Limited, Respondent. In the Federal Court of Australia Victoria Registry, Case No. VID 1317/2017. Expert Reports April 18, 2019 and March 27, 2020.

Alison Court, et al., Applicants vs. Spotless Group Holdings Limited, Respondent. In the Federal Court of Australia Victoria Registry, Case No. VID 561/2017. Expert Reports December 22, 2019 and March 25, 2020.

In Re American Realty Capital Properties, Inc. Litigation. In the United States District Court for the Southern District of New York, C.A. No. 1:15-mc-00040-AKH. Deposition testimony July 26, 2019.

In Re Appraisal of Jarden Corporation. In the Court of Chancery of the State of Delaware, Consol. C.A. No. 12456-VCS. Deposition testimony May 2, 2018. Trial testimony June 26, 2018 and June 28, 2018. Affidavit July 26, 2019.

In Re Bracket Holding Corp. Litigation. In the Superior Court of the State of Delaware, Consol. C.A. No. N15C-02-233 WCC CCLD. Deposition testimony September 20, 2018. Affidavit July 25, 2019.

Nathan F. Brand et al. v. William A. Linton and Promega Corporation. State of Wisconsin Dane County Circuit Court, Case No. 2016CV001978. Deposition testimony November 14, 2018. Trial testimony July 22, 2019.

Precision Castparts Corp. and PCC Germany Holdings GMBH v. Schulz Holding GMBH & Co. KG, et al. International Centre For Dispute Resolution, American Arbitration Association, Case No. 01-18-0001-0115. First witness statement November 16, 2018. Second witness statement May 17, 2019. Arbitration testimony July 1, 2019.

Reynolds American Inc. v. Third Motion Equities Master Fund Ltd, et al. State of North Carolina Forsythe County. In the General Court of Justice, Superior Court Division, Case No. 17 CVS 7086. Deposition testimony April 17, 2019. Trial testimony June 17, 2019.

In Re Appraisal of Stillwater Mining Company. In the Court of Chancery of the State of Delaware. Consol. C.A. No. 2017-0385-JTL. Deposition testimony November 27, 2018. Trial testimony December 13, 2018.

In Re Appraisal of Columbia Pipeline Group, Inc. In the Court of Chancery of the State of Delaware, Consol. C.A. No. 12736-VCL. Deposition testimony August 14, 2018. Trial testimony November 2, 2018.

Federal Trade Commission v. Tronox Limited, et al. In the United States District Court for the District of Columbia, Docket No. D09377. Deposition testimony May 15, 2018. Trial testimony May 31, 2018.

Brian Jones, Applicant vs. Treasury Wine Estates Limited, Respondent. In the Federal Court of Australia District of New South Wales, Case No. NSD 660 of 2014. Expert Report February 4, 2017, Expert Rebuttal Report July 10, 2017, Supplemental Expert Rebuttal Report August 17, 2017.

Money Max Int Pty Limited (ACN 152 073 580), as a trustee for the Goldie Superannuation Fund, Applicant vs. QBE Insurance Group Limited (ACN 008 485 014), Respondent. In the Federal Court of Australia, Case No. VID 513 of 2015. Expert Report August 10, 2017.

United States of America v. Bumble Bee Foods, LLC. In the United States District Court, Northern District of California, San Francisco Division, Case No. 17-CR-00249 CRB. Presentations before the U.S. Department of Justice, Antitrust Division September 20, 2016 and January 9, 2017. Declaration filed July 18, 2017.

Authenticom, Inc. v. CDK Global, LLC and The Reynolds and Reynolds Company. In the United States District Court for the Western District of Wisconsin, Case No. 17-CV-318. Declaration filed June 16, 2017. Trial testimony June 28, 2017.

United States Securities and Exchange Commission v. ITT Educational Services, Inc. et al. In the United States District Court, Southern District of Indiana, Indianapolis Division, Case No. 15-CV-00758. Deposition testimony May 10, 2017.

In the matter of Determination of Rates and Terms for Making and Distributing Phonorecords (Phonorecords III). Before the Copyright Royalty Board Library of Congress, Washington, D.C., Docket No. 16-CRB-0003-PR (2018-2022). Trial testimony April 12, 2017.

PharMerica Corporation et al. v. AmerisourceBergen Drug Corporation v. BGS Pharmacy Holding Company et al. In the Jefferson Circuit Court Division Ten (10), Case No. 14-CI-004682. Deposition testimony April 4, 2017.

In Re Caesars Entertainment Operating Company, Inc., et al. Chapter 11 Bankruptcy Case. In the United States Bankruptcy Court for the Northern District of Illinois Eastern Division, Case No. 15-01145 (ABG). Declaration filed December 2, 2016.

Beef Products, Inc., BPI Technology, Inc. and Freezing Machines, Inc. v. American Broadcasting Companies, Inc., ABC News, Inc., Diane Sawyer, Jim Avila, David Kerley, Gerald Zirnstein, Carl Custer, and Kit Foshee. In the State of South Dakota in the County of Union First Judicial Circuit, Case No. 12-292. Deposition testimony August 25, 2016.

In Re Harman International Industries, Inc. Securities Litigation. In the United States District Court for the District of Columbia, Case No. 1:07-cv-01757-RC. Deposition testimony July 27, 2016.

Avisep, S.A. de C.V., and Bevisep, S.A. de C.V., Claimants, v. The Sherwin-Williams Company, and Sherwin-Williams (Caribbean) N.V., Respondents. In the International Court of Arbitration, International Chamber of Commerce, No. 20169/RD. Arbitration testimony April 18, 2016.

Federal Trade Commission, et al., Plaintiffs v. Staples, Inc. and Office Depot, Inc., Defendants. In the United States District Court for the District of Columbia, Civil Action No. 1:15-cv-02115-EGS. Deposition testimony March 14, 2016.

In Re Groupon, Inc. Securities Litigation. In the United States District Court for the Northern District of Illinois, Eastern Division, 12-CV-2450. Deposition testimony November 5, 2015. Declaration filed January 15, 2016.

Exelon Corporation, as successor by merger to Unicom Corporation and Subsidiaries, et al., Petitioner, v. Commissioner of Internal Revenue Service, Respondent. In the United States Tax Court, Docket Nos. 29183-13 and 29184-13. Trial testimony August 20, 2015.

Ahmed D. Hussein, Plaintiff, v. Sheldon Razin et al., Defendants. In the Superior Court of the State of California For the County of Orange, Case No. 30-2013-00679600-CU-NP-CJC. Deposition testimony June 10, 2015.

Lavastone Capital LLC, Plaintiff, v. Coventry First LLC, LST I LLC, LST II LLC, LST Holdings Ltd., Montgomery Capital, Inc., Alan Buerger, Reid Buerger, Constance Buerger, and Krista Lake, Defendants. In the United States District Court for the Southern District of New York, Case No. 14-CF-7139 (JSR)(DCF). Deposition testimony April 29, 2015. Trial testimony October 23, 2015.

Exhibit 1

Railroad Percentiles within Sample - STB Definition of Return on Invested Capital (ROIC) and STB Definition of Cost of Capital (COC) (Railroads' Return on Invested Capital and Cost of Capital Using STB Data)

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Min	Max	Median	Average
Panel A: S&P 500 Companies Excluding Railroads, Financial Institutions and Real Estate Companies																		
Sample Number of Observations, Median, 25th Percentile, and % Positive ROIC minus COC:																		
Number of Observations in Sample	398	395	402	405	402	401	397	395	392	383	371	368	378	380	368	405	395	391
Median ROIC minus COC	16%	16%	16%	13%	18%	19%	19%	21%	20%	22%	22%	20%	29%	25%	13%	29%	19%	20%
25th Percentile ROIC minus COC	5%	5%	3%	-1%	5%	6%	5%	4%	5%	4%	4%	5%	6%	5%	-1%	6%	5%	4%
% with ROIC minus COC > 0.0%	90%	89%	86%	73%	89%	91%	89%	90%	90%	88%	85%	89%	90%	91%	73%	91%	89%	88%
Railroad Percentile in the Distribution of ROIC minus COC:																		
Industry Weighted Average ROIC	11	9	12	21	10	10	13	15	19	18	18	12	12	22	9	22	13	14
BNSF Railway	15	9	11	23	10	11	16	17	19	22	17	12	11	20	9	23	15	15
CSX Corporation	8	6	10	20	10	9	11	7	9	12	15	9	13	23	6	23	10	12
Grand Trunk Corporation	10	9	10	16	7	5	10	12	13	14	15	8	3	7	3	16	10	10
Kansas City Southern	9	8	8	18	9	8	10	5	6	9	12	8	4	5	4	18	8	9
Norfolk Southern Corporation	24	18	22	21	11	12	12	12	14	12	16	11	10	18	10	24	13	15
Soo Line Corporation	15	23	10	17	6	3	5	12	2	26	16	12	14	17	2	26	13	13
Union Pacific Corporation	8	8	11	23	13	13	22	25	30	28	27	22	22	28	8	30	22	20
Panel B: S&P 500 Companies in the Industrials Sector Excluding Railroads																		
Sample Number of Observations, Median, 25th Percentile, and % Positive ROIC minus COC:																		
Number of Observations in Sample	48	52	55	53	54	56	53	56	57	59	63	62	62	61	48	63	56	57
Median ROIC minus COC	20%	23%	21%	14%	17%	21%	22%	22%	23%	24%	28%	28%	30%	31%	14%	31%	23%	23%
25th Percentile ROIC minus COC	11%	13%	13%	4%	10%	13%	12%	14%	11%	13%	9%	14%	13%	14%	4%	14%	13%	12%
% with ROIC minus COC > 0.0%	96%	92%	98%	83%	94%	96%	96%	96%	96%	97%	94%	100%	95%	97%	83%	100%	96%	95%
Railroad Percentile in the Distribution of ROIC minus COC:																		
Industry Weighted Average ROIC	6	6	4	11	7	5	6	7	10	12	9	2	6	8	2	12	7	7
BNSF Railway	10	6	4	11	7	5	6	7	10	13	9	2	6	8	2	13	7	7
CSX Corporation	4	6	4	9	7	5	6	4	5	5	8	2	6	8	2	9	5	6
Grand Trunk Corporation	6	6	4	7	4	2	6	5	9	7	8	2	2	3	2	9	5	5
Kansas City Southern	6	6	4	9	5	5	6	4	3	3	6	2	2	3	2	9	4	5
Norfolk Southern Corporation	14	9	9	11	7	5	6	5	9	5	8	2	6	8	2	14	8	7
Soo Line Corporation	10	13	4	7	2	2	2	5	2	15	8	2	6	8	2	15	6	6
Union Pacific Corporation	4	6	4	11	9	5	7	9	21	15	11	6	13	15	4	21	9	10
Panel C: Railroad Customer Sample of S&P 500 Companies																		
Sample Number of Observations, Median, 25th Percentile, and % Positive ROIC minus COC:																		
Number of Observations in Sample	80	80	81	82	84	84	84	83	84	86	85	83	84	82	80	86	84	83
Median ROIC minus COC	13%	12%	9%	3%	12%	13%	10%	7%	7%	8%	6%	8%	11%	9%	3%	13%	9%	9%
25th Percentile ROIC minus COC	4%	4%	1%	-4%	3%	3%	2%	2%	1%	2%	-1%	2%	2%	1%	-4%	4%	2%	2%
% with ROIC minus COC > 0.0%	88%	86%	79%	61%	86%	85%	83%	87%	83%	81%	72%	83%	85%	79%	61%	88%	83%	81%
Railroad Percentile in the Distribution of ROIC minus COC:																		
Industry Weighted Average ROIC	14	7	18	30	15	19	25	24	34	28	36	20	20	36	7	36	22	23
BNSF Railway	17	7	16	33	14	20	27	29	34	36	35	20	16	34	7	36	24	24
CSX Corporation	11	5	13	30	15	16	15	10	16	18	29	17	20	36	5	36	16	18
Grand Trunk Corporation	12	7	13	24	14	8	14	17	24	21	29	13	5	17	5	29	14	16
Kansas City Southern	12	7	10	28	14	13	13	7	13	16	22	12	5	13	5	28	13	13
Norfolk Southern Corporation	28	20	30	30	15	21	18	17	25	18	29	18	15	31	15	31	20	23
Soo Line Corporation	17	27	13	24	12	6	6	17	6	43	30	20	21	30	6	43	19	19
Union Pacific Corporation	11	6	16	33	16	21	35	42	49	46	45	36	34	45	6	49	35	31

Sources: Bloomberg; Compustat; Ibbotson Yearbook (2006-2019); STB Revenue Adequacy Determination Report (2006-2018); RevAd 2019 AAR workpaper1.pdf, titled "AAR Duplication of STB Workpapers."

