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THE EFFECT OF THE MOTOR CARRIER ACT OF 1980 ON THE RISK AND RETURN CHARACTERISTICS OF COMMON EQUITY ISSUES

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ABSTRACT

THE EFFECT OF THE MOTOR CARRIER ACT OF 1980
ON THE RISK AND RETURN CHARACTERISTICS
OF COMMON EQUITY ISSUES

By

Duncan J. Kretovich

The objective of this research was to measure the effect of the passage of the Motor Carrier Act of 1980 (MCA) on the common stocks of motor carriers. Capital market data were analyzed to determine how the risk and return characteristics changed for a sample of motor carriers for a time period before and after the passage of the Motor Carrier Act.

Congress passed the Motor Carrier Act based on arguments that the existing economic regulation no longer protected the consumers of motor carrier services. The motor carrier industry, represented by the management of the carriers and the Teamsters union, opposed deregulation. Industry opposition was based on the argument that deregulation would lead to "cut-throat" competition and result in the loss of service to some communities. Additionally, management argued that deregulation would cause an adverse reaction in the capital markets to the securities of the motor carriers. Management maintained that the adverse reaction would take the form of an increased level of risk and higher required rates of return by the market.

Estimates of systematic risk and abnormal return performance were obtained from the market model on a sample of publicly traded motor carriers. T-tests were done to determine how risk estimates changed before and after passage of the MCA and if abnormal returns existed around the passage of the MCA. The uniqueness of this study is that tests for changes in risk were performed.

The results of the analysis were that the total risk of trucking securities did not change after deregulation. However, the systematic risk estimates changed significantly downward.

The results of the cumulative average residual analysis indicated that significant positive abnormal returns were available beginning in August of 1980. Since the systematic risk of the portfolio declined after deregulation, the abnormal returns found after August 1980 were biased downward. Thus, investors earned higher abnormal returns than were indicated by the cumulative average residual analysis.

DEDICATION

This dissertation is dedicated to Susan Moeller.

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I would like to thank my committee members, Drs. George Kutner, Kenneth D. Boyer, and Paul Rubin for their assistance with this research. I am grateful for all the valuable advice and guidance provided by my committee members throughout all phases of the study.

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CHAPTER I

INTRODUCTION

In June 1980, the Motor Carrier Act of 1980 (MCA) was signed into law. The MCA ended most of the economic regulation of the trucking industry. It eliminated the rigid pricing structure for services, the privately owned rights to carry freight between cities, and the barriers that prevented new firms from entering the interstate freight business.

The motor carrier industry has been regulated by the Interstate Commerce Commission (ICC) since 1935. The ICC has regulated rates, routes, entry, exit, and quality of service. The actual administration of the ICC Act of 1935 was delegated to regional rate bureaus controlled by the trucking companies in each region. The close association of the regulated firm with its regulators might have caused investors to perceive that an implicit level of income would be assured to the motor carriers. The expectation that trucking companies would earn a certain amount of income might have influenced how investors perceived the level of risk and returns on the common stocks of motor carriers.

Beginning in the 1960's academics questioned the value of the existent regulatory process and policies. The issues raised in the academic studies gave rise to policy studies which ultimately led to the Motor Carrier Act of 1980.

Investors evaluated many variables when assessing the common stock of a motor carrier as a potential investment. A partial list of the variables included:

1. amount of debt relative to equity,
2. stability of management,
3. long term strength of consumer demand,
4. predictability of operating cash flows.

Due to the many years of close collaboration between motor carriers and the rate bureaus, and the strict entry controls and constraints on competition, the uncertainty surrounding operating cash flows was minimized.

Deregulation might have caused the stock market to revalue the common stocks of motor carriers. There were several reasons for this:

1. Because there was more latitude in the pricing of services, the cash flow from revenues was not as predictable.
2. Without the barriers to entry that existed before deregulation, motor carriers were confronted by new carriers competing for a share of the market.
3. Exemption from antitrust legislation allowed rate bureaus to foster price collaboration.
4. The balance sheets of motor carriers previously listed as assets the route certificates purchased from other companies. With deregulation these intangible assets became worthless, thereby increasing the debt ratios of the firms.

This research examined the effect of deregulation on the risk and returns to the common stockholders of motor carriers.

Research Objective

The primary objective of the study was to determine how the risk and return characteristics of the common stocks of motor carriers

changed at the time the motor carrier industry was deregulated. The following empirical questions were addressed using capital market data: Were abnormal returns[1] earned by investors who purchased the common stocks of trucking firms after deregulation? Or in other words, did the market react to the news of deregulation efficiently and incorporate the news into its pricing mechanism for the trucking firm. The effects of the MCA were also evaluated by determining whether or not the systematic and total risk of the motor carriers shifted significantly around the time the MCA was passed into law.

The risk-return measures were estimated using the market model and capital market data. The cumulative average residual technique was then applied to the data to determine if the stocks of motor carrier firms earned abnormal returns after deregulation, and if the market incorporated the news of deregulation efficiently into the prices of these stocks.

The formal research hypotheses were stated as follows:

1. H_0: The purchase of the common stocks of motor carrier firms did not result in abnormal returns for investors.

   H_1: The purchase of the common stocks of motor carrier firms did result in abnormal returns for investors.

2. H_0: The risk of motor carrier firms did not change after deregulation.

   H_1: The risk of motor carrier firms did change after deregulation.

These questions and the results of the tests of the hypotheses are important to economic policy makers. Additionally, investors might

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[1] In the context of event studies, abnormal return means the actual return is different from the expected return when the expected was calculated without the information about the event (Spiller, 1983).

be better able to form expectations about the effects of major economic regulatory events.

Institutional Setting

The decade of the 1970's may be marked in the annals of economics as the beginning of a period. The period was characterized by a re-examination of traditional economic regulation and the subsequent reduction or elimination of the regulation. The actions taken were best described as regulatory reform. The regulatory reform movement of unprecedented proportions has touched all areas of regulation from health and safety to banking practices to transportation.

Transportation is closely tied to social and economic forces.[2] It is a very visible industry whose actions have far reaching consequences to the economy. The very existence and survival of many communities were tied to the availability of transportation. The first federal regulatory agency to have jurisdiction over a transportation mode was the Interstate Commerce Commission (ICC), formed in 1887 to regulate railroads. The regulatory system for railroads was originally implemented to assure the availability of transportation at a reasonable cost to farmers. Since the inception of the ICC, airlines and motor freight have developed and been included under the Civil Aeronautics Board (CAB) and ICC umbrellas. Accompanying the proliferation of transportation modes has been a number of regulatory bodies for the respective modes. Motor freight came under the jurisdiction of the ICC with the Motor Carrier Act of 1935. The airlines were removed from ICC jurisdiction and provided an exclusive regulatory agency in 1938 with

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[2]Department of Transportation, 1974 Annual Report, p. vii.

the establishment of the Civil Aeronautics Board (CAB). Water-borne commerce (inland, Great Lakes, and ocean) also came under the authority of various regulatory agencies. The regulatory bodies have promulgated extensive regulations and rulings since their respective inceptions.

These regulations have developed into a mosaic of conflicting and contradictory rules that have been extensively criticized. The ICC came under attack from consumer groups, congressional quarters, and from every U.S. President beginning with John F. Kennedy and continuing through Ronald Reagan. The central theme of all the criticism was that increased consumer costs for services resulted from the regulations. The magnitude and critical nature of the impact of the business costs attributable to the regulatory constraint has been estimated to range between nine and sixteen billion dollars annually.[3] Critics of regulation contend that the regulatory constraint misallocates resources.[4] Additionally, investors believe that the regulatory environment in transportation has constrained the ability of companies to earn higher or less risky returns.[5]

By the late 1970's many American economists had come to the conclusion that ICC regulation was protective of the carriers and that, far from reducing costs to users, regulation almost certainly increased

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[3]Davis, Grant M. and Leon J. Rosenberg. "Physical Distribution Management and Independent Regulatory Commissions: An Empirical Assessment," Research Issues in Logistics, ed. James F. Robeson, The Ohio State University, 1975, pp. 95.

[4]Weiss, Leonard W. "The Regulatory Reform Movement," in Case Studies in Regulation, Revolution and Reform, Weiss, Leonard W. and Klass, Michael, eds., Little, Brown, and Company, Inc., 1981, pp. 3.

[5]Department of Transportation, Internal Memorandum by J. L. Hazard, January 26, 1972.

costs by perhaps billions of dollars a year.[6] These concerns and criticisms led to the increased interest in regulatory reform of the transportation industry.

The regulatory reform movement met its first legislative success in 1975 with the deregulation of stock brokerage fees. The Securities and Exchange Commission (SEC) ordered the stock exchanges to end the practice of fixing brokerage fees. The result was the development of discount brokers and negotiated fees. In spite of the dire predictions of disaster, the brokerage industry continued to operate without major problems. Transportation was the next arena for the regulatory reform movement.

One of the most visible actions of the Administration of President Jimmy Carter was the reduction in airline regulation by the Civil Aeronautics Board (CAB). This deregulation movement possibly had its beginning during the Administration of President John F. Kennedy with the introduction of several bills in Congress calling for changes in the regulatory systems.[7] The bills failed to win legislative approval and the regulatory systems remained unchanged. During the Nixon Administration and continued by President Gerald Ford, discussions of regulatory reform were again raised. The discussions did not lead to the passage of legislation. It was not until the Carter Administration that the debate and academic research were successful in challenging the regulatory status-quo.

In 1975 the U.S. Senate held hearings on the CAB where the traditional concerns and criticisms of regulation were aired. Before the

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[6] Op. Cit., Weiss, pp. 2.

[7] Op. Cit., Davis and Rosenberg, pp. 95.

Senate passed legislation (Cannon-Kennedy Bill, 1978) substantially reducing the level of economic regulation, the airlines were deregulated through administration dictate by the new chairman of the CAB, Alfred E. Kahn. The industry initially prospered as a result of its ability to reduce fares in those markets where there was potential for high volume tourist traffic. The airlines discovered that the demand for their services was more price elastic than previously believed. Prompted by this success, the Carter Administration concentrated on the motor carrier industry. Regulatory reform of transportation was gaining momentum despite some old-line resistance from the industry and organized labor. Deregulation meant a change in the ability of firms to control rates and pass along all costs (including union won labor increases) to the users.

The rates that motor carriers charged were set collectively through regional rate bureaus. Entry to the industry was tightly controlled, thereby protecting firms from competition. Routes were rigidly prescribed, thereby limiting carriers from soliciting new customers. In fact, the certificate to use specific routes was a major asset on the balance sheet of motor carriers. The Motor Carrier Act of 1980 changed these practices. The MCA removed the barriers to entry, eliminated the tightly prescribed routes and intermediate points, allowed for a zone of price competition, and eliminated the antitrust protection enjoyed by the rate bureaus in setting certain rates. Motor carriers cited the likelihood of many small cities being abandoned by carriers as an argument against deregulation.[8] They also argued that

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[8]Burek, Charles G. "Truckers Roll Toward Deregulation," Fortune (December 18, 1978), p. 70.

deregulation would result in chaos and job losses. The uncertainty surrounding the effects of deregulation on the motor carrier industry was noted by security analysts.[9]

Many industry analysts felt that deregulation would have an adverse effect on the market for transportation securities. The primary reason for this opinion was the uncertainty surrounding the ability of the firms in the motor carrier industry to make the transition into the competitive market environment:

> "In the uncertain atmosphere of a free market, lending institutions or investors would be reluctant to advance new capital pending some sort of shakedown of the system."[10]

> "Certainly with the passage of the Motor Carrier Act of 1980 both industry members and their lenders anticipated significant changes in the months and years to come. No one expected this evolution from a 'regulated' to a 'free market' industry to be painless, but few could foresee the depth of the problems and the issues to be encountered."[11]

From the viewpoint of investors, the question was: What effect will deregulation have on the risk and returns to investors? From the viewpoint of the firms in the industry, a change in the risk and return of the securities would have an effect on the industry's financing abilities.

If the deregulation were to increase the risk of the securities of the industry, motor carriers would face increasing difficulties

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[9]Liddell, Florence. 1981 Financial Analysis of the Motor Carrier Industry, American Trucking Association, Inc., 1982.

