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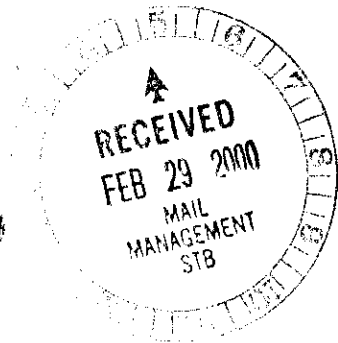
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February 29, 2000

BY HAND

Mr. Vernon A. Williams
Secretary
Surface Transportation Board
Office of the Secretary
Case Control Unit
ATTN: STB Ex Parte No. 582
1925 K Street, N.W.
Washington, D.C. 20423-0001

ENTERED
Office of the Secretary
FEB 29 2000
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Public Record



Re: Ex Parte No. 582, Public Views on Major Rail Consolidations

Dear Mr. Williams:

Enclosed for filing in the above-referenced docket, please find an original and 10 copies of the Statement of Jerry A. Hausman. Also enclosed is a diskette containing the text of this document in WordPerfect 7 format.

In accord with the procedures adopted by the Board in this proceeding (see Decision No. 3, served February 17, 2000, p. 2), Mr. Hausman's statement should be released to the public at the same time as the statements of other economists providing testimony in this proceeding, i.e., Thursday, March 9, 2000.

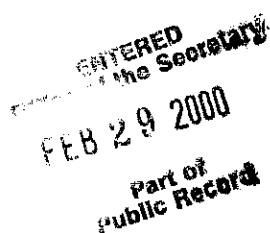
Please date-stamp the enclosed extra copy of this document and return it with our waiting messenger.

Thank you very much for your assistance.

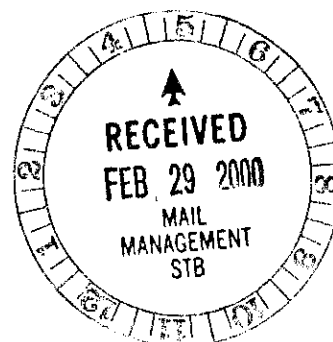
Sincerely,


David L. Meyer

Enclosures



BEFORE THE
SURFACE TRANSPORTATION BOARD



STB Ex Parte No. 582

PUBLIC VIEWS ON MAJOR RAIL CONSOLIDATIONS

STATEMENT

OF

JERRY A. HAUSMAN

My name is Jerry A. Hausman. Union Pacific asked me to provide the Board with my views on two of the important questions the Board raised in Ex Parte No. 582. The STB has asked for views regarding possible effects of major railroad consolidations on changes in the structure of the rail industry or in the way in which the industry is regulated.”¹ The Board also asked for views on the effects of railroad consolidations on the “financial condition of the railroad industry and the industry’s ability to provide responsive service at reasonable prices.”² Although UP is paying my fees, I independently developed all of the views and opinions in this statement. They are my own, not UP’s.

I. QUALIFICATIONS

I am MacDonald Professor of Economics at the Massachusetts Institute of Technology (“MIT”) in Cambridge, Massachusetts. I received a Doctor of Philosophy degree (D.Phil.) in economics from Oxford University, where I was a Marshall Scholar. I have been a member of the faculty at MIT for 26 years since completing my D.Phil. My academic and research specialties are econometrics, the application of statistical techniques to economic data, and applied microeconomics, the study of the behavior of consumers and firms. I attach a copy of my CV to this statement.

¹ STB Decision, Jan. 24, 2000, p. 3.

² Id., p. 4.

I have been an associate editor of *Econometrica*, one of the world's leading economics journals, and the *Rand (Bell) Journal of Economics*, one of the world's leading journals of applied microeconomics and regulation. I have published over 120 research papers in economics journals. In 1985, I received the John Bates Clark Award of the American Economic Association, awarded every other year for "the most significant contributions to economics" by an economist under forty years of age. I am a fellow of the Econometric Society, and in 1980 I was awarded the Frisch Medal of the Econometric Society.

I have significant experience in analyzing regulated industries. I have published numerous papers on the effects of regulation on the telecommunications industry. I have previous experience in the railroad industry and its regulation. I consulted for Southern Pacific on the Ex Parte No. 347 maximum rail rate regulation proceeding; advised ICC Commissioner Alexis on econometric issues; and, most recently, submitted testimony to the STB on behalf of Union Pacific in 1998 and 1999 in a major rate reasonableness case involving traffic of FMC Corporation and FMC Wyoming Corporation, Docket No. 42022.