Exhibit 2

Railroad Percentiles within Sample - Adjusted STB Definition of Return on Invested Capital (ROIC) and STB Definition of Cost of Capital (COC)
(Railroads' Return on Invested Capital and Cost of Capital Using STB Data)

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Min	Max	Median	Average
Panel A: S&P 500 Companies Excluding Railroads, Financial Institutions and Real Estate Companies																		
<u>Sample Number of Observations, Median, 25th Percentile, and % Positive ROIC minus COC:</u>																		
Number of Observations in Sample	405	401	409	415	413	414	413	412	410	408	402	393	395	394	393	415	409	406
Median ROIC minus COC	9%	9%	9%	5%	11%	11%	10%	11%	9%	10%	9%	7%	12%	10%	5%	12%	10%	9%
25th Percentile ROIC minus COC	1%	2%	1%	-2%	3%	3%	3%	2%	2%	2%	2%	2%	2%	2%	-2%	3%	2%	2%
% with ROIC minus COC > 0.0%	81%	82%	80%	68%	86%	87%	86%	87%	87%	84%	82%	82%	84%	84%	68%	87%	84%	83%
<u>Railroad Percentile in the Distribution of ROIC minus COC:</u>																		
Industry Weighted Average ROIC	14	9	12	22	9	12	13	11	13	17	18	11	11	23	9	23	13	14
BNSF Railway	17	10	12	24	10	16	13	12	14	20	18	11	8	20	8	24	14	15
CSX Corporation	10	8	10	20	9	10	12	6	8	11	15	10	12	25	6	25	10	12
Grand Trunk Corporation	13	9	10	14	7	6	8	7	9	15	15	9	4	10	4	15	9	10
Kansas City Southern	15	11	10	20	11	10	13	9	9	12	14	9	5	8	5	20	10	11
Norfolk Southern Corporation	16	12	17	21	7	11	11	8	9	10	15	11	8	19	7	21	11	13
Soo Line Corporation	28	34	10	16	7	5	4	13	1	23	18	11	14	16	1	34	13	14
Union Pacific Corporation	10	8	14	23	11	13	17	16	30	30	26	17	22	34	8	34	17	19
Panel B: S&P 500 Companies in the Industrials Sector Excluding Railroads																		
<u>Sample Number of Observations, Median, 25th Percentile, and % Positive ROIC minus COC:</u>																		
Number of Observations in Sample	48	53	56	54	55	57	56	60	61	63	66	65	65	64	48	66	59	59
Median ROIC minus COC	13%	15%	15%	5%	12%	15%	13%	13%	12%	12%	11%	12%	13%	14%	5%	15%	13%	13%
25th Percentile ROIC minus COC	9%	8%	7%	1%	6%	8%	6%	6%	4%	7%	7%	7%	6%	9%	1%	9%	7%	6%
% with ROIC minus COC > 0.0%	92%	91%	95%	80%	95%	95%	93%	95%	90%	90%	92%	97%	94%	95%	80%	97%	93%	92%
<u>Railroad Percentile in the Distribution of ROIC minus COC:</u>																		
Industry Weighted Average ROIC	6	6	4	13	5	7	9	5	10	13	7	2	3	11	2	13	7	7
BNSF Railway	6	6	4	15	5	9	9	5	11	16	6	2	3	9	2	16	6	7
CSX Corporation	4	4	4	13	5	5	9	3	3	8	6	2	6	11	2	13	5	6
Grand Trunk Corporation	4	6	4	7	4	2	5	3	6	11	6	2	2	3	2	11	4	5
Kansas City Southern	6	6	4	11	5	5	9	5	6	8	6	2	2	3	2	11	5	5
Norfolk Southern Corporation	6	6	5	13	4	5	9	5	6	5	6	2	3	9	2	13	5	6
Soo Line Corporation	16	19	4	7	4	2	4	7	2	17	6	2	8	6	2	19	6	7
Union Pacific Corporation	4	4	4	13	5	7	12	7	23	17	10	3	8	12	3	23	7	9
Panel C: Railroad Customer Sample of S&P 500 Companies																		
<u>Sample Number of Observations, Median, 25th Percentile, and % Positive ROIC minus COC:</u>																		
Number of Observations in Sample	80	80	81	82	84	84	84	83	84	87	86	84	85	83	80	87	84	83
Median ROIC minus COC	9%	7%	6%	0%	7%	8%	5%	4%	3%	3%	3%	3%	5%	5%	0%	9%	5%	5%
25th Percentile ROIC minus COC	1%	2%	0%	-5%	2%	2%	0%	1%	0%	1%	-2%	0%	1%	0%	-5%	2%	0%	0%
% with ROIC minus COC > 0.0%	84%	81%	70%	52%	81%	83%	76%	81%	74%	79%	67%	76%	81%	76%	52%	84%	78%	76%
<u>Railroad Percentile in the Distribution of ROIC minus COC:</u>																		
Industry Weighted Average ROIC	12	7	20	34	15	16	21	17	27	22	31	15	16	39	7	39	18	21
BNSF Railway	14	7	18	36	15	20	22	19	27	33	31	14	12	33	7	36	20	22
CSX Corporation	9	6	17	31	15	16	18	10	15	16	29	13	16	39	6	39	16	18
Grand Trunk Corporation	12	7	15	22	14	9	11	10	16	22	29	13	5	21	5	29	14	15
Kansas City Southern	12	9	15	31	15	16	19	15	16	16	25	13	6	15	6	31	15	16
Norfolk Southern Corporation	12	11	24	33	15	16	18	12	16	15	28	14	12	31	11	33	16	18
Soo Line Corporation	32	36	15	25	14	6	8	20	6	39	31	15	17	25	6	39	19	21
Union Pacific Corporation	9	7	22	36	15	16	29	24	49	49	47	24	29	48	7	49	26	29

Sources: Bloomberg; Compustat; Ibbotson Yearbook (2006-2019); STB Revenue Adequacy Determination Report (2006-2018); RevAd 2019 AAR workpaper1.pdf, titled "AAR Duplication of STB Workpapers."

S&P 500 Companies by Year

ACTIVISION BLIZZARD INC	ATVI	Communication Services	0	0	0	0	0	0	0	0	0	1	1	1	1	1
ALLTEL CORP	AT.2	Communication Services	1	0	0	0	0	0	0	0	0	0	0	0	0	0
ALPHABET INC	GOOGL	Communication Services	1	1	1	1	1	1	1	1	1	1	1	1	1	1
ALTICE USA INC	ATUS	Communication Services	0	0	0	0	1	1	1	1	1	1	0	0	0	0
AT&T INC	T	Communication Services	1	1	1	1	1	1	1	1	1	1	1	1	1	1
BELLSOUTH CORP	BLS	Communication Services	1	0	0	0	0	0	0	0	0	0	0	0	0	0
CENTURYLINK INC	CTL	Communication Services	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CHARTER COMMUNICATIONS INC	CHTR	Communication Services	0	0	0	0	0	0	0	0	0	0	1	1	1	1
COMCAST CORP	CMCSA	Communication Services	1	1	1	1	1	1	1	1	1	1	1	1	1	1
DISCOVERY INC	DISCA	Communication Services	0	0	0	0	1	1	1	1	1	1	1	1	1	1
DISH NETWORK CORP	DISH	Communication Services	0	0	0	0	0	0	0	0	0	0	0	1	1	1
DISNEY (WALT) CO	DIS	Communication Services	1	1	1	1	1	1	1	1	1	1	1	1	1	1
ELECTRONIC ARTS INC	EA	Communication Services	1	1	1	1	1	1	1	1	1	1	1	1	1	1
EMBARQ CORP	EQ.2	Communication Services	1	1	1	0	0	0	0	0	0	0	0	0	0	0
EW SCRIPPS -CL A	SSP	Communication Services	1	1	0	0	0	0	0	0	0	0	0	0	0	0
FACEBOOK INC	FB	Communication Services	0	0	0	0	0	0	0	1	1	1	1	1	1	1
FOX CORP	FOXA	Communication Services	0	0	0	0	0	0	0	0	0	0	0	0	0	1
FRONTIER COMMUNICATIONS CORP	FTRCQ	Communication Services	1	1	1	1	1	1	1	1	1	1	1	0	0	0
IHEARTMEDIA INC	IHRT	Communication Services	1	1	0	0	0	0	0	0	0	0	0	0	0	0
INTERPUBLIC GROUP OF COS	IPG	Communication Services	1	1	1	1	1	1	1	1	1	1	1	1	1	1
LEVEL 3 COMMUNICATIONS INC	LVLTL	Communication Services	0	0	0	0	0	0	0	0	1	1	1	0	0	0
LIVE NATION ENTERTAINMENT	LYV	Communication Services	0	0	0	0	0	0	0	0	0	0	0	0	0	1
MATCH GROUP INC	MTCH	Communication Services	1	1	0	0	0	0	0	0	0	0	0	0	0	0
MEREDITH CORP	MDP	Communication Services	1	1	1	1	1	0	0	0	0	0	0	0	0	0
METROPCS COMMUNICATIONS INC	PCS	Communication Services	0	0	0	1	1	1	1	0	0	0	0	0	0	0
NETFLIX INC	NFLX	Communication Services	0	0	0	0	1	1	1	1	1	1	1	1	1	1
NEW YORK TIMES CO -CL A	NYT	Communication Services	1	1	1	1	0	0	0	0	0	0	0	0	0	0
NEWS CORP	NWSA	Communication Services	0	0	0	0	0	0	0	1	1	1	1	1	1	1
OMNICOM GROUP	OMC	Communication Services	1	1	1	1	1	1	1	1	1	1	1	1	1	1
QWEST COMMUNICATION INTL INC	Q.2	Communication Services	1	1	1	1	1	0	0	0	0	0	0	0	0	0
SPRINT CORP	S	Communication Services	1	1	1	1	1	1	1	0	0	0	0	0	0	0
TAKE-TWO INTERACTIVE SFTWR	TTWO	Communication Services	0	0	0	0	0	0	0	0	0	0	0	0	1	1
TEGNA INC	TGNA	Communication Services	1	1	1	1	1	1	1	1	1	1	1	0	0	0
T-MOBILE US INC	TMUS	Communication Services	0	0	0	0	0	0	0	0	0	0	0	0	0	1
TRIBUNE MEDIA CO	TRCO	Communication Services	1	0	0	0	0	0	0	0	0	0	0	0	0	0
TRIPADVISOR INC	TRIP	Communication Services	0	0	0	0	0	1	1	1	1	1	1	1	1	0
TWENTY-FIRST CENTURY FOX INC	TFCFA	Communication Services	1	1	1	1	1	1	1	1	1	1	1	1	1	0
TWITTER INC	TWTR	Communication Services	0	0	0	0	0	0	0	0	0	0	0	0	1	1
VERIZON COMMUNICATIONS INC	VZ	Communication Services	1	1	1	1	1	1	1	1	1	1	1	1	1	1
VIACOM INC	VIAB	Communication Services	1	1	1	1	1	1	1	1	1	1	1	1	1	0