[10]Standard and Poor's Industry Surveys, Vol. I, No. 1, A-L, (July 1978), pp. 465.

[11]Lisciandro, Patricia. 1982 Financial Analysis of the Motor Carrier Industry, American Trucking Association, Inc., 1983, pp. 6.

in securing the necessary capital to replace equipment and meet future demands for services. The hypothesis was that equityholders might demand higher returns to compensate for the increased risk, thereby reducing the market price of the equity. The lower price would increase the number of shares that had to be sold to raise a given amount of capital. Similarly, bondholders might have viewed deregulation as leading to increased uncertainty about the future cash flows to the firm. The uncertainty could lead to lower bond ratings and the debt holders would demand higher returns commensurate with the lower ratings. The net effect would be an increase in the cost of capital.

In summary the above discussions have dealt with the effects of deregulation on shippers and carriers from a political and marketing perspective. The economics literature has been concerned with measuring the cost of the regulatory-induced inefficiencies and with the effects of deregulation on the costs of transportation firms. The next section discusses the relationship of the capital markets to the deregulation of the transportation industry within a risk-return theoretical framework.

Theoretical Framework

The previous section suggested that there was a relationship between market measures of risk and economic deregulation. One purpose of this study was to determine if economic deregulation of motor carriers affected the risk of their common stocks. The measures of risk used are those suggested by capital market theory. The total risk of a firm's common stock was measured by the variance of its return (Var R_j; where R_j is the return on security j). The systematic risk (the risk of a company relative to the market) was measured by the

covariance of a firm's returns with the market portfolio's return, standardized by the variance of the market returns (Cov (R_j, R_m)/Var R_m; where R_m is the return on the market), commonly referred to as a firm's beta (β). These are the measures of risk used by the market when making investment decisions. This section reviews why economic deregulation might effect the risk of common stocks.

The value of a share of common stock is the present value of future cash flows. Since the cash flows from operations for a given period (e.g. one fiscal year) are not reported (or perhaps even known) it is necessary to use a proxy variable to represent cash flows. A reasonable proxy for cash flows over the long run is net income. Therefore, any factors which alter the variability of net income are also altering the variability of a firm's cash flow. It is necessary to demonstrate why economic deregulation may have an effect on earnings variability and market measures of risk.

Effects on Earnings Variability

For motor carriers the main thrust of deregulation was a significant reduction in entry and rate controls. Prior to deregulation, a given market was serviced by certain carriers. New carriers were not able to enter the market without going through a long application and approval process. Existing carriers were able to object to the new applicant. As a result, new entrants were very uncommon and those admitted began the process many months before entering. As a practical matter in the case of motor carriers, the only way a carrier could enter a new market was by purchasing an existing carrier in the market. Of course, that approach did not lead to new competition because the number of carriers declined. Motor carriers purchased carriers in a

market they wished to service or for routes they wanted. Often the purchased carrier disappeared and the acquiring firm recorded as an asset the newly purchased "operating authority." However, those actions by motor carriers did not increase the number of competitors. The merger/acquisition activity was perhaps most like a game of musical chairs: after each round there was one less carrier.

It is reasonable, therefore, to assume that the resulting level of competition after the passage of the MCA would cause revenue and income levels to be more uncertain for several reasons. First of all, the MCA specified the maximum amount of time the respective agencies have to deny entrance to new applicants. The time limit is now only a few months. Thus, the primary reason for expecting greater uncertainty of revenues was that the market may be shared by more carriers. Then the existing companies would sell fewer units or would have to lower their per unit price in order to keep their customers. Both scenarios or any combination of lower output and lower selling price would lead to lower revenues and incomes. A second reason for increased uncertainty was the willingness of management to undertake riskier business decisions because of reduced regulatory barriers to innovative services.

Certainly both of these possibilities have been realized in the airline industry since deregulation. There are more new airlines competing for business, there have been fare "wars" to attract or keep customers, and some firms have expanded too rapidly and suffered as a result (e.g. Braniff Airlines and Air Florida went bankrupt). Several large motor carriers have filed for bankruptcy.

One effect of these changes in the industry was that the income of each carrier became more uncertain. The revenues earned by a firm were sensitive to the changes in the environment, while the costs associated with motor carrier operations were not as sensitive. A motor carrier may not abandon warehouses or reduce inter-city delivery because of lower revenues. Levels of service in the industry were maintained for reasons of safety and marketing. In economic terms, deregulation has forced carriers to become pricetakers whereas previously, carriers set prices based on recovering all of their costs and earning a reasonable profit. The result has been the increased uncertainty of revenues resulting in increased uncertainty of net income.

This relationship can be demonstrated more formally as follows:

(1) $R - E = I$

where

R = Revenues

E = Expenses

I = Net Income.

The uncertainty can be represented by

(2) $\text{Var}(R - E) = \text{Var}(I)$

where

$\text{Var}(R - E)$ = Variance of the difference between revenues and expenses

and

$\text{Var}(I)$ = Variance of the net income.

It follows that

(3) $\text{Var}(R) + \text{Var}(E) - 2\text{Cov}(R,E) = \text{Var}(I)$

where

Var (R) = Variance of a firm's revenues

Var (E) = Variance of a firm's expense

and

Cov (R,E) = Covariance of a firm's revenues to its expenses.

Thus if Var(R) increased with deregulation due to an increase in the uncertainty of revenues, then it is possible that the variability of net income also increased. It is reasonable to assume some increase in the Var(E) since some costs are highly correlated with the amount of activity. Var(E) would have increased less than Var(R) because of the high fixed cost component of total costs. Thus some increase in the variability of net income would be expected whether or not Var(E) increased.

It can also be argued that the covariance between revenues and expenses will decline because of the change in how prices for services were established. Before deregulation, prices were set by the regulatory agencies so as to completely recover all costs. The covariance between prices and costs was high as a result of this price setting procedure. After passage of the MCA, prices were more sensitive to competitive markets for services and not simply a function of costs. It is not unreasonable to assume that the covariance between revenue and expenses has declined. Since the covariance term is subtracted from the Var(R) and Var(E) in equation (3), a lower value of the covariance also results in an increase in the variance of the net income.

Effects of Market Measures of Risk

The relationship between deregulation and earnings variability for motor carriers has been argued previously in this section. The link between earnings variability and market measures of risk is also cited in the literature. Using multiple regression, Rosenberg and McKibbon (1973), Lev and Kunitsky (1974), and Beaver, Kettler, and Scholes (1970) all found earnings variability or cash flow variability to be positively related to systematic risk.

It is possible to demonstrate that a reason for the existence of the positive relationship between earnings variability and systematic risk found by researchers rests in the components of systematic risk. The Sharpe (1964) - Lintner (1965) two parameter model defined systematic risk for an asset (j) as:

$$(4) \quad \beta_j = \frac{\text{Cov}\,(R_j,\ R_m)}{\text{Var}\,(R_m)}$$

where

β_j = the systematic risk of j

R_m = the return on the market portfolio

R_j = the return on asset j

$\text{Cov}\,(R_j, R_m)$ = the covariance of the return on the market portfolio with the return on asset j.

$\text{Var}\,(R_m)$ = the variance of the return on the market portfolio.

The volatility of a given asset relative to the volatility of the market is described by β_j, and it is through the covariance term that deregulation affects the systematic risk.

Thompson (1974) developed a model which related systematic risk to the variability of a firm's earnings. He showed that β_j can be directly related to three covariant risk measures such that

$$(5) \quad \beta_j = \frac{Cov(d_j,d_m) + Cov(e_j,e_m) + Cov(k_j,k_m)}{Var(d_m) + Var(e_m) + Var(k_m)}$$

where

d_j = the expected dividend yield on firm j

d_m = the expected dividend yield on the market

e_j = the forecasted earnings of firm j

e_m = the forecasted earnings of the market

k_j = the forecasted earnings multiple of firm j

and

k_m = the forecasted earnings multiple of the market.

Of interest in this study is the covariance of a firm's earnings with the earnings of the market, $Cov(e_j,e_m)$. The $Cov(e_j,e_m)$ is equal to $r_{je}\ \sigma_j\sigma_m$ where r_{je} is the correlation coefficient between the earnings of security j and the market. Thus if a firm's earnings become more variable, then a firm's systematic risk will increase, assuming the constancy of the other relationships.[12]

In summary, the first part of this section gave detailed reasons for why the earnings of motor carrier firms have become more variable. The second part of this section describes a model which relates earnings variability for firms to their systematic risk measures. Additionally, three studies are cited that give empirical evidence which

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[12]It is reasonable to assume that the earnings of the market were not significantly affected by the deregulation of the motor carrier industry, nor was there a significant change in the correlation coefficient.

link earnings variability to systematic risk. The reasons presented in the first section plus the empirical evidence and theoretical model in the second part demonstrate that deregulation affects the risk and returns of motor carrier common stocks.

CHAPTER II

LITERATURE REVIEW

Economic Regulation

Recent literature on the economic regulation of transportation has shown a growing disenchantment with regulation. In a pioneering article, George Stigler (1971) articulated a position that was perhaps harbored by many observers of the regulatory process. He helped to crystallize the disenchantment with the usefulness of regulation as a mechanism to allocate the consequences of market failure. Certainly, the early motivation for the regulation of the transportation industry was to protect small shippers from the whims of the marketplace. In addition, the role of the regulatory agencies was to protect consumers from rapacious transportation companies. Stigler brought the issue into focus for the decade of the seventies and beyond.

Stigler gave his support to the creeping recognition that regulation seemed seldom to correct the resource misallocation that it was supposed to correct. In fact, regulation may have contributed to increasing the misallocation of resources. He formulated a theoretical foundation for his "producer protection" view of the regulatory process. He did not address the role of the capital markets or the effects of regulation on the common stocks of regulated companies. The importance of his work was that it allowed others to begin questioning the traditional role and methods of regulation. Other authors began to examine the microeconomics of the regulatory process. A principle theoretical

work by Sam Peltzman (1976) draws on Stigler and presented a general theory of regulation that can be integrated into the theory of finance.

Peltzman made an important addition to Stigler's early work when he developed a research design model which could be used in the study of regulated industries. He maintained that regulation should reduce the conventional measures of risk experienced by the common stockholders of regulated firms. He believed that such a risk reduction would occur because regulation shelters a firm from changes in the demand and cost structures for its products and services. As a consequence, the variability of a firm's profits and its stock price would be reduced. He stated that "to the extent that cost and demand changes are economy-wide, regulation should reduce systematic as well as diversifiable risk."[1] Peltzman cited two empirical studies he had done with respect to the effect of new regulation on the risk of a firm as evidence with which to support his position.

In the case of new regulations applied to the drug industry resulting from the thalidomide scare in Europe, Peltzman (1973) found that both the total and systematic risks of the stocks of drug companies decreased substantially after regulation. In a second, unpublished, study he correlated annual changes in the Standard and Poor's indexes of railroad and utility stock prices with those of the industrial index for equal periods spanning the onset of regulation. He found that the risk decreased but not significantly.

The first major work that addressed the impact of deregulation on a firm's stock return was by Pablo Spiller (1983). In his work Spiller

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[1]Peltzman, S. "Towards a More General Theory of Regulation," Journal of Law and Economics, Vol. XVIX (August 1976) pp. 211-240, The University of Chicago.

addressed many of the issues associated with the deregulation of airlines, such as pricing policy, load characteristics, and the demand function. He then tested to see how changes in these variables due to deregulation effected the stock returns of airline firms. It is interesting to note that Spiller took the position in an earlier paper (Spiller, 1982) that it was necessary to differentiate changes in the value of a firm that are the result of profitability changes from those that result from risk changes. In his airline study Spiller assumed constant risk. Holding risk constant he found, using residual analysis, that the common stocks of some airlines showed abnormal returns. His evidence would seem to indicate that the effects of deregulation are not constant across all firms.

Morash and Enis (1982) examined stock price data to detect the stock market perspective of the effects of motor carrier deregulation. They were interested in determining whether the MCA resulted in a net positive benefit for shareholders. Their measure of performance was average monthly change in stock price. They calculated the average monthly security performance for a portfolio of motor carriers for the twelve months before and after June 1980. They found a statistically significant increase in performance after deregulation in both absolute terms and in comparison with the NYSE Composite Index. They also examined systematic risk using the Value Line Investment Survey financial betas. The betas of a sub-sample of firms were compared over time and they concluded that there was a decrease in systematic risk as measured by Value Line beta.