II. INTRODUCTION

One consequence of additional major rail consolidations is to increase calls -- principally by shippers and shipper groups -- for various forms of re-regulation of the railroad industry. Although I am not an expert on the American legislative process, it seems likely that as pressure for re-regulation grows, the likelihood of increased regulation will grow.

As I explain in this statement, any form of re-regulation -- and even *increasing the potential for re-regulation* -- would have very serious adverse consequences for the railroad industry as a whole. As an economist, I will analyze the consequences of potential re-regulation of the railroad industry from the perspective of consumer welfare, which I believe is equivalent to the public interest.³

³ In the context of telecommunications regulation I have explained how consumer welfare is equivalent to the public interest. See, e.g., J. Hausman "Taxation By Telecommunications Regulation," *Tax Policy and the Economy*, 12, 1998; J. Hausman and
(continued...)

III. A BRIEF HISTORY OF RAIL REGULATION

A brief amount of history may be helpful here. In the past 20 years the value of railroad service has improved tremendously over the levels that previous regulation had created. Real (inflation adjusted) railroad rates have decreased by more than 50% since the railroads were de-regulated.⁴ For instance, a recent GAO report states that real railroad rates have generally decreased since 1990 and have been decreasing since the early 1980s.⁵ Of course, not all rates declined at the same pace, but rates decreased in varying degrees for almost all categories of shipments. In normally functioning markets, economists expect the interaction of demand factors, cost factors, and competitive factors, both including intramodal intermodal competition, to lead to different competitive outcomes. It is therefore striking that almost *every* group of shippers has benefited from the effects of deregulation of the railroad industry over the past 20 years. As most railroad rates decreased significantly, railroad productivity increased significantly.

Despite the success of deregulation, some shippers and shipper groups have called in

(...continued)

H. Shelanski, "Economic Welfare and Telecommunications Welfare: The E-Rate Policy for Universal Service Subsidies," Yale Journal on Regulation, 16, 1999; and J. Hausman and G. Sidak, "A Consumer-Welfare Approach to the Mandatory Unbundling of Telecommunications Networks," Yale Law Journal, 109, 1999.

⁴ For academic articles that discuss the improvement in service, see, e.g., M. Burton, "Railroad Deregulation, Carrier Behavior, and Shipper Response," Journal of Regulatory Economics, 5, 1993; C. Barnekov and A. Kleit, "The Efficiency Effects of Railroad deregulation in the U.S.," International Journal of Transport Economics, 17, 1990; and J. MacDonald and L. Cavalluzzo, "Railroad Deregulation: Pricing Reforms, Shipper Responses, and the Effects on Labor," Industrial and Labor Relations Review, 50, 1996. From 1980 to 1998 real railroad rates fell by 52% while train accidents fell by 66% (source: Federal Railroad Administration) and volume shipped grew by 50%. For a study of cost reduction see, e.g., W. Wilson, "Cost Savings and Productivity in the Railroad Industry," Journal of Regulatory Economics, 11, 1997.

⁵ U.S. Government Accounting Office ("GAO"), Railroad Regulation: Changes in Railroad Rates and Service Quality Since 1990, Apr. 1999, p. 47

recent years for re-regulation of the railroad industry. Two principal type of re-regulatory proposals have been advanced in recent years: various forms of “open access” and “bottleneck” rate regulation, both of which I address in more detail below.

Those who call for re-regulation seemingly want improved service while paying lower prices. Could this outcome occur through increased regulation? The answer is no. Service improvements have required and will continue to require significant investment by the railroads in track capacity, locomotives, management and information technology, and other assets. The recent GAO report on railroad regulation explicitly recognizes that high quality rail service “involves trade-offs between investment and service.”⁶

The fundamental economic outcome of re-regulation of the railroad industry would be a significant reduction in the incentives for investment in railroad assets, including not only rails and locomotives, but also the communications and information technologies that hold the most promise of improving railroad service. Most railroad traffic is subject to competition from trucking. If railroads do not continue to invest, their competitive position will deteriorate. Re-regulation will lead to disincentives for investment, competitive losses to competition, and decreased railroad financial performance. The railroad industry would likely not survive this outcome.

Calls for re-regulation have intensified with the recent announcement of the proposed BNSF/CN merger. From the perspective of economic theory, I do not believe that the BNSF/CN merger proposal, or any other aspect of rail industry structure, would *justify* re-regulation of the industry. Nevertheless, there is no question that the vigor with which re-regulation will be pursued will be greater and the likelihood of some re-regulation being enacted will be increased in the event that BNSF/CN goes forward, and even more likely still if there are follow-on transactions.