Appendix A, Exhibit A1

S&P 500 Companies by Year

Company Name	Company Ticker	GICS Sector	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Number of S&P 500 Companies			500	500	500	500	500	500	500	500	500	500	500	500	500	500
Railroads, Financial Institutions, and Real Estate Companies			92	99	90	85	87	86	87	87	89	91	96	104	103	101
Sample Number of S&P 500 Companies			408	401	410	415	413	414	413	413	411	409	404	396	397	399
VIACOMCBS INC	VIAC	Communication Services	1	1	1	1	1	1	1	1	1	1	1	1	1	1
WINDSTREAM HOLDINGS INC	WINMQ	Communication Services	1	1	1	1	1	1	1	1	1	0	0	0	0	0
ABERCROMBIE & FITCH -CL A	ANF	Consumer Discretionary	0	1	1	1	1	1	1	0	0	0	0	0	0	0
ADTALEM GLOBAL EDUCATION INC	ATGE	Consumer Discretionary	0	0	0	1	1	1	0	0	0	0	0	0	0	0
ADVANCE AUTO PARTS INC	AAP	Consumer Discretionary	0	0	0	0	0	0	0	0	0	1	1	1	1	1
ALTABA INC	AABA	Consumer Discretionary	1	1	1	1	1	1	1	1	1	1	1	0	0	0
AMAZON.COM INC	AMZN	Consumer Discretionary	1	1	1	1	1	1	1	1	1	1	1	1	1	1
APOLLO EDUCATION GROUP INC	APOL	Consumer Discretionary	1	1	1	1	1	1	1	0	0	0	0	0	0	0
APTIV PLC	APTV	Consumer Discretionary	0	0	0	0	0	0	1	1	1	1	1	1	1	1
AUTONATION INC	AN	Consumer Discretionary	1	1	1	1	1	1	1	1	1	1	1	0	0	0
AUTOZONE INC	AZO	Consumer Discretionary	1	1	1	1	1	1	1	1	1	1	1	1	1	1
BED BATH & BEYOND INC	BBBY	Consumer Discretionary	1	1	1	1	1	1	1	1	1	1	1	0	0	0
BEST BUY CO INC	BBY	Consumer Discretionary	1	1	1	1	1	1	1	1	1	1	1	1	1	1
BIG LOTS INC	BIG	Consumer Discretionary	1	1	1	1	1	1	1	0	0	0	0	0	0	0
BLACK & DECKER CORP	BDK	Consumer Discretionary	1	1	1	1	0	0	0	0	0	0	0	0	0	0
BLOCK H & R INC	HRB	Consumer Discretionary	1	1	1	1	1	1	1	1	1	1	1	1	1	1
BOOKING HOLDINGS INC	BKNG	Consumer Discretionary	0	0	0	1	1	1	1	1	1	1	1	1	1	1
BORGWARNER INC	BWA	Consumer Discretionary	0	0	0	0	0	1	1	1	1	1	1	1	1	1
BRUNSWICK CORP	BC	Consumer Discretionary	1	1	0	0	0	0	0	0	0	0	0	0	0	0
CAESARS ENTERTAINMENT CORP	CZR	Consumer Discretionary	1	1	0	0	0	0	0	0	0	0	0	0	0	0
CAPRI HOLDINGS LTD	CPRI	Consumer Discretionary	0	0	0	0	0	0	0	1	1	1	1	1	1	1
CARMAX INC	KMX	Consumer Discretionary	0	0	0	0	1	1	1	1	1	1	1	1	1	1
CARNIVAL CORPORATION & PLC	CCL	Consumer Discretionary	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CENTEX CORP	CTX.2	Consumer Discretionary	1	1	1	0	0	0	0	0	0	0	0	0	0	0
CHIPOTLE MEXICAN GRILL INC	CMG	Consumer Discretionary	0	0	0	0	0	1	1	1	1	1	1	1	1	1
CIRCUIT CITY STORES INC	CCTYQ	Consumer Discretionary	1	1	0	0	0	0	0	0	0	0	0	0	0	0
D R HORTON INC	DHI	Consumer Discretionary	1	1	1	1	1	1	1	1	1	1	1	1	1	1
DARDEN RESTAURANTS INC	DRI	Consumer Discretionary	1	1	1	1	1	1	1	1	1	1	1	1	1	1
DILLARDS INC -CL A	DDS	Consumer Discretionary	1	1	0	0	0	0	0	0	0	0	0	0	0	0
DIRECTV	DTV.2	Consumer Discretionary	1	1	1	1	1	1	1	1	1	0	0	0	0	0
DOLLAR GENERAL CORP	DG	Consumer Discretionary	1	0	0	0	0	0	1	1	1	1	1	1	1	1
DOLLAR TREE INC	DLTR	Consumer Discretionary	0	0	0	0	0	1	1	1	1	1	1	1	1	1
DOW JONES & CO INC	DJ	Consumer Discretionary	1	0	0	0	0	0	0	0	0	0	0	0	0	0
EBAY INC	EBAY	Consumer Discretionary	1	1	1	1	1	1	1	1	1	1	1	1	1	1
EXPEDIA GROUP INC	EXPE	Consumer Discretionary	0	1	1	1	1	1	1	1	1	1	1	1	1	1
FAMILY DOLLAR STORES	FDO	Consumer Discretionary	1	1	1	1	1	1	1	1	1	0	0	0	0	0
FOOT LOCKER INC	FL	Consumer Discretionary	0	0	0	0	0	0	0	0	0	0	1	1	1	0
FORD MOTOR CO	F	Consumer Discretionary	1	1	1	1	1	1	1	1	1	1	1	1	1	1
FOSSIL GROUP INC	FOSL	Consumer Discretionary	0	0	0	0	0	0	1	1	1	1	0	0	0	0
GAMESTOP CORP	GME	Consumer Discretionary	0	1	1	1	1	1	1	1	1	1	0	0	0	0

S&P 500 Companies by Year

Company Name	Company Ticker	GICS Sector	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Number of S&P 500 Companies			500	500	500	500	500	500	500	500	500	500	500	500	500	500
Railroads, Financial Institutions, and Real Estate Companies			92	99	90	85	87	86	87	87	89	91	96	104	103	101
Sample Number of S&P 500 Companies			408	401	410	415	413	414	413	413	411	409	404	396	397	399
GAP INC	GPS	Consumer Discretionary	1	1	1	1	1	1	1	1	1	1	1	1	1	1
GARMIN LTD	GRMN	Consumer Discretionary	0	0	0	0	0	0	1	1	1	1	1	1	1	1
GENERAL MOTORS CO	GM	Consumer Discretionary	1	1	1	0	0	0	0	1	1	1	1	1	1	1
GENUINE PARTS CO	GPC	Consumer Discretionary	1	1	1	1	1	1	1	1	1	1	1	1	1	1
GOODYEAR TIRE & RUBBER CO	GT	Consumer Discretionary	1	1	1	1	1	1	1	1	1	1	1	1	1	0
GRAHAM HOLDINGS CO	GHC	Consumer Discretionary	0	1	1	1	1	1	1	1	0	0	0	0	0	0
HANESBRANDS INC	HBI	Consumer Discretionary	0	0	0	0	0	0	0	0	0	1	1	1	1	1
HARLEY-DAVIDSON INC	HOG	Consumer Discretionary	1	1	1	1	1	1	1	1	1	1	1	1	1	1
HARMAN INTERNATIONAL INDS	HAR	Consumer Discretionary	1	1	1	1	1	1	1	1	1	1	1	0	0	0
HASBRO INC	HAS	Consumer Discretionary	1	1	1	1	1	1	1	1	1	1	1	1	1	1
HILTON WORLDWIDE HOLDINGS	HLT	Consumer Discretionary	1	0	0	0	0	0	0	0	0	0	0	1	1	1
HOME DEPOT INC	HD	Consumer Discretionary	1	1	1	1	1	1	1	1	1	1	1	1	1	1
INTL GAME TECHNOLOGY	IGT.1	Consumer Discretionary	1	1	1	1	1	1	1	1	0	0	0	0	0	0
JONES GROUP INC	JNY	Consumer Discretionary	1	1	1	0	0	0	0	0	0	0	0	0	0	0
KATE SPADE & CO	KATE	Consumer Discretionary	1	1	0	0	0	0	0	0	0	0	0	0	0	0
KB HOME	KBH	Consumer Discretionary	1	1	1	0	0	0	0	0	0	0	0	0	0	0
KOHL'S CORP	KSS	Consumer Discretionary	1	1	1	1	1	1	1	1	1	1	1	1	1	1
L BRANDS INC	LB	Consumer Discretionary	1	1	1	1	1	1	1	1	1	1	1	1	1	1
LAS VEGAS SANDS CORP	LVS	Consumer Discretionary	0	0	0	0	0	0	0	0	0	0	0	0	0	1
LEGGETT & PLATT INC	LEG	Consumer Discretionary	1	1	1	1	1	1	1	1	1	1	1	1	1	1
LENNAR CORP	LEN	Consumer Discretionary	1	1	1	1	1	1	1	1	1	1	1	1	1	1
LKQ CORP	LKQ	Consumer Discretionary	0	0	0	0	0	0	0	0	0	0	1	1	1	1
LOWE'S COS INC	LOW	Consumer Discretionary	1	1	1	1	1	1	1	1	1	1	1	1	1	1
MACY'S INC	M	Consumer Discretionary	1	1	1	1	1	1	1	1	1	1	1	1	1	1
MARRIOTT INTL INC	MAR	Consumer Discretionary	1	1	1	1	1	1	1	1	1	1	1	1	1	1
MATTEL INC	MAT	Consumer Discretionary	1	1	1	1	1	1	1	1	1	1	1	1	1	0
MCDONALD'S CORP	MCD	Consumer Discretionary	1	1	1	1	1	1	1	1	1	1	1	1	1	1
MGM RESORTS INTERNATIONAL	MGM	Consumer Discretionary	0	0	0	0	0	0	0	0	0	0	0	1	1	1
MOHAWK INDUSTRIES INC	MHK	Consumer Discretionary	0	0	0	0	0	0	0	1	1	1	1	1	1	1
NEWELL BRANDS INC	NWL	Consumer Discretionary	1	1	1	1	1	1	1	1	1	1	1	1	1	1
NIKE INC -CL B	NKE	Consumer Discretionary	1	1	1	1	1	1	1	1	1	1	1	1	1	1
NORDSTROM INC	JWN	Consumer Discretionary	1	1	1	1	1	1	1	1	1	1	1	1	1	1
NORWEGIAN CRUISE LINE HLDGS	NCLH	Consumer Discretionary	0	0	0	0	0	0	0	0	0	0	0	1	1	1
NVR INC	NVR	Consumer Discretionary	0	0	0	0	0	0	0	0	0	0	0	0	0	1
ODP CORP	ODP	Consumer Discretionary	1	1	1	1	0	0	0	0	0	0	0	0	0	0
OFFICEMAX INC	OMX	Consumer Discretionary	1	1	0	0	0	0	0	0	0	0	0	0	0	0
O'REILLY AUTOMOTIVE INC	ORLY	Consumer Discretionary	0	0	0	1	1	1	1	1	1	1	1	1	1	1
PENNEY (J C) CO	JCPNQ	Consumer Discretionary	1	1	1	1	1	1	1	0	0	0	0	0	0	0
PETSMART INC	PETM	Consumer Discretionary	0	0	0	0	0	0	1	1	1	0	0	0	0	0
PULTEGROUP INC	PHM	Consumer Discretionary	1	1	1	1	1	1	1	1	1	1	1	1	1	1

S&P 500 Companies by Year

[illegible]

Appendix A, Exhibit A1

S&P 500 Companies by Year

Company Name	Company Ticker	GICS Sector	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Number of S&P 500 Companies			500	500	500	500	500	500	500	500	500	500	500	500	500	500
Railroads, Financial Institutions, and Real Estate Companies			92	99	90	85	87	86	87	87	89	91	96	104	103	101
Sample Number of S&P 500 Companies			408	401	410	415	413	414	413	413	411	409	404	396	397	399
CONAGRA BRANDS INC	CAG	Consumer Staples	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CONSTELLATION BRANDS	STZ	Consumer Staples	1	1	1	1	1	1	1	1	1	1	1	1	1	1
COSTCO WHOLESALE CORP	COST	Consumer Staples	1	1	1	1	1	1	1	1	1	1	1	1	1	1
COTY INC	COTY	Consumer Staples	0	0	0	0	0	0	0	0	0	0	1	1	1	1
DEAN FOODS CO	DFODQ	Consumer Staples	1	1	1	1	1	1	1	0	0	0	0	0	0	0
DR PEPPER SNAPPLE GROUP INC	DPS	Consumer Staples	0	0	1	1	1	1	1	1	1	1	1	1	0	0
GENERAL MILLS INC	GIS	Consumer Staples	1	1	1	1	1	1	1	1	1	1	1	1	1	1
HERSHEY CO	HSY	Consumer Staples	1	1	1	1	1	1	1	1	1	1	1	1	1	1
HILLSHIRE BRANDS CO	HSH	Consumer Staples	1	1	1	1	1	1	0	0	0	0	0	0	0	0
HORMEL FOODS CORP	HRL	Consumer Staples	0	0	0	1	1	1	1	1	1	1	1	1	1	1
KELLOGG CO	K	Consumer Staples	1	1	1	1	1	1	1	1	1	1	1	1	1	1
KEURIG DR PEPPER INC	KDP	Consumer Staples	0	0	0	0	0	0	0	0	1	1	0	0	0	0
KIMBERLY-CLARK CORP	KMB	Consumer Staples	1	1	1	1	1	1	1	1	1	1	1	1	1	1
KRAFT FOODS GROUP INC	KRFT	Consumer Staples	0	0	0	0	0	0	1	1	1	0	0	0	0	0
KRAFT HEINZ CO	KHC	Consumer Staples	1	1	1	1	1	1	1	0	0	1	1	1	1	1
KROGER CO	KR	Consumer Staples	1	1	1	1	1	1	1	1	1	1	1	1	1	1
LAMB WESTON HOLDINGS INC	LW	Consumer Staples	0	0	0	0	0	0	0	0	0	0	0	0	1	1
LAUDER (ESTEE) COS INC -CL A	EL	Consumer Staples	1	1	1	1	1	1	1	1	1	1	1	1	1	1
LORILLARD INC	LO	Consumer Staples	0	0	1	1	1	1	1	1	1	0	0	0	0	0
MCCORMICK & CO INC	MKC	Consumer Staples	1	1	1	1	1	1	1	1	1	1	1	1	1	1
MEAD JOHNSON NUTRITION CO	MJN	Consumer Staples	0	0	0	1	1	1	1	1	1	1	1	0	0	0
MOLSON COORS BEVERAGE CO	TAP	Consumer Staples	1	1	1	1	1	1	1	1	1	1	1	1	1	1
MONDELEZ INTERNATIONAL INC	MDLZ	Consumer Staples	0	1	1	1	1	1	1	1	1	1	1	1	1	1
MONSTER BEVERAGE CORP	MNST	Consumer Staples	0	0	0	0	0	0	1	1	1	1	1	1	1	1
PEPSI BOTTLING GROUP INC	PBG	Consumer Staples	1	1	1	1	0	0	0	0	0	0	0	0	0	0
PEPSICO INC	PEP	Consumer Staples	1	1	1	1	1	1	1	1	1	1	1	1	1	1
PHILIP MORRIS INTERNATIONAL	PM	Consumer Staples	0	0	1	1	1	1	1	1	1	1	1	1	1	1
PROCTER & GAMBLE CO	PG	Consumer Staples	1	1	1	1	1	1	1	1	1	1	1	1	1	1
REYNOLDS AMERICAN INC	RAI	Consumer Staples	1	1	1	1	1	1	1	1	1	1	1	0	0	0
SAFEWAY INC	SWY	Consumer Staples	1	1	1	1	1	1	1	1	1	0	0	0	0	0
SMUCKER (JM) CO	SJM	Consumer Staples	0	0	1	1	1	1	1	1	1	1	1	1	1	1
SUPERVALU INC	SVU	Consumer Staples	1	1	1	1	1	1	0	0	0	0	0	0	0	0
SYSCO CORP	SYU	Consumer Staples	1	1	1	1	1	1	1	1	1	1	1	1	1	1
TYSON FOODS INC -CL A	TSN	Consumer Staples	1	1	1	1	1	1	1	1	1	1	1	1	1	1
UST INC	UST.1	Consumer Staples	1	1	1	0	0	0	0	0	0	0	0	0	0	0
WALGREENS BOOTS ALLIANCE INC	WBA	Consumer Staples	1	1	1	1	1	1	1	1	1	1	1	1	1	1
WALMART INC	WMT	Consumer Staples	1	1	1	1	1	1	1	1	1	1	1	1	1	1
WHOLE FOODS MARKET INC	WFM	Consumer Staples	1	1	1	1	1	1	1	1	1	1	1	0	0	0
WRIGLEY (WM) JR CO	WWY	Consumer Staples	1	1	0	0	0	0	0	0	0	0	0	0	0	0
ALPHA NATURAL RESOURCES INC	ANRZQ	Energy	0	0	0	0	0	1	0	0	0	0	0	0	0	0