The methodology they used was deficient for the following reasons:

1. They did not measure for abnormal return performance. They used stock price changes rather than stock returns.

2. They did not calculate betas from return data. Value Line estimates were used without regard for the time periods used by Value Line in calculating those betas.

3. The conclusion that beta decreased after the passage of the MCA was not based on a statistical test, but rather on a visual inspection.

4. The sub-sample of firms used in the calculation of betas was not randomly selected or otherwise identified.

5. Their conclusion that a net benefit accrued to stockholders was based only on price changes with total disregard for risk changes.

6. Using only beta as a measure of risk for a non diversified portfolio has been shown by Levy (1978) to be a poor measure of risk. Levy suggested that the variance of total return was a better measure.

In another study, Edward Bruning and Edward Morash (1983) attempted to estimate the cost effects of deregulation on the cost of capital of publicly held motor carriers. They were primarily interested in testing for a differential effect between general freight carriers and specialized carriers. They used the Capital Asset Pricing Model to estimate the required rate of return on the equity capital of the firms. They found that the cost of equity capital increased for most carriers. In their study they did not report or test for changes in risk around the time of passage of the MCA.

Edward Morash and Charles Enis (1983) examined the return on equity (ROE) and the earnings per share (EPS) for the period 1971 through 1982. They divided the industry by carrier type. They concluded that there was an industry wide decrease in ROE associated with the MCA. They do not present statistical tests of the changes in ROE.

It was not clear from examining the ROE data that there was a statistically significant change in ROE. For their examination of the EPS of the carriers, they focused on whether the write-down of earnings to reflect the loss in book value of the operating rights had an effect on monthly share prices. They concluded that the write-down of earnings due to loss of operating rights had no effect on the changes in market price. This conclusion is consistent with the body of accounting research on anticipated accounting changes.

Morash and Enis also examined share price performance by comparing monthly motor carrier stock performance with the New York Stock Exchange (NYSE) Composite Indicator, they found that for the 1-year and 2-year periods before the MCA, the carriers performed significantly worse than the market. However, for the 1-year and 2-year periods following the MCA, they found that the carriers' stock performance was not significantly different from the NYSE Composite Indicator. Their conclusion was that the financial performance of the carriers after the MCA was a function of economic conditions and not the MCA. Their study, like the others cited, explicitly assumed no change in risk throughout the deregulation period.

Thomas Gale Moore (1983) offered further evidence to the effects of deregulation on railroads and motor carriers. He presented financial information indicating that motor carriers were less profitable, had lower returns on investment, and lost market share as a result of their deregulation.

A recent study on the impact of deregulation on motor carrier firms was done by Howard Van Auken and Michael R. Crum (1984). They studied the impact of the Motor Carrier Act of 1980 on the common stock

returns of motor carriers. Using monthly return data and the market model they calculated cumulative average residuals around the time of deregulation. Their analysis indicated that the effect of the MCA on the residuals was short-lived during the twelve weeks before and after the passage of the act. When they looked at a longer time period, the twenty-six weeks before and after the passage of the act, they found no long term effect on the residuals. The weakness of their study was that they assumed no change in the risk measures throughout the deregulation period.

The latest known study on the impact of deregulation at the time of this research project was done by Nancy Rose (1985). Her paper attempted to answer two questions. The first was--did monopoly rents exist in the motor carrier industry? The second question, predicated on the first, attempted to determine who benefited from these rents. Using share price data and a multiple factor Capital Asset Pricing Model she determined that there were monopoly rents. The study found that there were declines in profits of 8 to 19 percent of a firm's value. She concluded that the monopoly profits had been accuring to the owners and the unionized labor represented by the Teamsters. Throughout her study she assumed constant measures of risk and did not test for abnormal returns after deregulation.

Research Methodology for Event Studies

The most common research methodology used in event studies is cumulative average residual analysis. Fama, Fisher, Jensen, and Roll (1969) wrote the seminal article on the topic. In their article they used the existence of non-zero cumulative average residuals as a test for the presence of abnormal returns for investors who purchased the

common stocks of firms which had just split. After forming portfolios of randomly chosen stocks they averaged their measure of abnormal returns across firms for specific time periods. The average abnormal return for a given time period t was specified by the following equation:

$$(6)\quad \overline{AR}_t = \frac{\sum_{j=1}^{N} AR_{jt}}{N}$$

where N was the number of firms in a specific portfolio, $\overline{AR}_t$ was the average residual for all the firms in a specific portfolio at time t and $\overline{AR}_{jt}$ was the average residual of firm j at time t estimated using the market model.

In addition to examining the behavior of the average abnormal returns for each period, the cumulative effects of abnormal behavior in the periods surrounding a stock split were examined. The cumulative average residual or abnormal return was defined by

$$(7)\quad CAR_T = \sum_{t=0}^{T} \overline{AR}_t$$

where

CAR_T= the cumulative deviation from time 0 to time T, where 0 is the beginning of the test period prior to the passage of the MCA.

and

$\overline{AR}_t$ = the average abnormal return in each time period t relative to the event of the stock splits.

The cumulative average residual at time t shows the cumulative effects of the movements of the actual returns of the common stocks from their expected returns as measured by the market model. Since the time of

this article, many researchers have used cumulative average residual analysis to determine how certain events affect the stock returns of firms and if investors purchasing these stocks after the events had occurred could earn abnormal returns. These authors were testing to see if the market incorporated the news of certain events into their assessments of the prices of the affected stocks before and after the events occurred.

Since one of the objectives of this research project was to determine if the market for the common stocks of motor carrier firms behaved efficiently around the time of the passage of the Motor Carrier Act of 1980, cumulative average residual analysis was also used in this study with some modifications.

Since 1969, many researchers have questioned the use of cumulative average residual analysis as a way of determining if abnormal returns can be earned by investors. Sunder (1973) believed that the technique falsely indicated that abnormal returns had occurred when in fact what really happened was that the risk of the firm changed due to the occurrence of a specific event. He stated that in the presence of changes in risk the estimated abnormal returns on stocks are dependent on the time series data used for the estimation of relative risk. Brenner (1977) also found evidence which supported Sunder's argument. He claimed that where a change in risk is associated with an event in time, an observed pattern in the time series of residuals may be due to a risk change and is not evidence for or against efficient markets.

Brown and Warner (1980) studied various methodologies for measuring abnormal performance. Using simulation on monthly data, they generated abnormal performance of different levels and tested to see

which methodology correctly specified that significant abnormal return performance occurred in the data. With regard to cumulative average residual analysis, they found that if the exact month of the event could be pinpointed then the technique correctly indicated the presence of abnormal returns, but that the level of those abnormal returns was not correctly specified.

Binder (1985) argued that the standard event study using market data was more difficult for research on regulatory changes. He charged that when the event date could not be correctly specified. He also argued that when a regulatory change affects all firms in the same industry, it is not possible to seperate the effects of the regulatory change from some other industry specific shock. This research has the benefit of a specific month for the announcement of regulatory change. Also, there were no other industry specific shocks around the time of the passage of the MCA of 1980.

Binder (1985) argued that the standard event study using stock market data was more difficult to use for research on regulatory changes. He charged that when the event date could not be correctly specified, then it is not possible to know when expectations change. He also argued that when a regulatory change affects all firms in the same industy, it is not possible to separate the effects of the regulatory change from some other industry specific shock. It could be argued for this research that it is not possible to accurately determine when expectations about the effect of the MCA were known. This criticism applies to most event studies and is most valid when

no effect has been found. When a significant effect is found and there are no other industry specific shocks around the event, Binder's arguments are less convincing.

In summary, although the study used the cumulative average residual technique to determine if abnormal performance was evident around the time of the MCA of 1980, tests for changes in the market measures of risk were also done around the time of deregulation. In addition, a method used by Asquith and Kim (1982) which analyzed the significance of cumulative abnormal performance measures using t-tests was employed in the study.

CHAPTER III

RESEARCH DESIGN AND METHODOLOGY

Objectives

The research was designed to test for the effects, if any, that the MCA of 1980 had on investors' assessments of the risk and return of the equities of the trucking industry. It was concerned with determining if the announcement of the passage of the MCA into law was efficiently incorporated into the market prices of such securities. This type of research has become known in the finance literature as an "event study." The event of this study was the passage of the deregulation act which occurred in May 1980.

The study addressed two empirical questions using capital market data. First, the market measures of risk were analyzed by comparing the risk characteristics before and after deregulation to determine if a change occurred. The risk measures used were those suggested by the market model. Second, the data was analyzed to determine if there were any abnormal returns earned by investors holding the common stock of motor carriers. The risk-return measures derived from capital market data provided a theoretical basis for analyzing risk in that they reflected investors' expectations with regard to the future of the motor carrier industry.

The Market Model

The most common technique used in event studies for examining common stock price behavior is the market model method. The most famous study in the finance literature using this technique is the previously mentioned study of stock splits by Fama, Fisher, Jensen, and Roll (1969). They examined residuals from the market model for a period of time before and after stock splits. Much of the discussion which follows on the use of the market model in financial research was taken from Fama (1976).

The use of this model required an assumption of a multivariate normal distribution for the returns on all securities. This, in turn, implied a bivariate normal distribution for the returns of any single security, $\tilde{R}_{jt}$, and the return on a market portfolio of all securities, $\tilde{R}_{mt}$. The assumption of bivariate normality, in turn, implied that the regression function of $\tilde{R}_{jt}$ on $\tilde{R}_{mt}$ can be written as:

$$(8) \quad E(\tilde{R}_{jt}|\tilde{R}_{mt}) = \alpha_{jt} + \beta_j \tilde{R}_{mt}$$

where

$$\beta_j = \frac{Cov(\tilde{R}_{jt},\tilde{R}_{mt})}{Var(\tilde{R}_{mt})}$$

and

$$\alpha_{jt} = E(\tilde{R}_{jt}) - \beta_j E(\tilde{R}_{mt})$$

β_j is a measure of the systematic risk of a firm j when it is added to a portfolio, while α_{jt} is a measure of the abnormal performance exhibited by the stocks of firm j at time t. The return on security j will not be equal to its conditional expectation in every period t.

In any given period, the return on security j will be expressed by the expost form of the market model equation such that

$$(9) \quad \tilde{R}_{jt} = \alpha_{jt} + \beta_{jt}\tilde{R}_{mt} + \tilde{\varepsilon}_{j}$$

where the ε's are iid normal with mean zero and variance, σ^2_{ej}.

The market model as described above was assumed to be the process by which the security price returns were generated for the motor carrier industry. It was the first observed by King (1966) that all securities were influenced to different extents by certain common factors. The return of the market portfolio, $\tilde{R}_{mt}$, reflected all information available at time t that affected the returns of all securities. The market model coefficient β_{jt} in equation (9) was used to measure the sensitivity of the return on security j to the return on the market. The residual term $\tilde{\varepsilon}_{jt}$ in equation (9) was used to reflect all information available at time t that was specific to security j. Since the study was concerned with how industry-specific information affected security prices, the analysis focused on the behavior of estimates of $\tilde{\varepsilon}_{jt}$.

To use the theoretical market model with real world data, it was necessary to assume that the distributions of the following variables were stationary over time:

$$\alpha_{jt} = \alpha_{j}$$

$$\beta_{jt} = \beta_{j}$$

$$E(\tilde{\varepsilon}_{jt}) = E(\tilde{\varepsilon}_{j})$$

where t = 1, ..., T.

If stationarity holds, then the necessary parameter estimates can be

obtained from an ordinary least squares (OLS) regression which can be written as:

$$(10) \quad \tilde{R}_{jt} = \hat{\alpha}_j + \hat{\beta}_j \tilde{R}_{mt} + \hat{\varepsilon}_{jt}$$

where

$\tilde{R}_{jt}, \tilde{R}_{mt}$ = the actual returns observed over time for firm j and the market portfolio at time t.

and

$\hat{\alpha}_j, \hat{\beta}_j, \hat{\varepsilon}_j$ = OLS estimates.