IV. PROPOSED RE-REGULATION AND ITS EFFECTS

In this section I will discuss the two most likely types of re-regulation: “open access,”

⁶ GAO, Railroad Regulation: Changes in Railroad Rates and Service Quality Since 1990, Apr. 1999, p. 73.

where railroads are required to share their infrastructure with competitors, and “bottleneck rate regulation,” where shippers get to choose segments of railroads networks they want to subject to rate regulation.

Shippers have proposed “open access” regulation in several forms. Several legislative proposals would require reciprocal switching access to all solely-served shippers in terminal areas at cost-based switching charges. The current Administration’s proposed STB Reauthorization Act contains a mandated reciprocal switching provision (Section 6).

Shippers sought “bottleneck rate” regulation (a form of “unbundling”) from the STB in 1996, and several pending bills would require it. The recently proposed H.R. 3446 (Nov. 18, 1999) contains a mandatory bottleneck rate provision in Section 102. These proposals would require railroads to quote rates for shipments over the so-called “bottleneck” segment of track between the shipper or receiver that is exclusively served by railroad and the nearest point of connection with a competing railroad. This rate would be subject to regulation under the stand-alone cost test or other forms of rate regulation. For the remainder of the movement, the shipper would secure bids from competing railroads.

Both of these proposals would create situations where a railroad would not be able to earn its cost of capital. This outcome of investment returns below the cost of capital would occur because it would lead to rates that are below the cost of serving the customers, where the cost includes a market-based return to invested capital.

1. “Open access” regulation would create a disincentive to investment by the railroad that owns a track for several reasons. First, competition from competing railroads would drive rail rates prices down toward variable costs, since the railroad who owned the infrastructure would be required to share it with its competitors and no capacity constraints would prevent the competitor from winning 100% of the traffic previously handled by the owner. Under conditions of competition where significant fixed and sunk costs exist, as in the railroad industry, entry of a new head-to-head competitor will drive the R/VC ratio downward toward 100%, regardless of whether it starts above or below 180%. These decreased rates and decreased net revenues will decrease investment incentives for railroads.

If the railroads recover only their variable costs but do not recover their fixed and common costs, they will not earn a market return on their investments.⁷

Second, the expected regulatory battles over the correct way to set the cost-based rates would increase the uncertainty hanging over the railroad industry.⁸ This increased uncertainty would also reduce incentives for investment in the industry.

Third, cost-based compensation for use of shared assets would not allow railroads to obtain a market-based return on investments. In an industry with significant sunk costs, cost-based regulation for sharing of railroad assets has especially large adverse effects because of uncertainty over future economic conditions. Much railroad investment is sunk and irreversible. Sunk costs are non-retrievable investments that arise from the irreversible investment. If economic conditions take a turn for the worse – say, there is an unexpected and significant decrease in demand for rail services – the sunk investments cannot be sold for use in another industry, nor can they be used elsewhere. Thus, the investing railroad runs the risk of losing its investment, while cost-based regulation with sharing of railroad facilities places an upside limit on economic returns to an investment. Thus, while there exists a limit on the upside of the (probability) distribution of potential economic returns due to the effect of regulation, no floor exists on downside outcomes due to the existence of sunk costs. The result is an asymmetric and truncated probability distribution of returns as shown in Figure JAH-1, which is attached. This regulation-induced truncation effect will further decrease the incentives for investment.⁹

⁷ Even if fixed costs were included in the regulation set rates, common costs would still not be recovered.

⁸ The FCC's method of setting cost-based rates for local exchange companies is still being litigated 3.5 years after the FCC's initial decision in 1996.

⁹ This effect of regulation due to the presence of sunk and irreversible investment can be quite large as I have demonstrated in the context of telecommunications. See J. Hausman, "Valuation and the Effect of Regulation on New Services in Telecommunications," Brookings Papers on Economic Activity: Microeconomics, 1997 and "The Effect of Sunk Costs in Telecommunication Regulation," in J. Alleman and E. Noam, eds, The New Investment Theory of Real Options and its Implications for Telecommunications Economics, (continued...)

This truncation effect is likely to have especially negative effects for the introduction of new technology in the railroad industry, because of the significant uncertainty related to the introduction of new technology. New information technology (IT) and communications systems have the potential for improving service and equipment utilization and for changing the way shippers arrange for transportation (e-commerce). IT systems are largely software based and are almost all sunk costs, in that they are railroad industry specific, and the investment cannot be recovered by using the IT systems in another industry. Cost-based regulation has an especially large disincentive effect on this type of sunk investment.