S&P 500 Companies by Year

[illegible]

S&P 500 Companies by Year

PEABODY ENERGY CORP	BTU	Energy	1	1	1	1	1	1	1	1	0	0	0	0	0	0
PHILLIPS 66	PSX	Energy	0	0	0	0	0	0	1	1	1	1	1	1	1	1
PIONEER NATURAL RESOURCES CO	PXD	Energy	0	0	1	1	1	1	1	1	1	1	1	1	1	1
QEP RESOURCES INC	QEP	Energy	0	0	0	0	1	1	1	1	1	0	0	0	0	0
RANGE RESOURCES CORP	RRC	Energy	0	1	1	1	1	1	1	1	1	1	1	1	0	0
ROWAN COMPANIES PLC	RDC	Energy	1	1	1	1	1	1	1	1	0	0	0	0	0	0
SCHLUMBERGER LTD	SLB	Energy	1	1	1	1	1	1	1	1	1	1	1	1	1	1
SMITH INTERNATIONAL INC	SIL.1	Energy	1	1	1	1	0	0	0	0	0	0	0	0	0	0
SOUTHWESTERN ENERGY CO	SWN	Energy	0	0	1	1	1	1	1	1	1	1	1	0	0	0
SPECTRA ENERGY CORP	SE.7	Energy	0	1	1	1	1	1	1	1	1	1	1	0	0	0
SUNOCO INC	SUN.1	Energy	1	1	1	1	1	1	0	0	0	0	0	0	0	0
TECHNIPFMC PLC	FTI	Energy	0	0	0	0	0	0	0	0	0	0	0	1	1	1
TRANSOCEAN LTD	RIG	Energy	1	1	0	0	0	0	0	1	1	1	1	0	0	0
VALARIS PLC	VAL	Energy	0	1	1	0	0	0	1	1	1	1	0	0	0	0
VALERO ENERGY CORP	VLO	Energy	1	1	1	1	1	1	1	1	1	1	1	1	1	1
WEATHERFORD INTL PLC	WFTLF	Energy	1	1	1	0	0	0	0	0	0	0	0	0	0	0
WILLIAMS COS INC	WMB	Energy	1	1	1	1	1	1	1	1	1	1	1	1	1	1
WPX ENERGY INC	WPX	Energy	0	0	0	0	0	0	1	1	0	0	0	0	0	0
XTO ENERGY INC	XTO	Energy	1	1	1	1	0	0	0	0	0	0	0	0	0	0
AFFILIATED MANAGERS GRP INC	AMG*	Financials	0	0	0	0	0	0	0	0	1	1	1	1	1	0
AFLAC INC	AFL*	Financials	1	1	1	1	1	1	1	1	1	1	1	1	1	1
ALLSTATE CORP	ALL*	Financials	1	1	1	1	1	1	1	1	1	1	1	1	1	1
AMBAC FINANCIAL GROUP INC	AMBC*	Financials	1	1	0	0	0	0	0	0	0	0	0	0	0	0
AMERICAN CAPITAL LTD	ACAS*	Financials	0	1	1	0	0	0	0	0	0	0	0	0	0	0
AMERICAN EXPRESS CO	AXP*	Financials	1	1	1	1	1	1	1	1	1	1	1	1	1	1
AMERICAN INTERNATIONAL GROUP	AIG*	Financials	1	1	1	1	1	1	1	1	1	1	1	1	1	1
AMERIPRISE FINANCIAL INC	AMP*	Financials	1	1	1	1	1	1	1	1	1	1	1	1	1	1
AON PLC	AON*	Financials	1	1	1	1	1	1	1	1	1	1	1	1	1	1
ARCHSTONE INC-REDH	ASN*	Financials	1	0	0	0	0	0	0	0	0	0	0	0	0	0
ARTHUR J GALLAGHER & CO	AJG*	Financials	0	0	0	0	0	0	0	0	0	0	1	1	1	1
ASSURANT INC	AIZ*	Financials	0	1	1	1	1	1	1	1	1	1	1	1	1	1
BANK OF AMERICA CORP	BAC*	Financials	1	1	1	1	1	1	1	1	1	1	1	1	1	1
BANK OF NEW YORK MELLON CORP	BK*	Financials	1	1	1	1	1	1	1	1	1	1	1	1	1	1
BBVA COMPASS BANCSHARES INC	BBVA1*	Financials	1	0	0	0	0	0	0	0	0	0	0	0	0	0
BEAR STEARNS COMPANIES INC	BSC.1*	Financials	1	1	0	0	0	0	0	0	0	0	0	0	0	0
BERKLEY (W R) CORP	WRB*	Financials	0	0	0	0	0	0	0	0	0	0	0	0	0	1
BERKSHIRE HATHAWAY	BRK.B*	Financials	0	0	0	0	1	1	1	1	1	1	1	1	1	1
BLACKROCK INC	BLK*	Financials	0	0	0	0	0	1	1	1	1	1	1	1	1	1
BRIGHTHOUSE FINANL INC	BHF*	Financials	0	0	0	0	0	0	0	0	0	0	0	1	1	0
CAPITAL ONE FINANCIAL CORP	COF*	Financials	1	1	1	1	1	1	1	1	1	1	1	1	1	1

S&P 500 Companies by Year

Company Name	Company Ticker	GICS Sector	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Number of S&P 500 Companies			500	500	500	500	500	500	500	500	500	500	500	500	500	500
Railroads, Financial Institutions, and Real Estate Companies			92	99	90	85	87	86	87	87	89	91	96	104	103	101
Sample Number of S&P 500 Companies			408	401	410	415	413	414	413	413	411	409	404	396	397	399
CBOE GLOBAL MARKETS INC	CBOE*	Financials	0	0	0	0	0	0	0	0	0	0	0	1	1	1
CHUBB CORP	CB.1*	Financials	1	1	1	1	1	1	1	1	1	1	0	0	0	0
CHUBB LTD	CB*	Financials	1	1	0	0	1	1	1	1	1	1	1	1	1	1
CINCINNATI FINANCIAL CORP	CINF*	Financials	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CIT GROUP INC	CIT*	Financials	1	1	1	0	0	0	0	0	0	0	0	0	0	0
CITIGROUP INC	C*	Financials	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CITIZENS FINANCIAL GROUP INC	CFG*	Financials	0	0	0	0	0	0	0	0	0	0	1	1	1	1
CME GROUP INC	CME*	Financials	1	1	1	1	1	1	1	1	1	1	1	1	1	1
COMERICA INC	CMA*	Financials	1	1	1	1	1	1	1	1	1	1	1	1	1	1
COMMERCE BANCORP INC/NJ	CBH.1*	Financials	1	1	0	0	0	0	0	0	0	0	0	0	0	0
COUNTRYWIDE FINANCIAL CORP	CFC.3*	Financials	1	1	0	0	0	0	0	0	0	0	0	0	0	0
DISCOVER FINANCIAL SVCS	DFS*	Financials	0	1	1	1	1	1	1	1	1	1	1	1	1	1
E TRADE FINANCIAL CORP	ETFC*	Financials	1	1	1	1	1	1	1	1	1	1	1	1	1	1
EQUITY OFFICE PROPERTIES TR	EOP*	Financials	1	0	0	0	0	0	0	0	0	0	0	0	0	0
EVEREST RE GROUP LTD	RE*	Financials	0	0	0	0	0	0	0	0	0	0	0	1	1	1
FEDERAL HOME LOAN MORTG CORP	FMCC*	Financials	1	1	0	0	0	0	0	0	0	0	0	0	0	0
FEDERAL NATIONAL MORTGA ASSN	FNMA*	Financials	1	1	0	0	0	0	0	0	0	0	0	0	0	0
FEDERATED HERMES INC	FHI*	Financials	1	1	1	1	1	1	1	0	0	0	0	0	0	0
FIFTH THIRD BANCORP	FITB*	Financials	1	1	1	1	1	1	1	1	1	1	1	1	1	1
FIRST HORIZON NATIONAL CORP	FHN*	Financials	1	1	1	1	1	1	1	0	0	0	0	0	0	0
FIRST REPUBLIC BANK	FRC*	Financials	0	0	0	0	0	0	0	0	0	0	0	0	0	1
FRANKLIN RESOURCES INC	BEN*	Financials	1	1	1	1	1	1	1	1	1	1	1	1	1	1
GENWORTH FINANCIAL INC	GNW*	Financials	1	1	1	1	1	1	1	1	1	0	0	0	0	0
GLOBE LIFE INC	GL*	Financials	1	1	1	1	1	1	1	1	1	1	1	1	1	1
GOLDMAN SACHS GROUP INC	GS*	Financials	1	1	1	1	1	1	1	1	1	1	1	1	1	1
HARTFORD FINANCIAL SERVICES	HIG*	Financials	1	1	1	1	1	1	1	1	1	1	1	1	1	1
HUDSON CITY BANCORP INC	HCBK*	Financials	0	1	1	1	1	1	1	1	1	0	0	0	0	0
HUNTINGTON BANCSHARES	HBAN*	Financials	1	1	1	1	1	1	1	1	1	1	1	1	1	1
INTERCONTINENTAL EXCHANGE	ICE*	Financials	0	1	1	1	1	1	1	1	1	1	1	1	1	1
INVESCO LTD	IVZ*	Financials	0	0	1	1	1	1	1	1	1	1	1	1	1	1
JANUS CAPITAL GROUP INC	JNS*	Financials	1	1	1	1	1	0	0	0	0	0	0	0	0	0
JEFFERIES FINANCIAL GRP INC	JEF*	Financials	0	1	1	1	1	1	1	1	1	1	1	1	1	0
JPMORGAN CHASE & CO	JPM*	Financials	1	1	1	1	1	1	1	1	1	1	1	1	1	1
KEYCORP	KEY*	Financials	1	1	1	1	1	1	1	1	1	1	1	1	1	1
LEGG MASON INC	LM*	Financials	1	1	1	1	1	1	1	1	1	1	0	0	0	0
LEHMAN BROTHERS HOLDINGS INC	LEHMQ*	Financials	1	1	0	0	0	0	0	0	0	0	0	0	0	0
LINCOLN NATIONAL CORP	LNC*	Financials	1	1	1	1	1	1	1	1	1	1	1	1	1	1
LOEWS CORP	L*	Financials	1	1	1	1	1	1	1	1	1	1	1	1	1	1
M & T BANK CORP	MTB*	Financials	1	1	1	1	1	1	1	1	1	1	1	1	1	1
MARKETAXESS HOLDINGS INC	MKTX*	Financials	0	0	0	0	0	0	0	0	0	0	0	0	0	1