If the market is efficient and equilibrium returns are generated according to a stationary market model equation, then the following condition must hold:

$$(11) \quad E(\hat{\varepsilon}_{jt} | I_{t-1}, \tilde{R}_{mt}) = 0$$

where

I_{t-1} = information available at period t-1.

Thus, in an efficient market with stationary return distributions, there is no way to use information available at t-1 to form correct non-zero assessments of the expected value of $\hat{\varepsilon}_{jt}$. However, non-zero expected values of $\hat{\varepsilon}_{jt}$ can be assessed correctly on the basis of information available at time t. When information having implications for the future prospects of a firm arrives in the market, prices should adjust rapidly to reflect the valuation consequences of such information.

Risk Measurements

The risk of an investment in common stock can be described as the variability of its rates of return. The variance of the rate of return on a share of common stock is the measure of total risk perceived by

the shareholder. The market model in equation (9) incorporates the "systematic" risk of security j, β_j. The measure of the relative risk of the security is β_j. Systematic risk depicts the sensitivity of the security's return to returns on the market for all investments. The other component of total risk is the unsystematic or residual risk of holding a security. It is the risk that is specific to security j and is not explained by market movements. The unsystematic risk is measured by the variance of the residuals from the expost form of the market model.

Fama (1976) described the total risk of a security to be equal to:

Total Risk = Systematic Risk + Unsystematic Risk.

He demonstrated that the total risk can be given by the following equation:

$$(12) \quad Var(\tilde{R}_j) = \beta_j^2 Var(\tilde{R}_m) + Var(\tilde{\varepsilon}_j)$$

where

$Var(\tilde{R}_j)$ = the total variance of the returns of security j.

$Var(\tilde{R}_m)$ = the total variance of the returns of market portfolio.

and

$Var(\tilde{\varepsilon}_j)$ = the variance of the residuals or measure of unsystematic risk.

To examine the question of changes in the risk of the motor carrier stocks it was necessary to determine whether any possible shift in total risk was the result of firm-specific effects or was the result of changes in market-wide factors. Chapter II suggested that the market's evaluation of the risk of motor carrier stocks may change due to

deregulation since the environment may be more competitive after deregulation then it was beforehand.

Abnormal Performance

Abnormal performance of securities implies that an investor may earn returns in excess of those suggested by the equilibrium return generating process. The market model provides a return generating process that incorporates risk. Abnormal return are returns in excess of those suggested by the risk of the security.

In this study the measure of abnormal performance was generated by the market model and was the residual term ($\hat{\varepsilon}_{jt}$) from equation (10). The purpose of examining market model residuals was to abstract from the effects of market-wide factors which influence the returns on all securities. This technique prevented the confounding of security returns which were the result of economic deregulation with those caused by other market-wide factors.

Equation (10) can be rewritten to focus on the residual returns such that

$$(13) \quad \hat{\varepsilon}_{jt} = AR_{jt} = R_{jt} - (\hat{\alpha}_j + \hat{\beta}_j R_{mt})$$

where

AR_{jt} = the abnormal return in period t.

Equation (13) defined the ex-post "abnormal" return for firm j in period t. The return is called abnormal if its value is significantly different than zero. When firm-specific information such as deregulation of an industry arrives at the market in time t, and is not properly incorporated into the common stock pricing structure of the affected firms, then a non-zero abnormal return is expected.

Since this study was concerned with abnormal returns associated with economic deregulation, the cumulative average residual technique as described in Chapter II was used to determine if abnormal returns occurred after deregulation.

Statistical Testing Procedures

Data Selection

The data set for the study consisted of publicly traded motor carrier firms for which daily return data was available on the tapes from the Center for Research in Security Prices (CRSP) at the University of Chicago. Additionally, data for two major carriers for which CRSP data was not available were drawn from the Standard and Poor's Daily OTC Stock Price Record. All companies included in the data sample had return data available for the five year period 1978 through 1982. Daily return data from the Standard and Poor's 500 Index was used as a surrogate for the returns on the market portfolio.

One of the difficulties in this study was to determine when the market anticipated the beginning and understood the extent of the deregulation. May 1980 was used as the "event" point because that was the month that the MCA was approved by a House panel. The approval meant that the bill would not go to a conference committee. The time period of interest was chosen so that it straddled the event year by two years before and after deregulation. It was believed that the anticipation and effect of deregulation would have been incorporated into stock prices beginning two years before and by two years after deregulation.

The companies included in the study are listed below:

Arkansas Best Corporation
Branch Industries
Carolina Freight Carriers Corporation
Consolidated Freightways, Inc.
Leaseway Transportation Corporation
Overnite Transportation Corporation
Roadway Express, Inc.
RLC Corporation
Telecom Corporation
Transway International Corporation
Tristate Motor Transportation Company
Xtra Corporation
Yellow Freight, Inc.

For testing purposes, an equally-weighted portfolio was formed of these companies' returns for each calendar date between 1978 and 1982. An equally-weighted portfolio was formed by adding together the per dollar invested returns of each firm in the sample and dividing the total by the number of firms. This was done to determine the effect that deregulation had on the industry itself, and also because it has been shown in the literature (Fama, 1976) that portfolio risk measurements are more stable than those of individual firms.

Tests for Changes in Risk

Since a conflict exists in the literature as to whether or not deregulation resulted in an increase in the risk of motor carrier firms, four risk measures were estimated for the portfolio of trucking firms. The risk measures were:

. systematic risk

. unsystematic risk

. variance of returns

. coefficient of variation

Equation (10) was used to estimate the portfolio's systematic risk, β_p,

and unsystematic risk, $\mathrm{Var}(\tilde{\varepsilon}_p)$. Each of the four measures was calculated over the following time periods:

- Before deregulation occurred on May 30, 1980 and after deregulation occurred through December 31, 1982.
- On an annual basis for the years around and including deregulation--1978, 1979, 1980, 1981, and 1982.

To test for differences between the systematic risk measures over time the following t-statistic was calculated and tested for significance at the .05 level:

$$(14)\quad t_{.05} = \frac{(\beta_1 - \beta_2) - 0}{\left[\frac{\sigma^2_{\beta_1}}{n_1} + \frac{\sigma^2_{\beta_2}}{n_2}\right]^{\frac{1}{2}}}$$

where n_1 and n_2 = the degrees of freedom for each period and β_1, β_2 are for two periods. Changes in the variance terms were tested for using the following F-test statistic at a significance level of .05:

$$(15)\quad F_{\gamma_1, \gamma_2} = \frac{\sigma_1^2}{\sigma_2^2}$$

where γ_1, γ_2 = the degrees of freedom for each period. The unsystematic risk was calculated using equation (12). The change in unsystematic risk between years was tested for using the F-test from equation (15).

In summary, these risk estimates were analyzed to detect a statistically significant change in the component measures of total risk, as well as the measure of total risk, that occurred from before to after deregulation.

Testing for Abnormal Return Performance

Cumulative average residual analysis was used to determine if abnormal returns accrued to holders of the common stocks of the trucking industry around the time of its deregulation. The procedure began by estimating the systematic risk, β_p, with the market model given by equation (9) using daily returns from 1978. Thus, the year 1978 was used as the estimation period. The testing period for the abnormal returns began with January 1, 1979. From this date forward through December 31, 1982, the residual term was calculated by subtracting the expected daily return, calculated using equation (9), from the actual daily return for a specific date. These residuals were then accumulated over time and plotted against time. The resulting plots were then examined to see if a pattern of abnormal performance existed around the time of deregulation. The use of the residual analysis technique required the assumption that the parameters of the market model were stationary over time. The technique was used even though it was determined that the systematic risk as measured by β_p changed. The technique allowed for a visual inspection of the CAR pattern surrounding May 1980. The change β_p affects the level of pattern and not the pattern itself. Accordingly the interpretation of the results was more difficult.

In addition the procedure described by Asquith and Kim (1982) was used to test the accumulated residuals (CAR's) for significance. T-tests were done on the CAR's to determine if they were significantly different from zero. This would indicate that abnormal return performance occurred over a certain time interval. The CAR's were tested to

see if they were significantly different from zero at the .05 level using the following t-statistic:

$$(16) \quad t_{.05} = \frac{CAR_t - 0}{\frac{\sigma_{CAR_t}}{\sqrt{n_1}}}$$

where

n_1 = the degrees of freedom associated with time t

and

σ_{CAR_t} = the standard deviation of the CAR's up until time t.

CHAPTER IV

RESEARCH RESULTS

Changes in Risk Measures

The research results indicated that definite changes in all forms of risk occurred for the sample portfolio around the time the Motor Carrier Act of 1980 was passed into law. Using the market model, the average systematic risk was estimated for the portfolio for the time periods before and after May 30, 1980, and on an annual basis for the years 1978 - 1982. Daily return data for each period was regressed against the corresonding daily market returns. The following discussion of the results of this analysis are divided into two sections. The first section discusses the results from a global perspective--before and after deregulation. The second section attempts to determine at what point in time the actual risk changes occurred.

Changes in Risk Before and After Deregulation

Table 1 shows that before deregulation the portfolio's systematic risk estimate was .761, while after deregulation the estimate declined to .601. The before deregulation regression parameter, β_{bp}, had a t-statistic of 25.12 which implied that the estimate was significantly different than zero at the .05 level. The market model also proved to be a statistically good fit for the relationship between the portfolio returns and the market returns before deregulation. With a coefficient

of determination (R^2) of 50.9% and a F-ratio of 637.98,[1] the market returns explained a large portion of the variance in the portfolio returns. In addition, the Durbin-Watson statistic of 1.99 indicated that no autocorrelation existed among the regression's residuals at the .05 significance level. Therefore, the parameter, β_{bp}, was an efficient and unbiased estimator of the portfolio's systematic risk.

The after deregulation regression equation also fit the data well. The systematic risk estimate was significantly different from zero at the .05 level given that it had a t-statistic of 11.58. The R^2 of the equation was lower at 18.1%, but it still had a strongly significant F-ratio at 133.59 which was significant at the .05 level. Finally, the Durbin-Watson statistic was 1.94. It can thus be concluded that both the before and after regression models fit the data well and further analysis taken from the models should provide unbiased results.

The results of the analysis also show that the systematic risk changed significantly after deregulation. Table 1 illustrates that a change in β_p occurred after deregulation. The t-statistic at 65.68 indicates that at a significance level of .05 the systematic risk of the portfolio declined after deregulation.

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[1]Tinic and West (1979) indicated that a high explanatory power is in evidence for the market model regressions if they explain more than 30% of the variance in a return. Also, if the F-ratios in this study are greater than 3.84 at the .05 significance level, then the regression equations provided a good fit to the data.

TABLE 1

SUMMARY OF CHANGES IN SYSTEMATIC RISK

Time Period	β_p	t-statistic[a]	Degrees of Freedom
Before	.761		625
		65.68	
After	.601		625

[a]The β_p were significantly different than zero at the .05 level. For a complete summary of the regression equation statistics see Appendix B. If the t-statistic is greater than 1.645, then the null hypothesis of no change in β_p can be rejected at the .05 level for degrees of freedom greater than 29.

Source: From M. Merrington, "Table of Percentage Points of the t-Distribution," Biometrika, 1941, 32.30.

In addition, the variance of the portfolio returns increased significantly after deregulation. Table 2 shows this result along with a F-ratio of 1.50 which was significant at the .05 level. This ratio indicates that the variance increased significantly after deregulation.

TABLE 2

SUMMARY OF CHANGES IN TOTAL RISK

Time Period	$Var(R_p)$	F-statistic[b]	Degrees of Freedom
Before	.00008		625
		1.50	
After	.00012		625

[b]If the F-statistic is greater than 1.35, then the null hypothesis of no change in the variances can be rejected at the .05 level for degrees of freedom greater than 120.

Source: From M. Merrington and C. M. Thompson, "Tables of Percentage Points of the Inverted Beta (F)-Distribution," Biometrika, 1943, 33, 73-88.

Using equation (12) from Chapter III and the variance of the market returns during these time periods it was determined that the unsystematic risk increased after deregulation significantly. The F-statistic which supported this conclusion can be seen on Table 3.