Cost-based regulation with extended depreciation schedules creates significant disincentives for investment in new technologies by regulated companies. Regulators always have the incentive to use extended depreciation schedules as a method to hold down prices. The longer the period of capital recovery, the lower the effect on current prices. But cost-based regulated firms are averse to investing in new technology because their old investments have not yet been recovered and the companies know they are unlikely to recover their new investments. The regulatory history of the telephone industry in the 1970s and 1980s demonstrates this point. Telephone companies did not invest initially in digital PBXs and digital switches because their older analog switches had very long regulatory depreciation lives (20 years). The FCC has adopted this type of "open access" policy for local telephone companies, setting cost-based rates. The FCC's approach neglects to account for the effect of sunk and irreversible investments and is suppressing investment in the telephone industry.¹⁰

An additional problem arises because FCC-type regulation decreases competitors' incentive to invest.¹¹ If a competitor faces a "make or buy" decision and a regulatory agency offers the use of an investment at a cost that does not account for the significant uncertainty

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1999.

¹⁰ See R. Crandall and J. Hausman, "Competition in U.S. Telecommunications Services Three Years After the 1996 Act," paper delivered at AEI-Brookings conference, Dec. 1999

¹¹ For a discussion see J. Hausman and G. Sidak, "A Consumer-Welfare Approach to the Mandatory Unbundling of Telecommunications Networks," Yale Law Journal, 1999.

regarding sunk investments, most companies will decide not to take the risk of investment. Instead, they will use their competitor's network to provide the needed resources. This outcome is becoming apparent in telecommunications where competitors invest in equipment such as switches in mobile telephone competition, where no regulatory sharing takes place, but are not investing in similar equipment in fixed line telephone competition where "open access" is compelled.¹² The FCC's regulatory approach gives competitors a "free option" which decreases their incentives to invest in their own networks.¹³ Similar regulatory grants of "free options" in the railroad industry would likely lead to an even further decline in the equity value of railroads from their already depressed levels.

2. Establishment of "bottleneck" rates using an approach similar to the Board's "stand-alone" cost test will also decrease railroad incentive to invest. The Board's stand-alone test relies on the "contestability" model of economics, which is inapplicable where significant sunk and irreversible investment takes place in an environment of uncertainty. Economic research over the past 15 years has demonstrated that uncertain outcomes have a significant effect on investment incentives, but the contestability approach assumes that investment is fixed, not sunk. An alternative approach to reach the same conclusion is to realize that the Board's regulatory approach does not consistently take account of barriers to entry and exit when sunk costs are present. Economists now realize that this approach is incorrect in the presence of sunk and irreversible investment.¹⁴

¹² See R. Crandall and J. Hausman, "Competition in U.S. Telecommunications Services Three Years After the 1996 Act," paper delivered at AEI-Brookings conference, Dec. 1999.

¹³ Another important point is that U.S. local telephone companies are in much better financial shape than railroads due to the rapid growth in demand arising from the internet. Thus, regulatory grants of "free options" to their competitors has not led to the problems that would likely occur in the railroad industry.

¹⁴ See footnote 10 where I discuss my previous research. Prof. Baumol has also realized the importance of sunk costs and uncertainty in these situations contrary to his previous recommendations of using "total service long run incremental cost." See W. Baumol, "Option Value Analysis and Telephone access Charges," in J. Alleman and E. Noam, eds, The New Investment Theory of Real Options and its Implications for Telecommunications

(continued...)

But even if the Board stand-alone approach were correct, establishment of bottleneck rates would have the effect of decreasing rates significantly, depriving the railroads of funds essential for investment. I would expect R/VC ratios to decrease to far below 180% for “bottleneck traffic” on the non-bottleneck segments. Indeed, I would expect R/VC ratios to be much nearer to 100%. Economic analysis demonstrates that when two or more firms are selling a homogeneous product without capacity constraints, price tends to be driven down toward variable cost by competition. The competitors have the economic incentive to continue to lower price as long as it covers its out-of-pocket costs. The railroads estimated a few years ago that bottleneck regulations would reduce their net revenues by \$2.4 billion annually, cutting investment and curtailing service.¹⁵

* * *

The recent financial performance of railroads and their very low stock prices demonstrates their current weak financial position. Both the Board and investment analysts on Wall Street recognize that the railroads are not earning their cost of capital. The Board has determined that most Class I railroads are revenue inadequate because they do not generate enough revenue to cover the industry’s cost of capital. The Board’s 1998 Determination of Railroad Revenue Adequacy determined that the 1998 railroad industry costs of capital was 10.7%.¹⁶ However, the Board found that none of the four largest railroad’s return on investment (ROI) exceeded the industry cost of capital, with only the Norfolk Southern within one percentage point of the cost of capital:

(...continued)
Economics, 1999.