S&P 500 Companies by Year

Company Name	Company Ticker	GICS Sector	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Number of S&P 500 Companies			500	500	500	500	500	500	500	500	500	500	500	500	500	500
Railroads, Financial Institutions, and Real Estate Companies			92	99	90	85	87	86	87	87	89	91	96	104	103	101
Sample Number of S&P 500 Companies			408	401	410	415	413	414	413	413	411	409	404	396	397	399
MARSH & MCLENNAN COS	MMC*	Financials	1	1	1	1	1	1	1	1	1	1	1	1	1	1
MARSHALL & ILSLEY CORP	MI.1*	Financials	1	1	1	1	1	0	0	0	0	0	0	0	0	0
MBIA INC	MBI*	Financials	1	1	1	0	0	0	0	0	0	0	0	0	0	0
MELLON FINANCIAL CORP	MEL.3*	Financials	1	0	0	0	0	0	0	0	0	0	0	0	0	0
MERRILL LYNCH & CO INC	BAC2*	Financials	1	1	1	0	0	0	0	0	0	0	0	0	0	0
METLIFE INC	MET*	Financials	1	1	1	1	1	1	1	1	1	1	1	1	1	1
MGIC INVESTMENT CORP/WI	MTG*	Financials	1	1	0	0	0	0	0	0	0	0	0	0	0	0
MOODY'S CORP	MCO*	Financials	1	1	1	1	1	1	1	1	1	1	1	1	1	1
MORGAN STANLEY	MS*	Financials	1	1	1	1	1	1	1	1	1	1	1	1	1	1
MSCI INC	MSCI*	Financials	0	0	0	0	0	0	0	0	0	0	0	0	1	1
NASDAQ INC	NDAQ*	Financials	0	0	1	1	1	1	1	1	1	1	1	1	1	1
NATIONAL CITY CORP	NCC*	Financials	1	1	1	0	0	0	0	0	0	0	0	0	0	0
NAVIENT CORP	NAVI*	Financials	1	1	1	1	1	1	1	1	1	1	1	1	0	0
NORTHERN TRUST CORP	NTRS*	Financials	1	1	1	1	1	1	1	1	1	1	1	1	1	1
NYSE EURONEXT	NYX*	Financials	0	1	1	1	1	1	1	0	0	0	0	0	0	0
PEOPLE'S UNITED FINL INC	PBCT*	Financials	0	0	1	1	1	1	1	1	1	1	1	1	1	1
PLUM CREEK TIMBER CO INC	PCL*	Financials	1	1	1	1	1	1	1	1	1	1	0	0	0	0
PNC FINANCIAL SVCS GROUP INC	PNC*	Financials	1	1	1	1	1	1	1	1	1	1	1	1	1	1
PRICE (T. ROWE) GROUP	TROW*	Financials	1	1	1	1	1	1	1	1	1	1	1	1	1	1
PRINCIPAL FINANCIAL GRP INC	PFG*	Financials	1	1	1	1	1	1	1	1	1	1	1	1	1	1
PROGRESSIVE CORP-OHIO	PGR*	Financials	1	1	1	1	1	1	1	1	1	1	1	1	1	1
PRUDENTIAL FINANCIAL INC	PRU*	Financials	1	1	1	1	1	1	1	1	1	1	1	1	1	1
RAYMOND JAMES FINANCIAL CORP	RJF*	Financials	0	0	0	0	0	0	0	0	0	0	0	1	1	1
REGIONS FINANCIAL CORP	RF*	Financials	1	1	1	1	1	1	1	1	1	1	1	1	1	1
S&P GLOBAL INC	SPGI*	Financials	1	1	1	1	1	1	1	1	1	1	1	1	1	1
SAFECO CORP	SAF.3*	Financials	1	1	0	0	0	0	0	0	0	0	0	0	0	0
SANTANDER HOLDINGS USA INC	STD2*	Financials	1	1	1	0	0	0	0	0	0	0	0	0	0	0
SCHWAB (CHARLES) CORP	SCHW*	Financials	1	1	1	1	1	1	1	1	1	1	1	1	1	1
STATE STREET CORP	STT*	Financials	1	1	1	1	1	1	1	1	1	1	1	1	1	1
SUNTRUST BANKS INC	STI*	Financials	1	1	1	1	1	1	1	1	1	1	1	1	1	0
SVB FINANCIAL GROUP	SIVB*	Financials	0	0	0	0	0	0	0	0	0	0	0	0	1	1
SYNCHRONY FINANCIAL	SYF*	Financials	0	0	0	0	0	0	0	0	0	1	1	1	1	1
SYNOVUS FINANCIAL CORP	SNV*	Financials	1	1	0	0	0	0	0	0	0	0	0	0	0	0
TRAVELERS COS INC	TRV*	Financials	1	1	1	1	1	1	1	1	1	1	1	1	1	1
TRUIST FINANCIAL CORP	TFC*	Financials	1	1	1	1	1	1	1	1	1	1	1	1	1	1
U S BANCORP	USB*	Financials	1	1	1	1	1	1	1	1	1	1	1	1	1	1
UNUM GROUP	UNM*	Financials	1	1	1	1	1	1	1	1	1	1	1	1	1	1
WACHOVIA CORP	WB.3*	Financials	1	1	1	0	0	0	0	0	0	0	0	0	0	0
WASHINGTON MUTUAL INC	WAMUQ*	Financials	1	1	0	0	0	0	0	0	0	0	0	0	0	0
WELLS FARGO & CO	WFC*	Financials	1	1	1	1	1	1	1	1	1	1	1	1	1	1

S&P 500 Companies by Year

Company Name	Company Ticker	GICS Sector	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Number of S&P 500 Companies			500	500	500	500	500	500	500	500	500	500	500	500	500	500
Railroads, Financial Institutions, and Real Estate Companies			92	99	90	85	87	86	87	87	89	91	96	104	103	101
Sample Number of S&P 500 Companies			408	401	410	415	413	414	413	413	411	409	404	396	397	399
WILLIS TOWERS WATSON PLC	WLTW*	Financials	0	0	0	0	0	0	0	0	0	0	1	1	1	1
XL GROUP LTD	XL*	Financials	1	1	1	1	1	1	1	1	1	1	1	1	0	0
ZIONS BANCORPORATION NA	ZION*	Financials	1	1	1	1	1	1	1	1	1	1	1	1	1	1
ABBOTT LABORATORIES	ABT	Health Care	1	1	1	1	1	1	1	1	1	1	1	1	1	1
ABBVIE INC	ABBV	Health Care	0	0	0	0	0	0	0	1	1	1	1	1	1	1
ABIOMED INC	ABMD	Health Care	0	0	0	0	0	0	0	0	0	0	0	0	1	1
AETNA INC	AET	Health Care	1	1	1	1	1	1	1	1	1	1	1	1	0	0
AGILENT TECHNOLOGIES INC	A	Health Care	1	1	1	1	1	1	1	1	1	1	1	1	1	1
ALEXION PHARMACEUTICALS INC	ALXN	Health Care	0	0	0	0	0	0	1	1	1	1	1	1	1	1
ALIGN TECHNOLOGY INC	ALGN	Health Care	0	0	0	0	0	0	0	0	0	0	0	1	1	1
ALLERGAN INC	AGN.2	Health Care	1	1	1	1	1	1	1	1	1	0	0	0	0	0
ALLERGAN PLC	AGN	Health Care	1	1	1	1	1	1	1	1	1	1	1	1	1	1
AMERISOURCEBERGEN CORP	ABC	Health Care	1	1	1	1	1	1	1	1	1	1	1	1	1	1
AMGEN INC	AMGN	Health Care	1	1	1	1	1	1	1	1	1	1	1	1	1	1
ANTHEM INC	ANTM	Health Care	1	1	1	1	1	1	1	1	1	1	1	1	1	1
APPLIED BIOSYSTEMS INC	ABL3	Health Care	1	1	0	0	0	0	0	0	0	0	0	0	0	0
BARD (C.R.) INC	BCR	Health Care	1	1	1	1	1	1	1	1	1	1	1	1	0	0
BARR PHARMACEUTICALS INC	BRL	Health Care	1	1	0	0	0	0	0	0	0	0	0	0	0	0
BAUSCH & LOMB HLDGS -REDH	6583B	Health Care	1	0	0	0	0	0	0	0	0	0	0	0	0	0
BAXALTA INC	BXLT	Health Care	0	0	0	0	0	0	0	0	0	1	0	0	0	0
BAXTER INTERNATIONAL INC	BAX	Health Care	1	1	1	1	1	1	1	1	1	1	1	1	1	1
BECTON DICKINSON & CO	BDX	Health Care	1	1	1	1	1	1	1	1	1	1	1	1	1	1
BIOGEN INC	BIIB	Health Care	1	1	1	1	1	1	1	1	1	1	1	1	1	1
BIOMET INC	5938B	Health Care	1	0	0	0	0	0	0	0	0	0	0	0	0	0
BOSTON SCIENTIFIC CORP	BSX	Health Care	1	1	1	1	1	1	1	1	1	1	1	1	1	1
BRISTOL-MYERS SQUIBB CO	BMJ	Health Care	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CARDINAL HEALTH INC	CAH	Health Care	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CAREFUSION CORP	CFN	Health Care	0	0	0	1	1	1	1	1	1	0	0	0	0	0
CAREMARK RX INC	CMX.1	Health Care	1	0	0	0	0	0	0	0	0	0	0	0	0	0
CELGENE CORP	CELG	Health Care	1	1	1	1	1	1	1	1	1	1	1	1	1	0
CENTENE CORP	CNC	Health Care	0	0	0	0	0	0	0	0	0	0	1	1	1	1
CEPHALON INC	CEPH	Health Care	0	0	1	1	1	0	0	0	0	0	0	0	0	0
CERNER CORP	CERN	Health Care	0	0	0	0	1	1	1	1	1	1	1	1	1	1
CIGNA CORP	CI	Health Care	1	1	1	1	1	1	1	1	1	1	1	1	1	1
COOPER COS INC (THE)	COO	Health Care	0	0	0	0	0	0	0	0	0	0	1	1	1	1
COVENTRY HEALTH CARE INC	CVH	Health Care	1	1	1	1	1	1	1	0	0	0	0	0	0	0
COVIDIEN PLC	COV	Health Care	0	1	1	0	0	1	1	1	1	0	0	0	0	0
CVS HEALTH CORP	CVS	Health Care	1	1	1	1	1	1	1	1	1	1	1	1	1	1
DANAHER CORP	DHR	Health Care	1	1	1	1	1	1	1	1	1	1	1	1	1	1
DAVITA INC	DVA	Health Care	0	0	1	1	1	1	1	1	1	1	1	1	1	1

S&P 500 Companies by Year

[illegible]