TABLE 3

SUMMARY OF CHANGES IN UNSYSTEMATIC RISK

Time Period	$Var(\varepsilon_p)$	F-statistic[c]	Degrees of Freedom
Before	.000038		625
		2.44 *	
After	.000094		625

[c]The unsystematic risk was measured using the mean squared residuals from the regressions.

*Significant at the .05 level.

The results of using the coefficient of variation as a risk measure conflict with the previously shown evidence that the risk of the portfolio increased after deregulation. Table 4 shows that although the total risk as measured by the variance of returns increased after deregulation, the actual returns also increased. Thus the coefficient of variation declined for the portfolio after deregulation. This result indicated that the portfolio had become a less risky investment for investors in terms of risk per unit of return.

TABLE 4

SUMMARY OF CHANGES IN THE COEFFICIENT OF VARIATION

Time Period	R_p	$Var(R_p)$	Coefficient of Variation
Before	.00047	.00008	19.03
After	.00083	.00012	13.19

In summary, using a global approach to the study of risk changes from before to after regulation showed that the systematic risk for the trucking firm portfolio declined after deregulation. However, as expected by many trucking industry executives the variance of the returns increased as did the firm-specific risk. For investors, higher returns from investing in these firms were available for a lower per unit measure of risk after, as compared to before deregulation.

Annual Changes in Risk

In an attempt to determine at what point in time the change in risk occurred for the firms in the portfolio, annual estimates of the risk measures were calculated. The study assumed that the entire year

of 1980 was an event year for these firms. An analysis done in a similar fashion to the one done on the portfolio risk measures, was performed on the returns on an annual basis for the years 1978 - 1982. The analysis of how well the market model fit the yearly data can be seen in Appendix B and will not be discussed here except to comment that as with the before and after regressions, the market model fit the data well. High R^2's and F-statistics were in evidence.

Tables 5 - 8 illustrate how the different risk measures changed each year. Included in these tables are the t and F-statistics which verify the significance of the changes at the .05 level.

TABLE 5

ANNUAL CHANGES IN SYSTEMATIC RISK

Year	β_p	t-statistic[d]
1978	.800	
		17.77
1979	.880	
		58.98
1980	.606	
		18.08
1981	.688	
		6.02
1982	.640	

[d]See Appendix B and Table 1 for an explanation of how the significance of the t-tests was determined and of evidence that the beta coefficients were significantly different than zero at the .05 level.

TABLE 6

ANNUAL CHANGES IN TOTAL RISK

Year	$Var(R_p)$	F-statistic[e]
1978	.00008	
		1.00
1979	.00008	
		1.00
1980	.00008	
		1.14
1981	.00007	
		3.71 *
1982	.00026	

[e]The F-statistic used here is explained on Table 2.

* Significant at the .05 level.

TABLE 7

ANNUAL CHANGES IN UNSYSTEMATIC RISK

Year	$Var(\varepsilon_p)$	F-statistic[f]	Degrees of Freedom
1978	.000034		250
		1.18	
1979	.000040		250
		1.15	
1980	.000046		250
		1.07	
1981	.000043		250
		5.37 *	
1982	.000231		250

[f]See Appendix C for calculations of unsystematic risk.

* Significant at the .05 level.

TABLE 8

ANNUAL CHANGES IN THE COEFFICIENT OF VARIATION

Year	R_p	$Var(R_p)$	Coefficient of Variation
1978	.00033	.00008	27.10
1979	.00115	.00008	7.78
1980	.00041	.00008	21.82
1981	.00010	.00007	83.67
1982	.00155	.00026	10.50

During 1980, when the deregulation bill passed in Congress, the systematic risk level declined significantly from .880 in 1979 to .606 in 1980. In fact it was significantly lower for all years after 1979. This result is consistent with the results obtained from the analysis of the data before and after passage of the MCA of 1980.

A result that is not consistent with the results obtained from the before and after data was that the variance of the portfolio returns did not signficantly change around the time of deregulation. It was not until 1982 that the variance increased significantly. This increase in variance of return in 1982 would have caused the variance in the after data to be higher than the before data even though the variance did not increase significantly in 1980. Thus, it appears that the variance of the portfolio returns did not increase as a result of the deregulation act.

A look at Table 7 also shows that the unsystematic risk did not increase significantly in 1980. This result indicates that the Motor Carrier Act of 1980 itself did not increase the exposure to industry

specific risk of the trucking firms in the sample. In conclusion, there was no statistically significant decline in the overall risk of the security returns of the firms after the passage of the MCA. However, there was a small change in variance in absolute value between 1980 and 1981.

Using the coefficient of variation as risk measure shows a different story for investors than the one described above. The coefficients of variation change every year. The risk per unit return declined from 1978 to 1979, but increased from 1979 to 1980. In 1981, the risk increased again but in 1982 it declined. This result, however, does not consider what was happening in the market for all stocks. Thus, it was determined that the coefficient of variation was not a good indicator of overall risk.

In summary, when comparing the before and after deregulation risk measures to those calculated on an annual basis, it can be noted that the changes in return and variance of return from 1982 weighed heavily in the overall after deregulation measures. Thus, the annual measures gave a better indication of the deregulation effect. Finally, it can be concluded that the market measure of systematic risk (β_p) declined significantly after deregulation, although the total risk did not change for investors after deregulation.

Cumulative Average Residual Analysis

Using the market model, the average systematic risk was estimated for the portfolio 24 months prior to deregulation. Daily return data for 1978 was regressed against corresponding daily market returns for the same calendar dates. The procedure resulted in the following regression equation:

$$(17) \quad E(R_{pt}) = -.000358 + .80(R_{mt})$$

where

$E(R_{pt})$ = the expected return of the portfolio at time t.

and

R_{mt} = the return on the market portfolio at time t.

The systematic risk estimate was equal to .8 and had a t-statistic of 18.4 which implied that the systematic risk estimate was significantly different from zero at the .05 level. The market model also proved to provide a statistically good fit for the relationship between the portfolio and the market returns. With a coefficient of determination of 57.4% and a F-ratio of 340.50, the market returns explained a large portion of the variance in the portfolio's returns. The Durbin-Watson statistic was 2.01 and was insignificant at the .05 level. This result indicated that no autocorrelation existed among the regression's residuals, and thus that the parameter, β_p, was an efficient and unbiased estimator of the portfolio's systematic risk.

Where the risk of the portfolio to remain unchanged through time, equation (17) was used to derive a time series of expected daily returns for the years 1979 through 1982. By subtracting the expected from the actual returns, abnormal return performance was measured for the portfolio around the time of deregulation such that:

$$(18) \quad R_{pt} - E(R_{pt}|R_{mt}) = \overline{AR}_{pt}$$

where

R_{pt} = the actual return of the portfolio at time t.

and

$\overline{AR}_{pt}$ = the average abnormal return for the portfolio at time t.

These average excess returns or residuals were then cumulated across time (CAR_{pt}) to see how efficiently the market reacted to the passage of the MCA in 1980. Figures 1-3 display graphically the pattern of the cumulative average residuals for the following time periods around deregulation:

June 1, 1979 - June 1, 1980

June 1, 1980 - June 1, 1981

June 1, 1981 - June 1, 1982

Theoretically, if the market correctly priced the stocks in the portfolio then the expected value of the CAR_{pt}'s should be zero. Figure 1 shows that beginning in June 1979 the residuals display a trend that is above zero and increasing. The trend levels off at the beginning of 1980, although it is still above zero. In March 1980 through June 1980 there is a dramatic decline in value in the cumulative residuals time series. Evidence of abnormal returns performance shows up in June 1980 and continues until July 1980. In Figure 2 the series returns to an equilibrium position by August 1980. At this point the residuals time series returns to zero and is relatively stable until 1982 where again abnormal returns begin an upward trend and are greater than zero as seen on Figure 3.

When using the cumulative average residual technique to demonstrate the market's reaction to an event, it must be recognized that the underlying assumption of the technique is that the systematic risk of the portfolio does not change. In this study that was not the case, since the systematic risk declined for the portfolio during the event

year. Thus it is possible that the negative abnormal return performance which occurred in June of 1980 was falsely interpreted. The decline in systematic risk would indicate that the portfolio could earn lower returns and still compensate investors for their risk. All that can be said from viewing the CAR graphs is that a change occurred at the time of deregulation and that the process returned to an equilibrium position within 2 months of the passage of the MCA.

The technique used by Asquith and Kim (1982) for testing for the significance of the CAR values was done on all the data points from 1979 through 1982. The results showed significant negative t-statistic values around the time of deregulation. This result is consistent with the observed pattern of the residuals around the time of deregulation. However, it was expected that the t-statistics would be insignificant after August 1980. This was not the case. In fact, the t-statistic indicated that significant positive abnormal returns were present for the entire period after deregulation. The t-tests and their component parts can be seen in Appendix D.

In summary, the results of the analysis on the risk and return characteristics of firms in the trucking industry around the time of deregulation indicated that the overall risk, as well as its unsystematic risk , decreased after deregulation, and that investors were able to earn abnormal returns if they purchased the stocks of these firms after deregulation.