¹⁵ Overall, railroad movements are very heterogeneous depending on the type of shipment. However, for a given shipment two or more railroads would be competing over the same (or similar) shipments, which would be competition for a homogeneous shipment.

¹⁶ STB Ex Parte No. 552 (Sub-No. 3), decided September 1, 1999.

Table 1: ROI and WACC of Major Railroads

	1998 STB ROI	1999 ROI ¹⁷	Firm WACC
BNSF	9.7%	9.7%	11.3%
CSX	8.1%	4.8%	7.9%
Norfolk Southern	10.5%	9.1%	10.9%
Union Pacific	2.9% ¹⁸	5.3%	8.6%

Investors will not have an economic incentive to commit capital for replacement or new investment unless they expect to receive at least their (risk-adjusted) cost of capital. Today the railroads fail to meet that minimum expectation. Furthermore, financial analysts on Wall Street uniformly agree that railroads are not recovering their cost of capital.¹⁹ Railroad stock prices have not increased from the level of the mid-1990s, when the latest round of major mergers was initiated by the BN/Santa Fe consolidation. As the graph of the railroad stock prices in Table 2 demonstrates, railroad stock prices are currently at essentially the same level as the beginning of 1995, despite a tripling of the S&P500 over the same time period. Indeed financial analysts report that in terms of commonly used measure such as price/earning that the railroad stocks are at their lowest levels since the early 1990s. Thus, using a variety of financial measures, railroads are in their worst financial position for many years and equity markets do not expect the railroads' financial performance to improve significantly in the near term.

Proposals for re-regulation would inevitably lead to lower prices and even lower returns on investment to railroads. Since widespread agreement exists that railroads are not currently earning their cost of capital, lower prices and lower returns on investment will decrease the economic incentive for further investment. Thus, the ability of the railroads to

¹⁷ Based on 1999 estimated earnings in Credit Suisse First Boston reports.

¹⁸ The Union Pacific results were significantly affected by the integration problems that occurred with the merger with the Southern Pacific.

¹⁹ See recent reports of Credit Suisse First Boston, Morgan Stanley, Brown Brothers Harriman, and others.

attract capital and reinvest in plant and improve levels of service will decrease. Indeed, the ability and incentive to maintain present levels of service to existing shippers may be placed in jeopardy because the economic benefit to replacement investment and the required investment to accommodate expected growth may not be forthcoming, given the low levels of expected returns. The railroads entered the period of deregulation with significant excess capacity. The growth over the past 20 years of over 50% in volume, as well as the rationalization of the railroad networks, has eliminated much of the excess capacity from the networks. Thus, I expect that railroads will need significant replacement investment as well as new investment to serve the expected growth. However, lower rates and decreased return on new investment following from industry re-regulation will act as an economic disincentive for this required investment.

V. EFFECTS OF THE THREAT OF RE-REGULATION

Even a “darkening cloud” of re-regulation would have adverse effects on the railroad industry. In the past two months since the BNSF/CN merger announcement, the equity stock market values of the railroads have decreased significantly. These decreases in the equity stock market values since mid-December 1999 are demonstrated in Table 2. Large railroad stocks have decreased by about 25% since the announcement, despite generally good earnings growth. Financial analysts have pointed out that the stocks are trading at their lowest price/earnings ratios since 1990.²⁰ For railroads to raise money in capital markets and to have the economic incentive to do replacement investment and further investment to improve service levels, investors must have the expectation of a risk adjusted market return. U.S. railroads have not provided this return over the recent past, and current valuation levels imply that investors do not believe they will achieve a sufficient return in the future.

A threat of re-regulation could deter current investment because railroads will exercise their option to delay investment until the regulatory framework becomes clearer. This delayed investment will lead to further problems for both the railroads and for their

²⁰ See, e.g., Credit Suisse First Boston Report on BNSF, January 6, 2000.

shipper customers. The Board has raised the question whether the industry currently or going forward has the capacity, infrastructure and configuration to meet the nation's existing and evolving transportation needs. Decreased investment caused by the threat of re-regulation will not help solve these requirements.

VI. CONCLUSION

In the railroad industry, regulation almost killed the patient. Twenty years of de-regulation have led to decreasing real rates, increased output, increased productivity, and improved financial performance by the railroads. However, railroads have not yet returned to the minimum level of financial health where they earn their cost of capital. And recent events have led to depressed stock prices for the major railroads.

Against this background, re-regulation or the threat of re-regulation will lead to decreased investment in the railroads. Decreased investment will lead to decreased service levels when both shippers and the railroads agree that service levels need to be improved. I therefore urge the Board to maintain consumer welfare, and further the public interest, by protecting the railroads and the public from increased risk of re-regulation.