Appendix A, Exhibit A1

S&P 500 Companies by Year

Company Name	Company Ticker	GICS Sector	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Number of S&P 500 Companies			500	500	500	500	500	500	500	500	500	500	500	500	500	500
Railroads, Financial Institutions, and Real Estate Companies			92	99	90	85	87	86	87	87	89	91	96	104	103	101
Sample Number of S&P 500 Companies			408	401	410	415	413	414	413	413	411	409	404	396	397	399
QUEST DIAGNOSTICS INC	DGX	Health Care	1	1	1	1	1	1	1	1	1	1	1	1	1	1
REGENERON PHARMACEUTICALS	REGN	Health Care	0	0	0	0	0	0	0	1	1	1	1	1	1	1
RESMED INC	RMD	Health Care	0	0	0	0	0	0	0	0	0	0	0	1	1	1
SCHERING-PLOUGH	SGP	Health Care	1	1	1	0	0	0	0	0	0	0	0	0	0	0
ST JUDE MEDICAL INC	STJ	Health Care	1	1	1	1	1	1	1	1	1	1	1	0	0	0
STERIS PLC	STE	Health Care	0	0	0	0	0	0	0	0	0	0	0	0	0	1
STRYKER CORP	SYK	Health Care	1	1	1	1	1	1	1	1	1	1	1	1	1	1
TELEFLEX INC	TFX	Health Care	0	0	0	0	0	0	0	0	0	0	0	0	0	1
TENET HEALTHCARE CORP	THC	Health Care	1	1	1	1	1	1	1	1	1	1	0	0	0	0
THERMO FISHER SCIENTIFIC INC	TMO	Health Care	1	1	1	1	1	1	1	1	1	1	1	1	1	1
UNITEDHEALTH GROUP INC	UNH	Health Care	1	1	1	1	1	1	1	1	1	1	1	1	1	1
UNIVERSAL HEALTH SVCS INC	UHS	Health Care	0	0	0	0	0	0	0	0	1	1	1	1	1	1
VARIAN MEDICAL SYSTEMS INC	VAR	Health Care	0	1	1	1	1	1	1	1	1	1	1	1	1	1
VERTEX PHARMACEUTICALS INC	VRTX	Health Care	0	0	0	0	0	0	0	1	1	1	1	1	1	1
WATERS CORP	WAT	Health Care	1	1	1	1	1	1	1	1	1	1	1	1	1	1
WELLCARE HEALTH PLANS INC	WCG	Health Care	0	0	0	0	0	0	0	0	0	0	0	0	1	1
WYETH	WYE	Health Care	1	1	1	0	0	0	0	0	0	0	0	0	0	0
ZIMMER BIOMET HOLDINGS INC	ZBH	Health Care	1	1	1	1	1	1	1	1	1	1	1	1	1	1
ZOETIS INC	ZTS	Health Care	0	0	0	0	0	0	0	1	1	1	1	1	1	1
3M CO	MMM	Industrials	1	1	1	1	1	1	1	1	1	1	1	1	1	1
ACUITY BRANDS INC	AYI	Industrials	0	0	0	0	0	0	0	0	0	0	1	1	0	0
ADT CORP	ADT.4	Industrials	0	0	0	0	0	0	1	1	1	1	0	0	0	0
ALASKA AIR GROUP INC	ALK	Industrials	0	0	0	0	0	0	0	0	0	0	1	1	1	1
ALLEGION PLC	ALLE	Industrials	0	0	0	0	0	0	0	1	1	1	1	1	1	1
ALLIED WASTE INDUSTRIES INC	AW	Industrials	1	1	0	0	0	0	0	0	0	0	0	0	0	0
AMERICAN AIRLINES GROUP INC	AAL	Industrials	0	0	0	0	0	0	0	0	0	1	1	1	1	1
AMERICAN POWER CONVERSION CP	APCC.	Industrials	1	0	0	0	0	0	0	0	0	0	0	0	0	0
AMETEK INC	AME	Industrials	0	0	0	0	0	0	0	1	1	1	1	1	1	1
BOEING CO	BA	Industrials	1	1	1	1	1	1	1	1	1	1	1	1	1	1
BURLINGTON NORTHERN SANTA FE	BRK3	Industrials	1	1	1	1	0	0	0	0	0	0	0	0	0	0
C H ROBINSON WORLDWIDE INC	CHRW	Industrials	0	1	1	1	1	1	1	1	1	1	1	1	1	1
CATERPILLAR INC	CAT	Industrials	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CINTAS CORP	CTAS	Industrials	1	1	1	1	1	1	1	1	1	1	1	1	1	1
COOPER INDUSTRIES PLC	CBE	Industrials	1	1	1	0	0	1	0	0	0	0	0	0	0	0
COPART INC	CPRT	Industrials	0	0	0	0	0	0	0	0	0	0	0	0	1	1
CSX CORP	CSX	Industrials	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CUMMINS INC	CMI	Industrials	1	1	1	1	1	1	1	1	1	1	1	1	1	1
DEERE & CO	DE	Industrials	1	1	1	1	1	1	1	1	1	1	1	1	1	1
DELTA AIR LINES INC	DAL	Industrials	0	0	0	0	0	0	0	1	1	1	1	1	1	1
DONNELLEY (R R) & SONS CO	RRD	Industrials	1	1	1	1	1	1	0	0	0	0	0	0	0	0

S&P 500 Companies by Year

[illegible]

Appendix A, Exhibit A1
S&P 500 Companies by Year

Company Name	Company Ticker	GICS Sector	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Number of S&P 500 Companies			500	500	500	500	500	500	500	500	500	500	500	500	500	500
Railroads, Financial Institutions, and Real Estate Companies			92	99	90	85	87	86	87	87	89	91	96	104	103	101
Sample Number of S&P 500 Companies			408	401	410	415	413	414	413	413	411	409	404	396	397	399
PENTAIR PLC	PNR	Industrials	0	0	0	0	0	0	1	1	1	1	1	1	1	1
PITNEY BOWES INC	PBI	Industrials	1	1	1	1	1	1	1	1	1	1	1	0	0	0
PRECISION CASTPARTS CORP	PCP	Industrials	0	1	1	1	1	1	1	1	1	1	0	0	0	0
QUANTA SERVICES INC	PWR	Industrials	0	0	0	1	1	1	1	1	1	1	1	1	1	1
RAYTHEON CO	RTN	Industrials	1	1	1	1	1	1	1	1	1	1	1	1	1	1
RAYTHEON TECHNOLOGIES CORP	RTX	Industrials	1	1	1	1	1	1	1	1	1	1	1	1	1	1
REPUBLIC SERVICES INC	RSG	Industrials	0	0	1	1	1	1	1	1	1	1	1	1	1	1
ROBERT HALF INTL INC	RHI	Industrials	1	1	1	1	1	1	1	1	1	1	1	1	1	1
ROCKWELL AUTOMATION	ROK	Industrials	1	1	1	1	1	1	1	1	1	1	1	1	1	1
ROCKWELL COLLINS	COL	Industrials	1	1	1	1	1	1	1	1	1	1	1	1	0	0
ROLLINS INC	ROL	Industrials	0	0	0	0	0	0	0	0	0	0	0	0	1	1
ROPER TECHNOLOGIES INC	ROP	Industrials	0	0	0	1	1	1	1	1	1	1	1	1	1	1
RYDER SYSTEM INC	R	Industrials	1	1	1	1	1	1	1	1	1	1	1	0	0	0
SMITH (A.O.)	AOS	Industrials	0	0	0	0	0	0	0	0	0	0	0	1	1	1
SNAP-ON INC	SNA	Industrials	1	1	1	1	1	1	1	1	1	1	1	1	1	1
SOUTHWEST AIRLINES	LUV	Industrials	1	1	1	1	1	1	1	1	1	1	1	1	1	1
STANLEY BLACK & DECKER INC	SWK	Industrials	1	1	1	1	1	1	1	1	1	1	1	1	1	1
STERICYCLE INC	SRCL	Industrials	0	0	1	1	1	1	1	1	1	1	1	1	0	0
TEREX CORP	TEX	Industrials	1	1	0	0	0	0	0	0	0	0	0	0	0	0
TEXTRON INC	TXT	Industrials	1	1	1	1	1	1	1	1	1	1	1	1	1	1
TRANE INC	TT.2	Industrials	1	1	0	0	0	0	0	0	0	0	0	0	0	0
TRANE TECHNOLOGIES PLC	TT	Industrials	1	1	1	0	1	1	1	1	1	1	1	1	1	1
TRANSDIGM GROUP INC	TDG	Industrials	0	0	0	0	0	0	0	0	0	0	1	1	1	1
TYCO INTERNATIONAL PLC	TYC	Industrials	1	1	1	0	1	1	1	1	1	1	0	0	0	0
UNION PACIFIC CORP	UNP	Industrials	1	1	1	1	1	1	1	1	1	1	1	1	1	1
UNITED AIRLINES HOLDINGS INC	UAL	Industrials	0	0	0	0	0	0	0	0	0	1	1	1	1	1
UNITED PARCEL SERVICE INC	UPS	Industrials	1	1	1	1	1	1	1	1	1	1	1	1	1	1
UNITED RENTALS INC	URI	Industrials	0	0	0	0	0	0	0	0	1	1	1	1	1	1
VERISK ANALYTICS INC	VRSK	Industrials	0	0	0	0	0	0	0	0	0	1	1	1	1	1
WABTEC CORP	WAB	Industrials	0	0	0	0	0	0	0	0	0	0	0	0	0	1
WASTE MANAGEMENT INC	WM	Industrials	1	1	1	1	1	1	1	1	1	1	1	1	1	1
XYLEM INC	XYL	Industrials	0	0	0	0	0	1	1	1	1	1	1	1	1	1
ACCENTURE PLC	ACN	Information Technology	0	0	0	0	0	1	1	1	1	1	1	1	1	1
ADC TELECOMMUNICATIONS INC	ADCT.1	Information Technology	1	0	0	0	0	0	0	0	0	0	0	0	0	0
ADOBE INC	ADBE	Information Technology	1	1	1	1	1	1	1	1	1	1	1	1	1	1
ADVANCED MICRO DEVICES	AMD	Information Technology	1	1	1	1	1	1	1	0	0	0	0	1	1	1
AFFILIATED COMPUTER SERVICES	ACS	Information Technology	1	1	1	1	0	0	0	0	0	0	0	0	0	0
AKAMAI TECHNOLOGIES INC	AKAM	Information Technology	0	1	1	1	1	1	1	1	1	1	1	1	1	1
ALLIANCE DATA SYSTEMS CORP	ADS	Information Technology	0	0	0	0	0	0	0	1	1	1	1	1	1	1
ALTERA CORP	ALTR.1	Information Technology	1	1	1	1	1	1	1	1	1	0	0	0	0	0

Appendix A, Exhibit A1

S&P 500 Companies by Year

Company Name	Company Ticker	GICS Sector	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Number of S&P 500 Companies			500	500	500	500	500	500	500	500	500	500	500	500	500	500
Railroads, Financial Institutions, and Real Estate Companies			92	99	90	85	87	86	87	87	89	91	96	104	103	101
Sample Number of S&P 500 Companies			408	401	410	415	413	414	413	413	411	409	404	396	397	399
AMPHENOL CORP	APH	Information Technology	0	0	1	1	1	1	1	1	1	1	1	1	1	1
ANALOG DEVICES	ADI	Information Technology	1	1	1	1	1	1	1	1	1	1	1	1	1	1
ANSYS INC	ANSS	Information Technology	0	0	0	0	0	0	0	0	0	0	0	1	1	1
APPLE INC	AAPL	Information Technology	1	1	1	1	1	1	1	1	1	1	1	1	1	1
APPLIED MATERIALS INC	AMAT	Information Technology	1	1	1	1	1	1	1	1	1	1	1	1	1	1
ARISTA NETWORKS INC	ANET	Information Technology	0	0	0	0	0	0	0	0	0	0	0	0	1	1
AUTODESK INC	ADSK	Information Technology	1	1	1	1	1	1	1	1	1	1	1	1	1	1
AUTOMATIC DATA PROCESSING	ADP	Information Technology	1	1	1	1	1	1	1	1	1	1	1	1	1	1
AVAYA INC	5933B	Information Technology	1	0	0	0	0	0	0	0	0	0	0	0	0	0
BMC SOFTWARE INC	BMC	Information Technology	1	1	1	1	1	1	1	0	0	0	0	0	0	0
BROADCOM CORP	BRCM	Information Technology	1	1	1	1	1	1	1	1	1	1	0	0	0	0
BROADCOM INC	AVGO	Information Technology	0	0	0	0	0	0	0	0	1	1	1	1	1	1
BROADRIDGE FINANCIAL SOLUTNS	BR	Information Technology	0	0	0	0	0	0	0	0	0	0	0	0	1	1
CA INC	CA	Information Technology	1	1	1	1	1	1	1	1	1	1	1	1	0	0
CADENCE DESIGN SYSTEMS INC	CDNS	Information Technology	0	0	0	0	0	0	0	0	0	0	0	1	1	1
CDW CORP	CDW	Information Technology	0	0	0	0	0	0	0	0	0	0	0	0	0	1
CIENA CORP	CIEN	Information Technology	1	1	1	0	0	0	0	0	0	0	0	0	0	0
CISCO SYSTEMS INC	CSCO	Information Technology	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CITRIX SYSTEMS INC	CTXS	Information Technology	1	1	1	1	1	1	1	1	1	1	1	1	1	1
COGNIZANT TECH SOLUTIONS	CTSH	Information Technology	1	1	1	1	1	1	1	1	1	1	1	1	1	1
COMPUWARE CORP	CPWR.1	Information Technology	1	1	1	1	1	1	0	0	0	0	0	0	0	0
COMVERSE TECHNOLOGY INC	CMVT	Information Technology	1	0	0	0	0	0	0	0	0	0	0	0	0	0
CONVERGYS CORP	CVG	Information Technology	1	1	1	0	0	0	0	0	0	0	0	0	0	0
CORNING INC	GLW	Information Technology	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CSRA INC	CSRA	Information Technology	0	0	0	0	0	0	0	0	0	1	1	1	0	0
DELL TECHNOLOGIES INC	DELL	Information Technology	1	1	1	1	1	1	1	0	0	0	0	0	0	0
DXC TECHNOLOGY CO	DXC	Information Technology	1	1	1	1	1	1	1	1	1	0	0	1	1	1
EASTMAN KODAK CO	KODK	Information Technology	1	1	1	1	0	0	0	0	0	0	0	0	0	0
ELECTRONIC DATA SYSTEMS CORP	EDS.	Information Technology	1	1	0	0	0	0	0	0	0	0	0	0	0	0
EMC CORP/MA	EMC	Information Technology	1	1	1	1	1	1	1	1	1	1	0	0	0	0
F5 NETWORKS INC	FFIV	Information Technology	0	0	0	0	1	1	1	1	1	1	1	1	1	1
FIDELITY NATIONAL INFO SVCS	FIS	Information Technology	1	1	1	1	1	1	1	1	1	1	1	1	1	1
FIRST DATA CORP	FDC	Information Technology	1	0	0	0	0	0	0	0	0	0	0	0	0	0
FIRST SOLAR INC	FSLR	Information Technology	0	0	0	1	1	1	1	1	1	1	1	0	0	0
FISERV INC	FISV	Information Technology	1	1	1	1	1	1	1	1	1	1	1	1	1	1
FLEETCOR TECHNOLOGIES INC	FLT	Information Technology	0	0	0	0	0	0	0	0	0	0	0	0	1	1
FLIR SYSTEMS INC	FLIR	Information Technology	0	0	0	1	1	1	1	1	1	1	1	1	1	1
FORTINET INC	FTNT	Information Technology	0	0	0	0	0	0	0	0	0	0	0	0	1	1
GARTNER INC	IT	Information Technology	0	0	0	0	0	0	0	0	0	0	0	1	1	1
GLOBAL PAYMENTS INC	GPN	Information Technology	0	0	0	0	0	0	0	0	0	0	1	1	1	1