FIGURE 1

CUMULATIVE RESIDUALS JUNE 1979 TO JUNE 1980

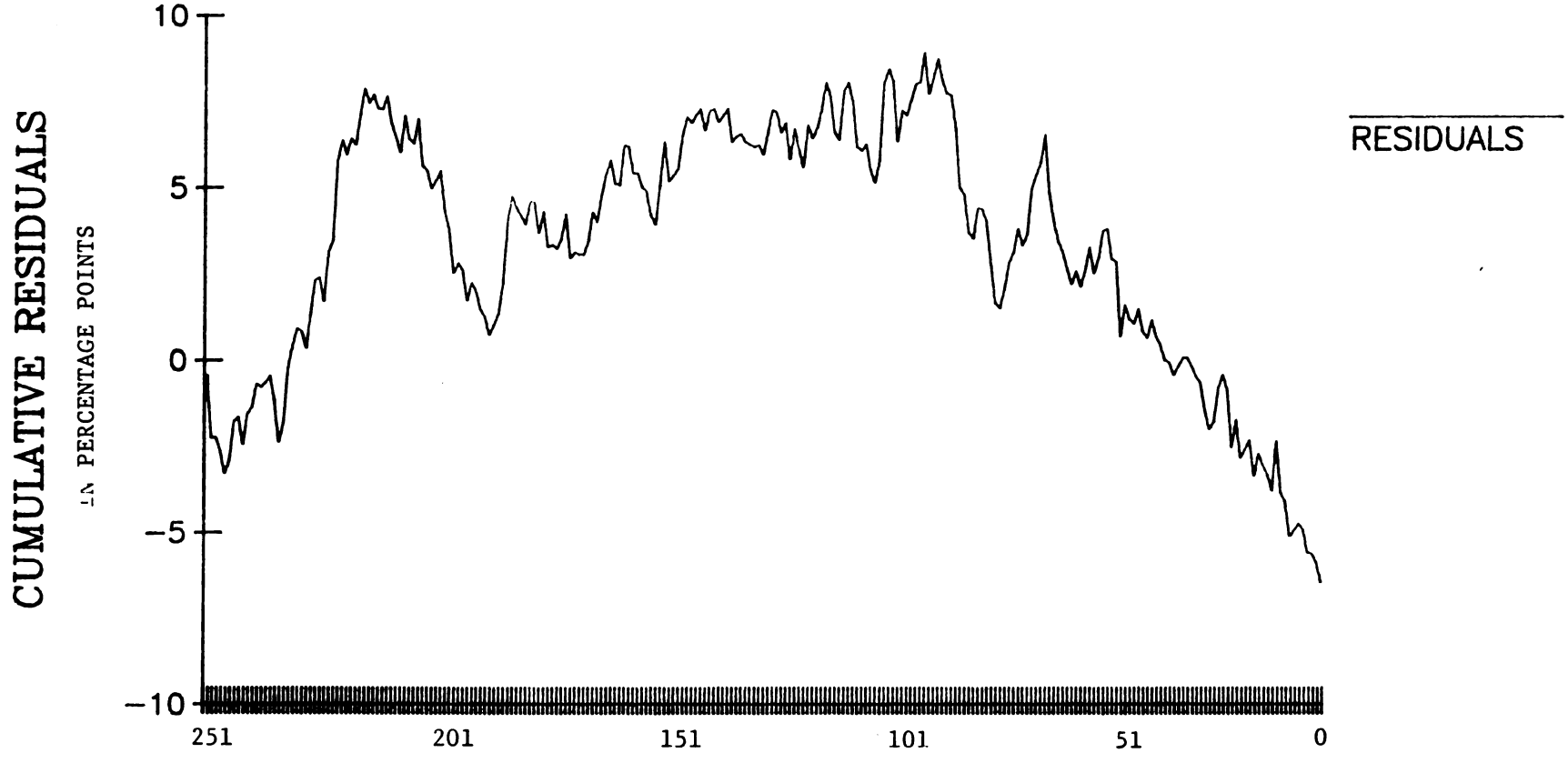


FIGURE 2

CUMULATIVE RESIDUALS JUNE 1980 TO JUNE 1981

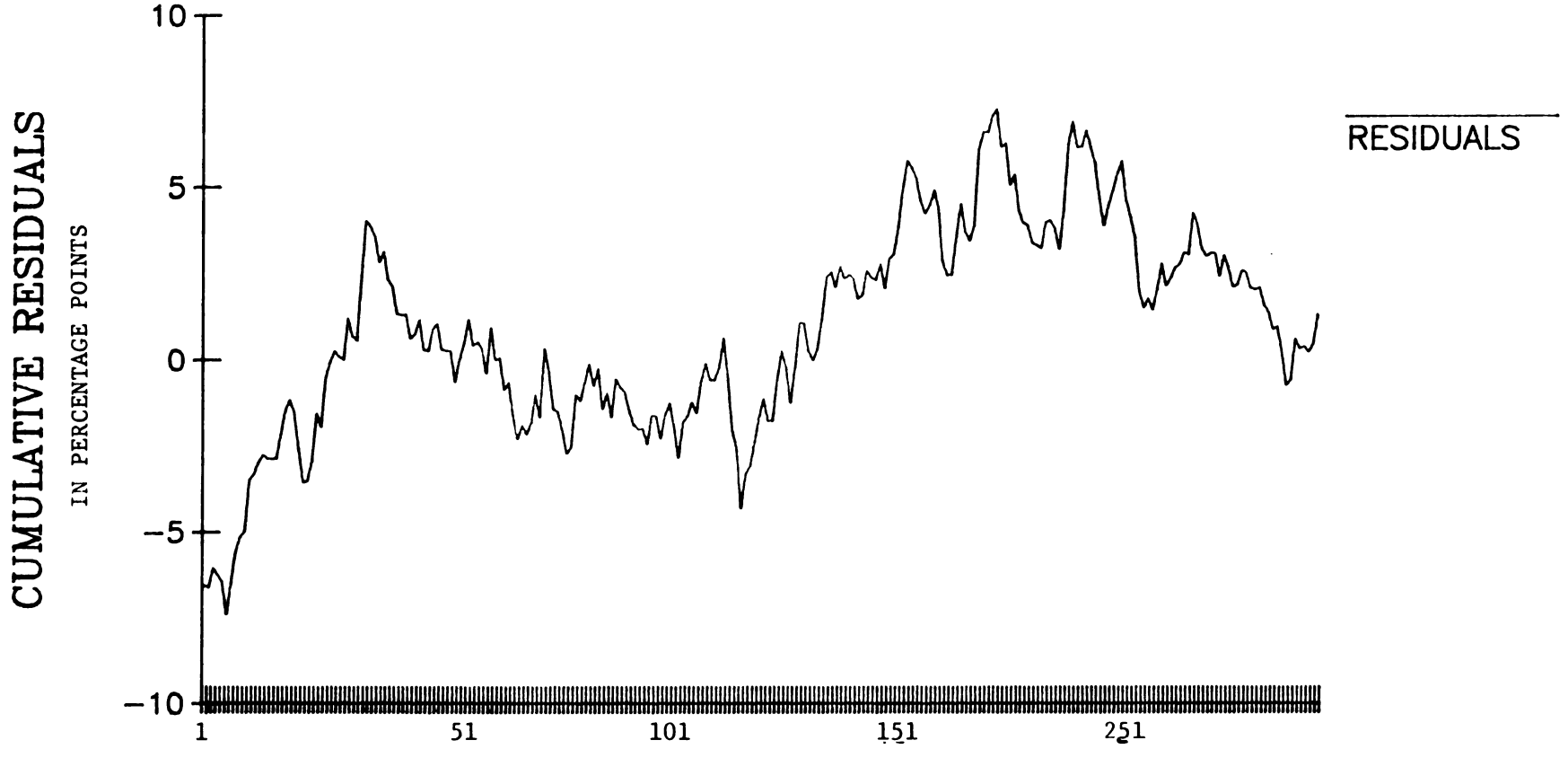
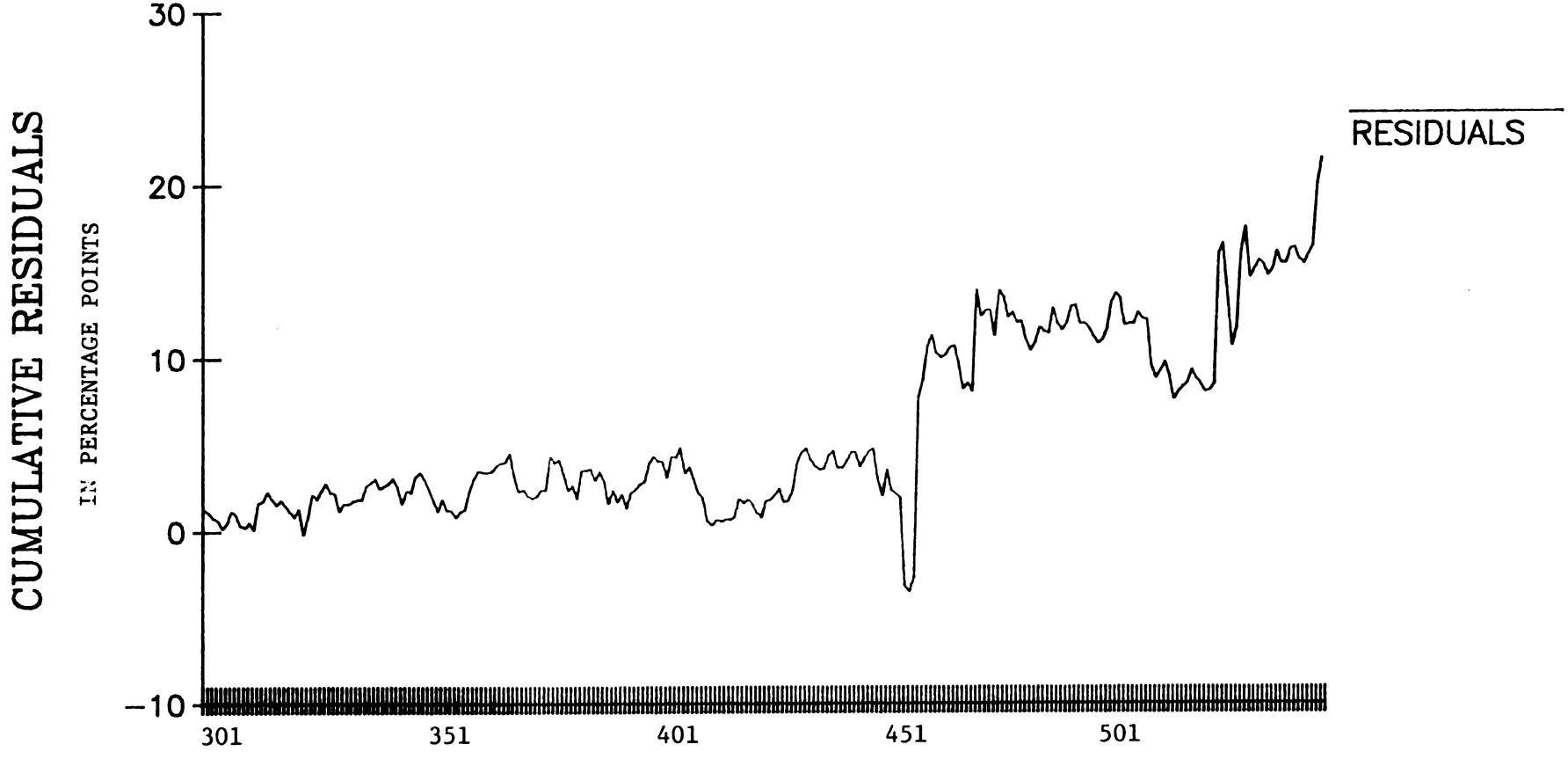


FIGURE 3

CUMULATIVE RESIDUALS JUNE 1981 TO JUNE 1982



CHAPTER V

SUMMARY AND CONCLUSIONS

Summary

The objective of this study was to test for the effects that the Motor Carrier Act of 1980 had on investors' assessments of the risk and return characteristics of the common stocks of trucking firms. The Motor Carrier Act was signed into law in May of 1980. This act ended most of the economic regulation of the trucking industry. It eliminated the rigid pricing structure for services, the privately owned rights to carry freight between cities, and the barriers that prevented new firms from entering the interstate freight business.

Most research in this area up until the time of this study focused on the macroeconomic effects of deregulation on society. The latest known empirical work on the impact of deregulation on the security holders' risk and return was done by Van Auken and Crum (1984). Their results indicated that the effect of the Motor Carrier Act was short-lived during the twelve weeks before and after the passage of the act. The weakness of their study was, however, that they assumed no change in the risk measures throughout the deregulation period.

The uniqueness of the current study is that not only were tests for abnormal return performance done on the returns of the trucking firms around the time of deregulation, but also tests were done to

ascertain whether the market measures of risk changed during the time of deregulation.

Changes in the market measures of risk were analyzed by comparing the risk characteristics before and after deregulation on a global basis and also on an annual basis. The risk measures used were those suggested by the market model as are listed below:

. The systematic risk as measured by β_p.

. The unsystematic risk as measured by $Var(\epsilon_p)$.

. The variance of returns as measured by $Var(R_p)$.

One additional risk measure which was calculated was the coefficient of variation of returns.

The data was also analyzed to determine if there were any abnormal returns earned by investors holding the common stock of motor carriers after deregulation and also if the market reacted efficiently to the news of deregulation. The cumulative average residual technique as suggested by Fama, Fisher, Jensen and Roll (1969) was used to analyze the effect the MCA of 1980 had on the equity returns of the trucking industry. Daily return data was collected for all trucking firms listed on the CRSP tapes and from daily OTC data for two firms. After forming a portfolio of these firms, portfolio returns were used to calculate the four previously listed risk measures. These measures were derived over the following two time intervals:

1. Before and after May 1980

2. On an annual basis for the years 1978-1982.

T-tests and F-tests were used on the .05 significance level to determine if the risk measures changed significantly around the time of deregulation. It was hypothesized that the risk of the portfolio would

change due to deregulation, and that the direction this change would take was an increase in the risk measures.

To test for market efficiency and abnormal return performance, the systematic risk was estimated with the market model using daily portfolio returns from 1978. Thus, the year 1978 was used as the estimation period for the cumulative average residual analysis. The testing period for the abnormal returns began in 1979. After subtracting the expected daily returns, calculated using the market model, from the actual daily return for a specific date, the resulting residuals were cumulated over time and presented graphically. These plots were visually examined to see if a pattern of abnormal return performance existed around the time of deregulation. In addition, t-tests were used to determine if the CAR values were significantly different from zero at the .05 level.

Conclusions

The results of the analysis were that the total risk of the trucking portfolio decreased after deregulation. However, the systematic risk estimates changed significantly, as tested by the t-test at the .05 significance level, from .880 in 1979 to .606 in 1980. In 1981, the systematic risk estimate had increased from the 1980 level to .688 but did not return to the level before deregulation. On the other hand, the variance of the portfolio returns did not change significantly from 1979 to 1980. The F-test indicated that no change occurred at the .05 significance level. In absolute terms the variance was .00008 in both 1979 and 1980. When incorporating the variance of the market returns, it was discovered that the level of the

portfolio's unsystematic risk did not change significantly from 1979 to 1980. The F-test was again used to test for any significant changes. The value of the unsystematic risk in 1979 was .000040 and .000046 in 1980. This difference was not significant. Thus, the firm-specific risk of the trucking industry did not increase significantly after deregulation as many critics of deregulation claimed would happen.