Figure JAH-1
Frequency Distribution of Returns for a Given Investment

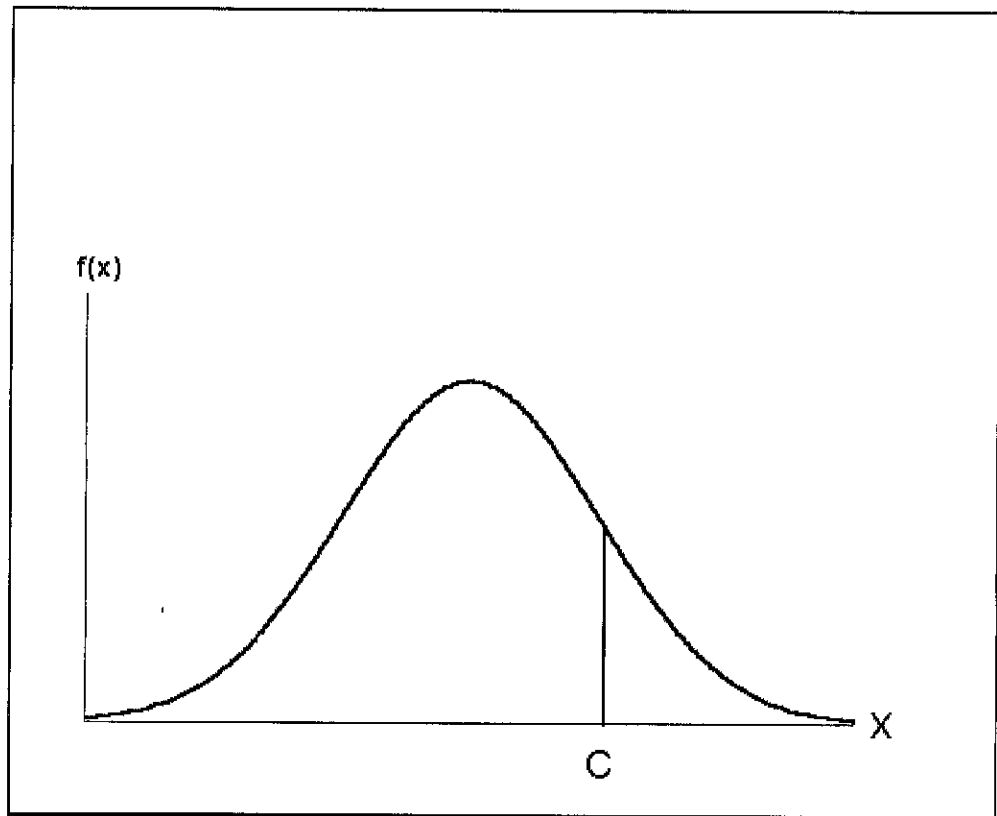
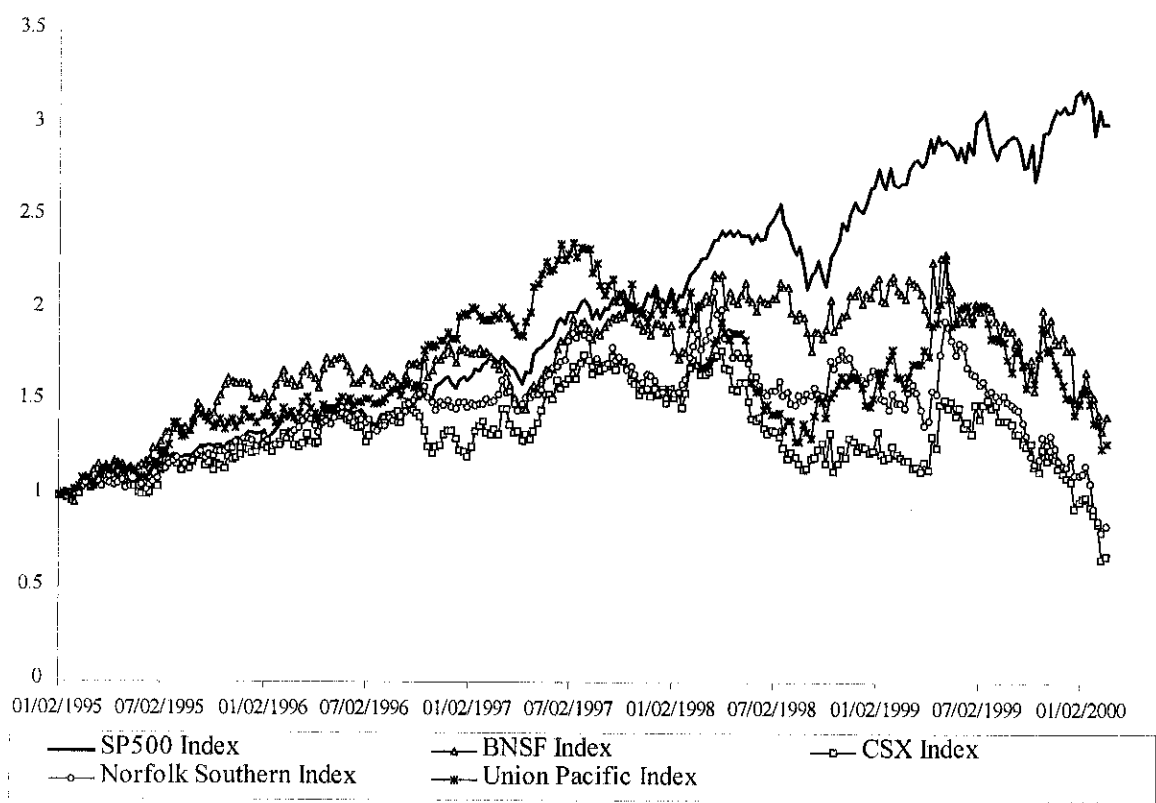