Appendix A, Exhibit A1

S&P 500 Companies by Year

Company Name	Company Ticker	GICS Sector	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Number of S&P 500 Companies			500	500	500	500	500	500	500	500	500	500	500	500	500	500
Railroads, Financial Institutions, and Real Estate Companies			92	99	90	85	87	86	87	87	89	91	96	104	103	101
Sample Number of S&P 500 Companies			408	401	410	415	413	414	413	413	411	409	404	396	397	399
HENRY (JACK) & ASSOCIATES	JKHY	Information Technology	0	0	0	0	0	0	0	0	0	0	0	0	1	1
HEWLETT PACKARD ENTERPRISE	HPE	Information Technology	0	0	0	0	0	0	0	0	0	1	1	1	1	1
HP INC	HPQ	Information Technology	1	1	1	1	1	1	1	1	1	1	1	1	1	1
INTEL CORP	INTC	Information Technology	1	1	1	1	1	1	1	1	1	1	1	1	1	1
INTL BUSINESS MACHINES CORP	IBM	Information Technology	1	1	1	1	1	1	1	1	1	1	1	1	1	1
INTUIT INC	INTU	Information Technology	1	1	1	1	1	1	1	1	1	1	1	1	1	1
IPG PHOTONICS CORP	IPGP	Information Technology	0	0	0	0	0	0	0	0	0	0	0	0	1	1
JABIL INC	JBL	Information Technology	1	1	1	1	1	1	1	1	0	0	0	0	0	0
JUNIPER NETWORKS INC	JNPR	Information Technology	1	1	1	1	1	1	1	1	1	1	1	1	1	1
KEYSIGHT TECHNOLOGIES INC	KEYS	Information Technology	0	0	0	0	0	0	0	0	0	0	0	0	1	1
KLA CORP	KLAC	Information Technology	1	1	1	1	1	1	1	1	1	1	1	1	1	1
LAM RESEARCH CORP	LRCX	Information Technology	0	0	0	0	0	0	1	1	1	1	1	1	1	1
LEIDOS HOLDINGS INC	LDOS	Information Technology	0	0	0	1	1	1	1	0	0	0	0	0	0	1
LEXMARK INTL INC -CL A	LXK	Information Technology	1	1	1	1	1	1	0	0	0	0	0	0	0	0
LINEAR TECHNOLOGY CORP	LLTC	Information Technology	1	1	1	1	1	1	1	1	1	1	1	0	0	0
LSI CORP	LSI.1	Information Technology	1	1	1	1	1	1	1	1	0	0	0	0	0	0
MASTERCARD INC	MA	Information Technology	0	0	1	1	1	1	1	1	1	1	1	1	1	1
MAXIM INTEGRATED PRODUCTS	MXIM	Information Technology	1	0	0	0	0	0	0	0	0	0	0	0	1	1
MCAFEE INC	MFE	Information Technology	0	0	1	1	1	0	0	0	0	0	0	0	0	0
MICROCHIP TECHNOLOGY INC	MCHP	Information Technology	0	1	1	1	1	1	1	1	1	1	1	1	1	1
MICRON TECHNOLOGY INC	MU	Information Technology	1	1	1	1	1	1	1	1	1	1	1	1	1	1
MICROSOFT CORP	MSFT	Information Technology	1	1	1	1	1	1	1	1	1	1	1	1	1	1
MOLEX INC	MOLX	Information Technology	1	1	1	1	1	1	1	0	0	0	0	0	0	0
MONSTER WORLDWIDE INC	MWW	Information Technology	1	1	1	1	1	0	0	0	0	0	0	0	0	0
MOTOROLA MOBILITY HLDGS INC	MMI.3	Information Technology	0	0	0	0	0	1	0	0	0	0	0	0	0	0
MOTOROLA SOLUTIONS INC	MSI	Information Technology	1	1	1	1	1	1	1	1	1	1	1	1	1	1
NATIONAL SEMICONDUCTOR CORP	NSM.2	Information Technology	1	1	1	1	1	0	0	0	0	0	0	0	0	0
NCR CORP	NCR	Information Technology	1	0	0	0	0	0	0	0	0	0	0	0	0	0
NETAPP INC	NTAP	Information Technology	1	1	1	1	1	1	1	1	1	1	1	1	1	1
NORTONLIFELOCK INC	NLOK	Information Technology	1	1	1	1	1	1	1	1	1	1	1	1	1	1
NOVELL INC	NOVL	Information Technology	1	1	1	1	1	0	0	0	0	0	0	0	0	0
NOVELLUS SYSTEMS INC	NVLS.1	Information Technology	1	1	1	1	1	1	0	0	0	0	0	0	0	0
NVIDIA CORP	NVDA	Information Technology	1	1	1	1	1	1	1	1	1	1	1	1	1	1
ORACLE CORP	ORCL	Information Technology	1	1	1	1	1	1	1	1	1	1	1	1	1	1
PAYCHEX INC	PAYX	Information Technology	1	1	1	1	1	1	1	1	1	1	1	1	1	1
PAYPAL HOLDINGS INC	PYPL	Information Technology	0	0	0	0	0	0	0	0	0	1	1	1	1	1
PMC-SIERRA INC	PMCS	Information Technology	1	0	0	0	0	0	0	0	0	0	0	0	0	0
PTC INC	PTC	Information Technology	1	0	0	0	0	0	0	0	0	0	0	0	0	0
QLOGIC CORP	QLGC	Information Technology	1	1	1	1	1	0	0	0	0	0	0	0	0	0
QORVO INC	QRVO	Information Technology	0	0	0	0	0	0	0	0	0	1	1	1	1	1

S&P 500 Companies by Year

[illegible]

S&P 500 Companies by Year

[illegible]

S&P 500 Companies by Year

[illegible]

Appendix A, Exhibit A1
S&P 500 Companies by Year

Company Name	Company Ticker	GICS Sector	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Number of S&P 500 Companies			500	500	500	500	500	500	500	500	500	500	500	500	500	500
Railroads, Financial Institutions, and Real Estate Companies			92	99	90	85	87	86	87	87	89	91	96	104	103	101
Sample Number of S&P 500 Companies			408	401	410	415	413	414	413	413	411	409	404	396	397	399
CMS ENERGY CORP	CMS	Utilities	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CONSOLIDATED EDISON INC	ED	Utilities	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CONSTELLATION ENERGY GRP INC	CEG	Utilities	1	1	1	1	1	1	0	0	0	0	0	0	0	0
DOMINION ENERGY INC	D	Utilities	1	1	1	1	1	1	1	1	1	1	1	1	1	1
DTE ENERGY CO	DTE	Utilities	1	1	1	1	1	1	1	1	1	1	1	1	1	1
DUKE ENERGY CORP	DUK	Utilities	1	1	1	1	1	1	1	1	1	1	1	1	1	1
DYNEGY INC	DYN	Utilities	1	1	1	0	0	0	0	0	0	0	0	0	0	0
EDISON INTERNATIONAL	EIX	Utilities	1	1	1	1	1	1	1	1	1	1	1	1	1	1
ENERGY FUTURE HOLDINGS CORP	0033A	Utilities	1	0	0	0	0	0	0	0	0	0	0	0	0	0
ENTERGY CORP	ETR	Utilities	1	1	1	1	1	1	1	1	1	1	1	1	1	1
EVERGY INC	EVRG	Utilities	0	0	0	0	0	0	0	0	0	0	0	0	1	1
EVERSOURCE ENERGY	ES	Utilities	0	0	0	1	1	1	1	1	1	1	1	1	1	1
EXELON CORP	EXC	Utilities	1	1	1	1	1	1	1	1	1	1	1	1	1	1
FIRSTENERGY CORP	FE	Utilities	1	1	1	1	1	1	1	1	1	1	1	1	1	1
INTEGRYS HOLDING INC	WEC3	Utilities	0	1	1	1	1	1	1	1	1	0	0	0	0	0
KEYSPAN CORP	KSE	Utilities	1	0	0	0	0	0	0	0	0	0	0	0	0	0
NEXTERA ENERGY INC	NEE	Utilities	1	1	1	1	1	1	1	1	1	1	1	1	1	1
NICOR INC	GAS.2	Utilities	1	1	1	1	1	0	0	0	0	0	0	0	0	0
NISOURCE INC	NI	Utilities	1	1	1	1	1	1	1	1	1	1	1	1	1	1
NRG ENERGY INC	NRG	Utilities	0	0	0	0	1	1	1	1	1	1	1	1	1	1
PEOPLES ENERGY CORP	PGL.1	Utilities	1	0	0	0	0	0	0	0	0	0	0	0	0	0
PEPCO HOLDINGS INC	POM	Utilities	0	1	1	1	1	1	1	1	1	1	0	0	0	0
PG&E CORP	PCG	Utilities	1	1	1	1	1	1	1	1	1	1	1	1	1	0
PINNACLE WEST CAPITAL CORP	PNW	Utilities	1	1	1	1	1	1	1	1	1	1	1	1	1	1
PPL CORP	PPL	Utilities	1	1	1	1	1	1	1	1	1	1	1	1	1	1
PROGRESS ENERGY INC	DUK8	Utilities	1	1	1	1	1	1	0	0	0	0	0	0	0	0
PUBLIC SERVICE ENTRP GRP INC	PEG	Utilities	1	1	1	1	1	1	1	1	1	1	1	1	1	1
QUESTAR CORP	STR	Utilities	1	1	1	1	0	0	0	0	0	0	0	0	0	0
SCANA CORP	SCG	Utilities	0	0	0	1	1	1	1	1	1	1	1	1	1	0
SEMPRA ENERGY	SRE	Utilities	1	1	1	1	1	1	1	1	1	1	1	1	1	1
SOUTHERN CO	SO	Utilities	1	1	1	1	1	1	1	1	1	1	1	1	1	1
SOUTHERN CO GAS	SO7	Utilities	0	0	0	0	0	1	1	1	1	1	0	0	0	0
TECO ENERGY INC	TE	Utilities	1	1	1	1	1	1	1	1	1	1	0	0	0	0
WEC ENERGY GROUP INC	WEC	Utilities	0	0	1	1	1	1	1	1	1	1	1	1	1	1
XCEL ENERGY INC	XEL	Utilities	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Source: Compustat.

Note: Ticker DD corresponds to Dow Chemical Company before 2017 and DowDuPont after 2017 following its merger with DuPont on August 31, 2017.

Appendix B, Exhibit B1
Railroad Return on Invested Capital (ROIC) minus Industry Cost of Capital (COC)