The results of the cumulative average residual analysis indicated that the market reacted efficiently to within two months before the passage of the Motor Carrier Act in 1980. Significant positive abnormal returns were available beginning in August 1980. Since the systematic risk of the portfolio declined after deregulation, the abnormal returns found after August 1980 were biased downward. Thus, investors earned higher abnormal returns then were indicated by the cumulative average residual analysis. One possible explanation for this behavior was that the market overreacted to the news of deregulation.

One of the concerns of the opponents of deregulation was that the MCA would have an adverse impact on the ability of firms to provide services and that the MCA would increase the risk for these firms. The results of the current study indicated that the expected change in risk was not substantiated. The risk of the firms did not increase. In fact, the portfolio systematic risk estimate declined after deregulation.

In conclusion it also appears that the market did not react efficiently to the actual impact of deregulation on these firms. The market tended to undervalue the stocks resulting in negative abnormal

returns before deregulation and positive abnormal returns after deregulation.

Implications of the Results

The results as presented in Chapter IV were surprising as it was indicated earlier that the author thought the market measures of risk to the portfolio returns would increase with deregulation. One economic justification for the conclusion of no change in total risk is that prior to deregulation the industry was subject to some form of regulatory risk that disappeared in 1980.

In the case of the motor carrier industry, regulation seems to have protected the least efficient carriers from the vagaries of the market place. Since the industry is composed of hundreds of small privately held carriers, it may be that the regulation was detrimental to the large publicly held carriers. In effect, the regulatory process may have been a risk to the carriers included in this study in that they were constrained. Once the large carriers were free to operate competitively, the market reacted correctly by re-evaluating the potential cash flows to these carriers.

Another explanation of the results deals with the provisions of the MCA itself. The MCA of 1980 as finally passed by Congress was a compromise package that had the support of the American Trucking Association. The opponents of deregulation were alarmed at the aggressiveness of the deregulation movement and the unilateral deregulation actions of the ICC itself. Therefore, to some extent, this act halted the passage of more sweeping reforms. The market may have been anticipating different legislation and accordingly, the decrease in CAR's

bottomed out after the market determined that the act was not as sweeping as anticipated.

Limitation of the Study

The effect of the MCA of 1980 on investors' perceptions of risk was evaluated at the portfolio level because past research indicated that firm level risk analysis lacks statistical power. The author attempted to examine the market model parameters at the firm level and confirmed the past research. A limitation of the portfolio level analysis was that it was not capable of providing information which may be disaggregated to the individual firm level. As a result it was possible that the total risk of some firms in the sample increased or decreased as a result of the passage of the MCA of 1980 although there was no change at the portfolio level.

The firms used in this study were drawn from the CRSP tapes which meant that the sample was limited (except for two firms) to firms listed on the New York and American Stock Exchanges. In addition the data on two large firms was hand pulled from over the counter daily price data.

Accordingly, the results of this analysis cannot be generalized beyond the firms in the sample. To the extent that there are firms similar to those in the sample that are not included, logical but not statistical inferences can be made about the effect of the MCA of 1980. The results might be different if small firms with limited distribution of common stocks were included.

Suggestions for Future Research

Further research may overcome some of the limitations of this current study. Several extensions of this research may expand the understanding of the deregulatory process by focusing on different other variables, and other methods of looking at returns.

The author has begun developing a data base on all publicly traded motor carriers and railroads. The express purpose of this data base is to develop criteria for portfolio formation and identifying those variables that best explain market reactions to regulatory events.

The variables to be examined include accounting measures, market values, and firm characteristics. The accounting variables include the following:

- The dollar value of investment in property, plant, and equipment for motor carrier operations.
- Estimated cash flow per share of common stock.
- Accounting return on investment.
- Debt to equity ratio.
- Ratio of motor carrier revenues to total revenue.
- Net working capital to total assets.

The market values include the following:

- Return per share of common stock.
- The systematic risk as measured by beta.
- The return on the market as measured by the Standard and Poor's 500 Index.

Firm characteristics include:

- Type of carrier.

. Size of carrier.

. Number of years the carrier has been in service.

The initial portfolios will be formed by dividing the firms by class of motor carrier. Then the returns will be regressed on the market returns for the periods before and after the passage of the MCA. The goal of this regression will be to determine if the risk measures change uniformally for all classes and sizes of carriers.

Based on the results of the initial regression, subsequent regressions will be formulated to determine which of the variables best explains the level of systematic risk. The goal of this work will be to determine why there are differential market reactions to deregulation.

The past decade has witnessed the deregulation of airlines, railroads, banks, stockbrokers, as well as trucking. It would be useful to know if the capital markets reacted in a similar fashion in these industries. From the perspective of public policy any information on likely market reactions to major changes in economic regulation would allow elected officials to make more informed decisions.

Another extension of the study would include a detailed study of all the firms in the industry. Such a study might uncover other variables such as asset base, leaseholds, management profile, or return on assets that may allow for the development of a model that better explains risk or return.

The author has begun an extension of this research with new portfolios. The firms used in the present study have been portioned for one set of portfolios by high and low debt/equity ratios. This will provide information about the relationship of capital structure

and deregulation. A second set of portfolios has been formed by partioning the firms on level of sales. This will provide information on whether there is a "size effect" to deregulation. These extensions will provide additional information to policy makers for use in the legislative process.

The investment community would be interested in further research that examined holding-period returns. Several different holding periods would be examined:

- purchase securities at deregulation and hold for some number of months
- purchase securities short before deregulation and clear the account near the formal passage of the MCA.

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APPENDIX A

APPENDIX A

CHANGES IN UNSYSTEMATIC RISK

Before Deregulation

$$.00008 = (.761)^2 (.000072) + \text{Var}(\varepsilon_p)$$

where $\text{Var}(\varepsilon_p) = .000038$

After Deregulation

$$.00012 = (.601)^2 (.000073) + \text{Var}(\varepsilon_p)$$

where $\text{Var}(\varepsilon_p) = .000094$

APPENDIX B

APPENDIX B

SUMMARY OF REGRESSION EQUATION STATISTICS[a]

Annual Regressions

Year	β_p	t-ratio	R^2	Durbin-Watson	F-ratio
1978	.800	18.4	57.4%	2.01	340.50
1979	.880	15.59	49.3%	2.02	241.43
1980	.606	12.83	39.7%	2.03	164.74
1981	.688	12.70	39.2%	1.88	161.42
1982	.640	5.62	11.2%	2.07	31.54

Before and After MCA Regressions

Time	β_p	t-ratio	R^2	Durbin-Watson	F-ratio
Before	.761	25.12	50.9%	1.99	637.98
After	.601	11.58	18.1%	1.94	133.59

[a]All statistics were tested for significance at the .05 level.

APPENDIX C

APPENDIX C

CHANGES IN ANNUAL UNSYSTEMATIC RISK MEASURES[a]

1978

$$.00008 = (.8)^2 (.0000721) + \text{Var}(\varepsilon_p)$$

where $\text{Var}(\varepsilon_p) = .000034$

1979

$$.00008 = (.880)^2 (.0000522) + \text{Var}(\varepsilon_p)$$

where $\text{Var}(\varepsilon_p) = .000040$

1980

$$.00008 = (.606)^2 (.0000916) + \text{Var}(\varepsilon_p)$$

where $\text{Var}(\varepsilon_p) = .000046$

1981

$$.00007 = (.688)^2 (.0000580) + \text{Var}(\varepsilon_p)$$

where $\text{Var}(\varepsilon_p) = .000043$

1982

$$.00026 = (.640)^2 (.0000704) + \text{Var}(\varepsilon_p)$$

where $\text{Var}(\varepsilon_p) = .0002312$

---

[a]The general form of the equation used to calculate the unsystematic risk estimates is:

$$\sigma^2_{R_p} = \beta^2 \sigma^2_{R_m} + \sigma^2_{\varepsilon}$$

↑ confounding

APPENDIX D

APPENDIX D

June 1979 - January 1980

CAR	σ	df	t-score
[illegible]	0.02036	[illegible]	[illegible]
[illegible]	0.020[illegible]	1[illegible]	4.5[illegible]
[illegible]	[illegible]	127.00	[illegible]
0.011[illegible]	0.020[illegible]	128.0000[illegible]	5.[illegible]24[illegible]
-0.00756	[illegible]	129.00000	-4.[illegible]
-0.01[illegible]	0.020[illegible]	130.0000[illegible]	-4.[illegible]
-0.01[illegible]	0.02001	131.0[illegible]	-[illegible]
-0.01[illegible]	0.02004	132.0[illegible]	-10.0[illegible]
-0.01373	0.02003	13[illegible].0[illegible]	-7.5[illegible]
-0.01214	0.01996	134.0000[illegible]	-1[illegible]
-0.00113	0.01989	135.00000	-0.61177
-0.00[illegible]14	0.01985	136.00000	-5.7704[illegible]
-0.00005	0.01978	137.00000	-0.[illegible]
0.00177	0.01971	138.00000	1.05512
0.00848	0.01964	139.00000	5.09093
0.00759	0.01957	140.00000	4.58903
0.00874	0.01950	141.00000	5.442[illegible]
0.01085	0.01944	142.00000	6.[illegible]84[illegible]
0.00396	0.01937	143.00000	2.444[illegible]
-0.00823	0.01933	144.00000	-5.10804
-0.00257	0.01928	145.00000	-1.60553
0.01362	0.01922	146.00000	8.56047
0.02010	0.01920	147.00000	12.69057
0.02494	0.01921	148.00000	15.79224
0.02416	0.01922	149.00000	15.34778
0.01941	0.01919	150.00000	12.38874
0.02907	0.01923	151.00000	1[illegible].57[illegible]
0.03919	0.01936	152.00000	24.95150
0.04009	0.01951	153.00000	25.41[illegible]
0.03320	0.01957	154.00000	21.05068
0.04772	0.01980	155.00000	30.00462
0.05106	0.02007	156.00000	31.78093
0.07449	0.02073	157.00000	45.00990
0.08028	0.02148	158.00000	46.96817
0.07617	0.02211	159.00000	43.44329
0.08082	0.02279	160.00000	44.85717
0.07902	0.02340	161.00000	42.85246
0.08772	0.02415	162.00000	4[illegible].23593
0.09555	0.02501	163.00000	48.76958
0.09136	0.02575	164.00000	45.45219
0.09387	0.02649	165.00000	45.52106
-0.08962	0.02712	166.00000	42.58820
0.08951	0.02771	167.00000	41.74248
0.09360	0.02835	168.00000	42.79616
0.08539	0.02883	169.00000	38.51035
0.08176	0.02923	170.00000	36.46941
0.07732	0.02956	171.00000	34.2031[illegible]
0.08796	0.03002	172.00000	38.42250
0.08082	0.03037	173.00000	35.000[illegible]
0.07976	0.03069	174.00000	34.[illegible]
0.08709	0.03110	175.00000	3[illegible].04[illegible]
0.07326	0.03132	176.00000	31.03075
0.07192	0.03152	177.00000	30.35[illegible]
0.0[illegible]	0.03167	178.00000	28.[illegible]
0.06951	0.03184	179.00000	[illegible]
0.07222	0.03[illegible]	180.00000	30.25[illegible]
0.06033	0.03211	181.00000	[illegible]
0.05507	0.03215	182.00000	2[illegible].11145
0.04248	0.03211	183.00000	17.8[illegible]
0.04591	0.03210	184.00000	19.273[illegible]
0.04341	0.03207	185.00000	19.41[illegible]
[illegible]	0.03201	18[illegible]	14.[illegible]
[illegible]	0.03196	187.0000[illegible]	1[illegible]
0.0[illegible]	[illegible]	[illegible]	16.[illegible]
0.07197	0.03[illegible]	18[illegible].00000	[illegible]
0.07[illegible]	0.03177	[illegible].00000	13.[illegible]
0.0[illegible]487	0.031[illegible]	191.00000	[illegible]
[illegible]	0.03162	192.00000	[illegible]
0.0[illegible]	0.03155	193.0[illegible]	17.69[illegible]
[illegible]	0.03151	194.0[illegible]	17.44[illegible]
0.050[illegible]	0.03156	195.000[illegible]	2[illegible].73[illegible]
0.0[illegible]555	0.03166	196.00000	29.0003[illegible]
0.0[illegible]	0.03173	197.00000	27.2325[illegible]
0.05905	0.03178	198.00000	26.14273
0.05677	0.031[illegible]	199.00000	2[illegible].16[illegible]
0.06357	0.03189	200.00000	[illegible].18711
0.06312	0.03197	201.00000	27.99496
0.05410	0.03198	202.00000	24.04344
0.06069	0.03203	203.00000	26.99548
0.05024	0.032[illegible]	204.00000	22.40750
0.05076	[illegible]	205.00000	22.698[illegible]
0.04949	0.03201	206.00000	22.1933[illegible]
0.05224	0.03201	207.00000	23.48[illegible]
0.05963	0.03204	208.00000	26.83754
0.04681	0.03202	209.00000	21.134[illegible]
0.04854	0.03200	210.00000	21.9611[illegible]
0.04795	0.03198	211.00000	21.780[illegible]
0.04803	0.03196	212.00000	21.88[illegible]
0.05205	0.03195	213.00000	23.[illegible]
0.06065	0.03199	214.00000	27.7[illegible]
0.05775	0.03201	215.00000	26.45[illegible]
0.06589	0.03208	216.00000	30.18505
0.07214	0.03219	217.00000	33.01338
0.07574	0.03232	218.00000	34.59904
0.06880	0.03240	219.00000	31.42376
0.06849	0.03248	220.00000	31.28123
0.08018	0.03263	221.00000	36.52737
0.07982	0.03278	222.00000	36.27918
0.07214	0.03287	223.00000	32.7720[illegible]
0.07251	0.03296	224.00000	32.92351
0.06811	0.03302	225.00000	30.938[illegible]
0.06684	0.03307	226.00000	30.38198
0.06021	0.03309	227.00000	27.416[illegible]
0.05743	0.03309	228.00000	26.2080[illegible]
0.06897	0.03315	229.00000	31.48691
0.08194	0.03329	230.00000	37.32759
0.07035	0.03335	231.00000	32.05675
-0.07225	0.03343	232.00000	32.92215
0.07428	0.03351	233.00000	33.8359[illegible]
0.08395	0.03366	234.00000	38.1555[illegible]
0.08921	0.03384	235.00000	40.41240
0.08766	0.03401	236.00000	39.59948
0.09000	0.03419	237.00000	40.52724
0.09186	0.03438	238.00000	41.2219[illegible]
0.08555	0.03452	239.00000	38.31645
0.09130	0.03469	240.00000	40.76744
0.09204	0.03487	241.00000	40.9721[illegible]
0.08822	0.03502	242.00000	39.18[illegible]
0.09009	0.03518	243.00000	39.924[illegible]
0.09229	0.03534	244.00000	40.78783
0.08267	0.03544	245.00000	36.50911
0.08417	0.03555	246.00000	37.1800[illegible]
0.08496	0.03566	247.00000	37.44[illegible]
0.08255	0.03575	248.00000	36.7458[illegible]
0.08184	0.03583	249.00000	36.0495[illegible]
0.08129	0.03591	250.00000	35.75[illegible]