Figure JAH-2
Stock Price Performance
1/95 - Present



I, Jerry A. Hausman, hereby declare under penalty of perjury under the laws of the United States of America that the above is true and correct to the best of my knowledge and belief.

Dated: 26 Feb 2000

J. A. Hausman

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EDUCATION:

OXFORD UNIVERSITY
D. Phil. 1973 (Ph.D)
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BROWN UNIVERSITY
A.B. (Summa Cum Laude), 1968

THESIS: "A Theoretical and Empirical Study of Vintage Investment and Production in Great Britain,"
Oxford University, 1973.

FELLOWSHIPS, HONORS AND AWARDS:

Phi Beta Kappa
Marshall Scholar at Oxford, 1970-1972
Scholarship at Nuffield College, Oxford, 1971-1972
Fellow of Econometric Society, 1979.
Frisch Medal of the Econometric Society, 1980
Fisher-Schultz Lecture for the Econometric Society, 1982
John Bates Clark Award of the American Economic Association, 1985
Jacob Marschak Lecture for the Econometric Society, 1988
American Academy of Arts and Sciences, 1991.
Fellow, Journal of Econometrics, 1998.

EMPLOYMENT:

	MASSACHUSETTS INSTITUTE OF TECHNOLOGY
1992-	<u>John and Jennie S. MacDonald Professor</u>
1979-	<u>Professor, Department of Economics</u>
1976-79	<u>Associate Professor, Department of Economics</u>
1973-76	<u>Assistant Professor, Department of Economics</u>
1972-73	<u>Visiting Scholar, Department of Economics</u>

	VISITING APPOINTMENTS:
1986-87	<u>Visiting Professor, Harvard Business School</u>
1982-83	<u>Visiting Professor, Harvard University Department of Economics</u>

	U.S. ARMY, ANCHORAGE, ALASKA
1968-70	<u>Corps of Engineers</u>

PROFESSIONAL ACTIVITIES:

Associate Editor, Bell Journal of Economics, 1974-1983
 Associate Editor, Rand Journal of Economics, 1984-1988
 Associate Editor, Econometrica, 1978-1987
 Reviewer, Mathematical Reviews, 1978-1980
 American Editor, Review of Economic Studies, 1979-82
 Associate Editor, Journal of Public Economics, 1982-
 Associate Editor, Journal of Applied Econometrics, 1985-1993
 Member of MIT Center for Energy and Environmental Policy Research, 1973-
 Research Associate, National Bureau of Economic Research, 1979-
 Member, American Statistical Association Committee on Energy Statistics, 1981-1984
 Special Witness (Master) for the Honorable John R. Bartels, U.S. District Court for the Eastern District of New York in Carter vs. Newsday, Inc., 1981-82
 Member of Governor's Advisory Council (Massachusetts) for Revenue and Taxation, 1984-1992
 Member, Committee on National Statistics, 1985-1990
 Member, National Academy of Social Insurance, 1990-
 Member, Committee to Revise U.S. Trade Statistics 1990-1992
 Director, MIT Telecommunications Economics Research Program, 1988-
 Board of Directors, Theseus Institute, France Telecom University, 1988-1995
 Member, Conference on Income and Wealth, National Bureau of Economic Research, 1992-