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Min	Max	Median	Average
Panel A: Railroad STB Definition of Cost of Capital																		
Railroad Industry Cost of Capital	9.9%	11.3%	11.8%	10.4%	11.0%	11.6%	11.1%	11.3%	10.7%	9.6%	8.9%	10.0%	12.2%	9.3%	8.9%	12.2%	10.8%	10.7%
Panel B: Railroad ROIC minus COC - Based on STB Definition of ROIC and STB Definition of Cost of Capital																		
Industry Weighted Average ROIC	0.2%	-1.5%	-1.0%	-2.5%	-0.3%	0.5%	1.4%	1.8%	2.2%	2.5%	1.5%	0.8%	0.5%	3.1%	-2.5%	3.1%	0.7%	0.7%
BNSF Railway	1.5%	-1.4%	-1.2%	-1.8%	-0.8%	0.8%	2.4%	2.7%	2.2%	3.2%	1.2%	0.7%	-0.3%	2.7%	-1.8%	3.2%	1.0%	0.9%
CSX Corporation	-1.8%	-3.7%	-2.4%	-3.1%	-0.2%	0.0%	-0.3%	-1.3%	-0.5%	-0.6%	-0.3%	-1.2%	1.0%	3.5%	-3.7%	3.5%	-0.5%	-0.8%
Grand Trunk Corporation	-0.5%	-1.2%	-1.9%	-4.4%	-1.8%	-2.8%	-0.9%	0.5%	0.6%	1.2%	-0.3%	-2.3%	-4.5%	-1.9%	-4.5%	1.2%	-1.5%	-1.4%
Kansas City Southern	-0.6%	-2.0%	-4.1%	-3.9%	-1.3%	-0.8%	-1.6%	-2.7%	-2.5%	-2.4%	-2.6%	-2.9%	-4.2%	-3.1%	-4.2%	-0.6%	-2.6%	-2.5%
Norfolk Southern Corporation	4.4%	2.2%	2.0%	-2.7%	-0.1%	1.3%	0.4%	0.7%	1.0%	-0.6%	0.3%	0.0%	-0.6%	2.3%	-2.7%	4.4%	0.6%	0.8%
Soo Line Corporation	1.7%	3.9%	-2.5%	-4.1%	-3.0%	-4.4%	-6.0%	0.7%	-11.1%	4.9%	0.7%	0.7%	1.3%	2.0%	-11.1%	4.9%	0.7%	-1.1%
Union Pacific Corporation	-1.7%	-2.4%	-1.3%	-1.8%	0.5%	1.5%	3.6%	4.1%	6.7%	5.9%	4.5%	4.0%	3.6%	6.2%	-2.4%	6.7%	3.6%	2.4%
Panel C: Railroad ROIC minus COC - Based on Adjusted STB Definition of ROIC and STB Definition of Cost of Capital																		
Industry Weighted Average ROIC	-2.2%	-3.5%	-2.5%	-3.1%	-1.7%	-0.5%	-0.9%	-1.0%	-0.3%	0.5%	-0.3%	-2.6%	-1.5%	1.4%	-3.5%	1.4%	-1.2%	-1.3%
BNSF Railway	-0.7%	-3.1%	-2.7%	-2.2%	-1.5%	1.1%	-0.2%	-0.4%	0.1%	1.2%	-0.4%	-2.9%	-2.3%	0.9%	-3.1%	1.2%	-0.5%	-0.9%
CSX Corporation	-3.6%	-5.0%	-3.4%	-3.7%	-1.7%	-1.2%	-2.0%	-3.4%	-2.6%	-1.9%	-1.7%	-4.0%	-1.0%	1.5%	-5.0%	1.5%	-2.3%	-2.4%
Grand Trunk Corporation	-2.3%	-3.3%	-4.3%	-5.5%	-2.9%	-3.1%	-3.4%	-2.8%	-1.8%	-0.5%	-1.4%	-4.7%	-5.1%	-2.3%	-5.5%	-0.5%	-3.0%	-3.1%
Kansas City Southern	-1.3%	-2.7%	-3.8%	-3.8%	-1.1%	-0.9%	-1.3%	-1.7%	-1.8%	-1.8%	-2.2%	-4.5%	-3.9%	-3.5%	-4.5%	-0.9%	-2.0%	-2.5%
Norfolk Southern Corporation	-0.9%	-2.2%	-0.7%	-3.5%	-2.2%	-0.8%	-2.1%	-2.1%	-1.6%	-2.4%	-1.7%	-3.1%	-2.3%	0.8%	-3.5%	0.8%	-2.1%	-1.8%
Soo Line Corporation	2.3%	4.1%	-4.0%	-5.0%	-3.1%	-4.7%	-7.1%	-0.1%	-13.7%	1.9%	-0.4%	-2.6%	-0.3%	0.0%	-13.7%	4.1%	-1.5%	-2.3%
Union Pacific Corporation	-3.6%	-4.1%	-2.1%	-2.5%	-1.1%	-0.2%	1.2%	0.9%	3.0%	3.0%	2.0%	-0.4%	1.0%	4.0%	-4.1%	4.0%	0.3%	0.1%

Sources: Bloomberg; Compustat; Ibbotson Yearbook (2006-2019); STB Revenue Adequacy Determination Report (2006-2018); RevAd 2019 AAR workpaper1.pdf, titled "AAR Duplication of STB Workpapers."

Appendix C, Exhibit C1

Railroad Percentiles within Sample - STB Definition of Return on Invested Capital (ROIC) and STB Definition of Cost of Capital (COC)
(Railroads' Return on Invested Capital and Cost of Capital Measured Using Non-STB Public Data)

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Min	Max	Median	Average
Panel A: S&P 500 Companies Excluding Railroads, Financial Institutions and Real Estate Companies																		
Sample Number of Observations, Median, 25th Percentile, and % Positive ROIC minus COC:																		
Number of Observations in Sample	398	395	402	405	402	401	397	395	392	383	371	368	378	380	368	405	395	391
Median ROIC minus COC	16%	16%	16%	13%	18%	19%	19%	21%	20%	22%	22%	20%	29%	25%	13%	29%	19%	20%
25th Percentile ROIC minus COC	5%	5%	3%	-1%	5%	6%	5%	4%	5%	4%	4%	5%	6%	5%	-1%	6%	5%	4%
% with ROIC minus COC > 0.0%	90%	89%	86%	73%	89%	91%	89%	90%	90%	88%	85%	89%	90%	91%	73%	91%	89%	88%
Railroad Percentile in the Distribution of ROIC minus COC:																		
Industry Weighted Average ROIC	15	15	14	20	15	12	17	19	25	23	24	27	23	26	12	27	19	20
CSX Corporation	16	17	22	26	22	14	16	16	19	18	20	20	23	28	14	28	19	20
Kansas City Southern	11	13	11	14	10	6	10	9	11	12	16	13	8	13	6	16	11	11
Norfolk Southern Corporation	24	22	26	23	17	14	13	13	19	14	19	22	17	23	13	26	19	19
Union Pacific Corporation	10	9	9	16	12	12	23	26	32	29	28	33	25	28	9	33	24	21
Panel B: S&P 500 Companies in the Industrials Sector Excluding Railroads																		
Sample Number of Observations, Median, 25th Percentile, and % Positive ROIC minus COC:																		
Number of Observations in Sample	48	52	55	53	54	56	53	56	57	59	63	62	62	61	48	63	56	57
Median ROIC minus COC	20%	23%	21%	14%	17%	21%	22%	22%	23%	24%	28%	28%	30%	31%	14%	31%	23%	23%
25th Percentile ROIC minus COC	11%	13%	13%	4%	10%	13%	12%	14%	11%	13%	9%	14%	13%	14%	4%	14%	13%	12%
% with ROIC minus COC > 0.0%	96%	92%	98%	83%	94%	96%	96%	96%	96%	97%	94%	100%	95%	97%	83%	100%	96%	95%
Railroad Percentile in the Distribution of ROIC minus COC:																		
Industry Weighted Average ROIC	10	9	4	9	11	5	6	7	17	13	9	11	13	13	4	17	10	10
CSX Corporation	10	9	9	15	13	5	6	7	10	10	9	6	13	15	5	15	10	10
Kansas City Southern	6	9	4	7	7	5	6	5	7	5	8	2	5	5	2	9	5	6
Norfolk Southern Corporation	14	13	11	11	11	5	6	5	10	7	9	6	6	8	5	14	9	9
Union Pacific Corporation	6	6	4	7	7	5	9	9	21	15	11	14	16	15	4	21	9	10
Panel C: Railroad Customer Sample of S&P 500 Companies																		
Sample Number of Observations, Median, 25th Percentile, and % Positive ROIC minus COC:																		
Number of Observations in Sample	80	80	81	82	84	84	84	83	84	86	85	83	84	82	80	86	84	83
Median ROIC minus COC	13%	12%	9%	3%	12%	13%	10%	7%	7%	8%	6%	8%	11%	9%	3%	13%	9%	9%
25th Percentile ROIC minus COC	4%	4%	1%	-4%	3%	3%	2%	2%	1%	2%	-1%	2%	2%	1%	-4%	4%	2%	2%
% with ROIC minus COC > 0.0%	88%	86%	79%	61%	86%	85%	83%	87%	83%	81%	72%	83%	85%	79%	61%	88%	83%	81%
Railroad Percentile in the Distribution of ROIC minus COC:																		
Industry Weighted Average ROIC	17	19	22	30	19	21	31	32	41	37	44	44	35	42	17	44	31	31
CSX Corporation	17	20	32	37	28	21	27	25	34	26	41	33	36	45	17	45	30	30
Kansas City Southern	14	17	16	22	15	9	13	13	21	20	29	24	13	25	9	29	17	18
Norfolk Southern Corporation	28	26	37	33	24	22	25	19	34	22	36	36	25	37	19	37	27	29
Union Pacific Corporation	14	9	13	23	16	21	36	43	51	46	48	50	38	45	9	51	37	32

Sources: Bloomberg; Compustat; Ibbotson Yearbook (2006-2019); STB Revenue Adequacy Determination Report (2006-2018); RevAd 2019 AAR workpaper1.pdf, titled "AAR Duplication of STB Workpapers."

Appendix C, Exhibit C2

Railroad Percentiles within Sample - Adjusted STB Definition of Return on Invested Capital (ROIC) and STB Definition of Cost of Capital (COC)
(Railroads' Return on Invested Capital and Cost of Capital Measured Using Non-STB Public Data)

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Min	Max	Median	Average
Panel A: S&P 500 Companies Excluding Railroads, Financial Institutions and Real Estate Companies																		
Sample Number of Observations, Median, 25th Percentile, and % Positive ROIC minus COC:																		
Number of Observations in Sample	405	401	409	415	413	414	413	412	410	408	402	393	395	394	393	415	409	406
Median ROIC minus COC	9%	9%	9%	5%	11%	11%	10%	11%	9%	10%	9%	7%	12%	10%	5%	12%	10%	9%
25th Percentile ROIC minus COC	1%	2%	1%	-2%	3%	3%	3%	2%	2%	2%	2%	2%	2%	2%	-2%	3%	2%	2%
% with ROIC minus COC > 0.0 %	81%	82%	80%	68%	86%	87%	86%	87%	87%	84%	82%	82%	84%	84%	68%	87%	84%	83%
Railroad Percentile in the Distribution of ROIC minus COC:																		
Industry Weighted Average ROIC	16	16	19	23	14	11	14	12	19	18	20	24	24	31	11	31	18	19
CSX Corporation	15	17	21	25	16	12	14	10	11	15	18	18	27	32	10	32	17	18
Kansas City Southern	17	18	14	14	14	10	14	12	16	16	18	17	10	17	10	18	15	15
Norfolk Southern Corporation	19	18	21	21	11	11	12	9	12	13	17	19	14	26	9	26	16	16
Union Pacific Corporation	14	14	17	23	15	11	17	18	31	28	26	34	30	33	11	34	20	22
Panel B: S&P 500 Companies in the Industrials Sector Excluding Railroads																		
Sample Number of Observations, Median, 25th Percentile, and % Positive ROIC minus COC:																		
Number of Observations in Sample	48	53	56	54	55	57	56	60	61	63	66	65	65	64	48	66	59	59
Median ROIC minus COC	13%	15%	15%	5%	12%	15%	13%	13%	12%	12%	11%	12%	13%	14%	5%	15%	13%	13%
25th Percentile ROIC minus COC	9%	8%	7%	1%	6%	8%	6%	6%	4%	7%	7%	7%	6%	9%	1%	9%	7%	6%
% with ROIC minus COC > 0.0 %	92%	91%	95%	80%	95%	95%	93%	95%	90%	90%	92%	97%	94%	95%	80%	97%	93%	92%
Railroad Percentile in the Distribution of ROIC minus COC:																		
Industry Weighted Average ROIC	6	9	5	13	9	5	11	5	18	14	9	8	9	11	5	18	9	9
CSX Corporation	6	9	7	15	9	7	9	5	10	11	7	5	11	11	5	15	9	9
Kansas City Southern	6	11	4	7	7	5	9	5	13	11	7	3	3	6	3	13	7	7
Norfolk Southern Corporation	10	11	7	13	5	5	9	5	10	8	6	5	8	11	5	13	8	8
Union Pacific Corporation	6	9	5	13	9	5	12	7	23	17	10	14	14	11	5	23	11	11
Panel C: Railroad Customer Sample of S&P 500 Companies																		
Sample Number of Observations, Median, 25th Percentile, and % Positive ROIC minus COC:																		
Number of Observations in Sample	80	80	81	82	84	84	84	83	84	87	86	84	85	83	80	87	84	83
Median ROIC minus COC	9%	7%	6%	0%	7%	8%	5%	4%	3%	3%	3%	3%	5%	5%	0%	9%	5%	5%
25th Percentile ROIC minus COC	1%	2%	0%	-5%	2%	2%	0%	1%	0%	1%	-2%	0%	1%	0%	-5%	2%	0%	0%
% with ROIC minus COC > 0.0 %	84%	81%	70%	52%	81%	83%	76%	81%	74%	79%	67%	76%	81%	76%	52%	84%	78%	76%
Railroad Percentile in the Distribution of ROIC minus COC:																		
Industry Weighted Average ROIC	12	19	27	35	20	16	26	19	32	25	37	36	31	45	12	45	26	27
CSX Corporation	12	20	32	39	22	16	25	15	20	22	32	25	36	45	12	45	24	26
Kansas City Southern	12	20	22	23	20	15	24	18	29	22	31	24	16	25	12	31	22	21
Norfolk Southern Corporation	17	20	32	34	19	16	18	14	22	20	30	28	19	40	14	40	20	24
Union Pacific Corporation	12	12	24	35	20	16	29	25	51	48	48	48	42	45	12	51	32	33

Sources: Bloomberg; Compustat; Ibbotson Yearbook (2006-2019); STB Revenue Adequacy Determination Report (2006-2018); RevAd 2019 AAR workpaper1.pdf, titled "AAR Duplication of STB Workpapers."