PUBLICATIONS:**I. Econometrics**

- "Minimum Mean Square Estimators and Robust Regression," Oxford Bulletin of Statistics, April 1974.
- "Minimum Distance and Maximum Likelihood Estimation of Structural Models in Econometrics," delivered at the European Econometric Congress, Grenoble: August 1974.
- "Full-Information Instrumental Variable Estimation of Simultaneous Equation Models," Annals of Economic and Social Measurement, October 1974.
- "Estimation and Inference in Nonlinear Structural Models," Annals of Economic and Social Measurement, with E. Berndt, R.E. Hall, and B.H. Hall, October 1974.
- "An Instrumental Variable Approach to Full-Information Estimators in Linear and Certain Nonlinear Econometric Models," Econometrica, May 1975.
- "Simultaneous Equations with Errors in Variables," delivered at Winter Econometric Meetings, San Francisco: December 1974; published in Journal of Econometrics 5, 1977, pp. 389-401.
- "Social Experimentation, Truncated Distributions, and Efficient Estimation," delivered at the World Econometric Congress, Toronto: August 1975; Econometrica, with D. Wise, June 1977.
- "A Conditional Probit Model for Qualitative Choice," delivered at World Econometric Congress, Toronto: August 1975; MIT Working Paper 173, April 1976; Econometrica, with D. Wise, March 1978.
- "Specification Tests in Econometrics," MIT Working Paper 185, June 1976; Econometrica, 1978.
- "Non-Random Missing Data," with A.M. Spence, MIT Working Paper 200, May 1977.

PUBLICATIONS cont.:

- "Attrition Bias in Experimental and Panel Data: The Gary Income Maintenance Experiment," with D. Wise, J.F. Kennedy School Working Paper, May 1977; Econometrica, January 1979.
- "Missing Data and Self Selection in Large Panels," with Z. Griliches and B.H. Hall, Harvard Economics Department Working Paper, August 1977; delivered at INSEE conference on Panel Data, Paris: August 1977; Annales de l'INSEE, April 1978.
- "Stratification on Endogenous Variables and Estimation," with D. Wise, J.F. Kennedy School Working Paper, January 1978; delivered at CME Conference, April 1978; in The Analysis of Discrete Economic Data, ed. C. Manski and D. McFadden, MIT Press, 1981.
- "Les modèles probit de choix qualitatifs," ("Alternative Conditional Probit Specifications for qualitative Choice.") (English Version), September 1977; EPRI report on discrete choice models, presented at INSEE Seminar, Paris: May 1978; Cahiers du Séminar d'Econometrie, 1980.
- "The Econometrics of Labor Supply on Convex Budget Sets," Economic Letters, 1979.
- "Panel Data and Unobservable Individual Effects," with W. Taylor, MIT Working Paper 225; Econometrica 49, November 1981.
- "Comparing Specification Tests and Classical Tests," with W. Taylor, August 1980, Economic Letters, 1981.
- "The Effect of Time on Economic Experiments," invited paper at Fifth World Econometrics Conference, August 1980; in Advances in Econometrics, ed. W. Hildebrand, Cambridge University Press, 1982.
- "Sample Design Considerations for the Vermont TOD Use Survey," with John Trimble, Journal of Public Use Data, 9, 1981.
- "Identification in Simultaneous Equations Systems with Covariance Restrictions: An Instrumental Variable Interpretation," with W. Taylor, December 1980; Econometrica, 1983.
- "Stochastic Problems in the Simulation of Labor Supply," presented at NBER conference, January 1981; in Tax Simulation Models, ed. M. Feldstein, University of Chicago Press, 1983.
- "The Design and Analysis of Social and Economic Experiments," invited paper for 43rd International Statistical Institute Meeting, 1981; Review of the ISI.
- "Specification and Estimation of Simultaneous Equation Models," in Handbook of Econometrics, ed. Z. Griliches and M. Intriligator, vol. 1, 1983.
- "Full-Information Estimators," in Kotz-Johnson, Encyclopedia of Statistical Science, vol. 3, 1983
- "Instrumental Variable Estimation," in Kotz-Johnson, Encyclopedia of Statistical Science, vol. 4, 1984
- "Specification Tests for the Multinomial Logit Model," with D. McFadden, October 1981; Econometrica, 1984.
- "Econometric Models for Count Data with an Application to the Patents R&D Relationship," with Z. Griliches and B. Hall, NBER Working Paper, August 1981; Econometrica, 1984.
- "The Econometrics of Nonlinear Budget Sets," Fisher-Shultz lecture for the Econometric Society, Dublin: 1982; Econometrica, 1985.
- "The J-Test as a Hausman Specification Test," with H. Pesaran, November 1982; Economic Letters, 1983.

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