January 1980 - May 1980

CAR		df	t-score	CAR		df	t-score
[illegible]	[illegible]	[illegible]	[illegible]	0.07819	0.03918	314.00000	[illegible]
[illegible]	0.03805	[illegible]	[illegible]	0.08596	0.03916	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	0.08511	0.03917	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	40.51570	0.08122	0.03913	317.00000	[illegible]
0.07151	[illegible]	[illegible]	40.12153	0.05535	0.03908	318.00000	25.25[illegible]
0.08503	0.03851	[illegible]	37.49043	0.05254	0.03901	319.00000	24.04[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	0.04753	0.03896	[illegible]	21.8[illegible]
0.07817	[illegible]	[illegible]	34.24444	0.04396	0.03889	321.00000	19.83[illegible]
[illegible]	0.03876	[illegible]	[illegible]	0.04695	0.03884	322.00000	21.64[illegible]
0.08317	[illegible]	[illegible]	35.54561	0.04251	0.03878	323.00000	19.70[illegible]
0.07621	[illegible]	[illegible]	[illegible]	0.04716	0.03871	[illegible]	21.9[illegible]
0.08477	0.03865	262.00000	38.65921	0.05417	0.03867	325.00000	25.25341
0.08475	0.03902	263.00000	37.12681	0.04450	0.03861	326.00000	21.74379
0.08776	0.03911	264.00000	38.42874	0.05050	0.03856	327.00000	23.87181
0.09313	0.03923	265.00000	40.72[illegible]	0.05903	0.03851	328.00000	27.755[illegible]
0.10114	0.03939	266.00000	44.11819	0.05942	0.03847	329.00000	28.02733
0.09687	0.03952	267.00000	42.18734	0.05050	0.03841	330.00000	23.88[illegible]
0.08651	0.03959	268.00000	37.67134	0.04976	0.03836	331.00000	23.60[illegible]
0.08450	0.03965	269.00000	36.80491	0.02855	0.03830	332.00000	13.5[illegible]
0.09907	0.03979	270.00000	43.07257	0.03798	0.03825	333.00000	18.12[illegible]
0.10131	0.03995	271.00000	43.95111	0.03346	0.03819	334.00000	16.01[illegible]
0.09576	0.03806	272.00000	41.49508	0.03236	0.03814	335.00000	15.53016
0.08259	0.03810	273.00000	35.81418	0.03666	0.03808	336.00000	17.64622
0.08160	0.03814	274.00000	35.41564	0.03013	0.03803	337.00000	14.54454
0.08376	0.03918	275.00000	36.37611	0.02836	0.03798	338.00000	13.728[illegible]
0.07598	0.03620	276.00000	33.04781	0.03365	0.03792	339.00000	16.33[illegible]
0.07242	0.03819	277.00000	31.55854	0.02881	0.03787	340.00000	14.02642
0.07929	0.03822	278.00000	34.59407	0.02643	0.03783	341.00000	12.90293
0.10196	0.03836	279.00000	44.40229	0.02202	0.03778	342.00000	10.77777
0.10579	0.03852	280.00000	45.96018	0.02154	0.03774	343.00000	10.54980
0.10208	0.03865	281.00000	44.27334	0.01801	0.03771	344.00000	8.856[illegible]
0.08476	0.03869	282.00000	36.78844	0.02063	0.03767	345.00000	10.17305
0.09389	0.03877	283.00000	40.73544	0.02312	0.03762	346.00000	11.43014
0.09238	0.03885	284.00000	40.07471	0.02314	0.03758	347.00000	11.47010
0.09676	0.03894	285.00000	41.94597	0.02086	0.03754	348.00000	10.36505
0.10150	0.03906	286.00000	43.94294	0.01788	0.03751	349.00000	8.90[illegible]
0.10197	0.03918	287.00000	44.08836	0.01594	0.03747	350.00000	7.9[illegible]
0.11058	0.03935	288.00000	47.68764	0.00806	0.03746	351.00000	4.03110
0.09867	0.03945	289.00000	42.52139	0.00281	0.03746	352.00000	1.40[illegible]
0.10347	0.03957	290.00000	44.53080	0.00501	0.03745	353.00000	2.51334
0.10887	0.03972	291.00000	46.75820	0.01516	0.03742	354.00000	7.60201
0.10225	0.03982	292.00000	43.87041	0.01896	0.03738	355.00000	9.55565
0.09857	0.03991	293.00000	42.27162	0.01439	0.03736	356.00000	7.26614
0.09813	0.04000	294.00000	42.06738	-0.00216	0.03737	357.00000	-1.09215
0.08865	0.04003	295.00000	38.07252	0.00597	0.03736	358.00000	3.02365
0.07108	0.04001	296.00000	30.65048	-0.00519	0.03738	359.00000	-2.63077
0.06929	0.03998	297.00000	29.88408	-0.00241	0.03739	360.00000	-1.21[illegible]
0.05820	0.03992	298.00000	25.16161	0.00022	0.03740	361.00000	0.11179
0.05660	0.03987	299.00000	24.54435	-0.01023	0.03743	362.00000	-5.1[illegible]
0.06531	0.03984	300.00000	28.39600	-0.00343	0.03745	363.00000	-1.74[illegible]
0.06475	0.03980	301.00000	28.27764	-0.00697	0.03747	364.00000	-3.54802
0.06100	0.03975	302.00000	26.66222	-0.00968	0.03751	365.00000	-4.[illegible]
0.04886	0.03969	303.00000	21.42874	-0.01425	0.03756	366.00000	-7.25[illegible]
0.03749	0.03960	304.00000	16.49726	0.00074	0.03756	367.00000	0.[illegible]34[illegible]
0.03624	0.03956	305.00000	15.99[illegible]	-0.01474	0.03761	368.00000	-7.5[illegible]
0.04194	0.03949	306.00000	18.57665	-0.01748	0.03767	369.00000	-8.51[illegible]
0.04526	0.03943	307.00000	21.88[illegible]	-0.02733	0.03777	370.00000	-13.91[illegible]
0.05228	0.03937	308.00000	23.30200	-0.02549	0.03786	371.00000	-12.86[illegible]
0.05927	0.03933	309.00000	26.45277	-0.02340	0.03794	372.00000	-11.89[illegible]
0.05430	0.03927	310.00000	24.34449	-0.02535	0.03803	373.00000	-12.87[illegible]
0.05747	0.03922	311.00000	25.84347	-0.03199	0.03815	374.00000	-16.[illegible]
0.07350	0.03920	312.00000	31.77001	-0.03219	0.03827	375.00000	-16.[illegible]
0.07456	0.03918	313.00000	33.[illegible]	-0.03475	0.03839	376.00000	-17.[illegible]

May 1980 - January 1981

CAR		df	t-score	CAR		df	t-score
-0.04032	[illegible]	[illegible]	-20.30481	0.03079	0.03811	440.00000	[illegible]
-0.04121	0.03870	376.00000	-20.76470	0.00331	0.03808	441.00000	13.67479
-0.04175	0.03868	379.00000	-20.91650	0.00304	0.03804	442.00000	[illegible]
-0.03e07	0.03871	380.00000	-15.03e [illegible]	0.02710	0.03800	443.00000	15.06e [illegible]
-0.03815	0.03912	381.00000	-19.07487	0.02555	0.03796	444.00000	15.57[illegible]
-0.04010	0.03915	382.00000	-19.96433	0.01887	0.03792	445.00000	10.47511
-0.04951	0.03545	383.00000	-24.56341	0.02106	0.03786	446.00000	11.74[illegible]
-0.04011	0.03909	384.00000	-19.85779	0.01141	0.03785	447.00000	6.36[illegible]
-0.03101	0.03967	385.00000	-15.33e[illegible]	0.00476	0.03784	448.00000	2.64[illegible]
-0.02648	0.03971	386.00000	-13.08964	0.00691	0.03781	449.00000	4.[illegible]
-0.02478	0.03981	387.00000	-12.24547	0.00631	0.03779	450.00000	3.54[illegible]
-0.00973	0.03982	388.00000	-4.81299	0.00974	0.03776	451.00000	5.47731
-0.00811	0.03983	389.00000	-4.01607	0.01810	0.03773	452.00000	10.19941
-0.00462	0.03983	390.00000	-2.29087	0.01132	0.03770	453.00000	6.39163
-0.00249	0.03982	391.00000	-1.23652	0.03166	0.03766	454.00000	17.91293
-0.00346	0.03981	392.00000	-1.72065	0.02451	0.03762	455.00000	13.89732
-0.00344	0.03981	393.00000	-1.71313	0.01377	0.03759	456.00000	7.82[illegible]
-0.00324	0.03980	394.00000	-1.61584	0.01306	0.03756	457.00000	7.43[illegible]
0.00386	0.03978	395.00000	1.92854	0.00785	0.03754	458.00000	4.47[illegible]
0.01077	0.03975	396.00000	5.39259	0.00099	0.03753	459.00000	0.5[illegible]
0.01393	0.03971	397.00000	6.98985	0.00300	0.03751	460.00000	1.71534
0.00996	0.03968	398.00000	5.00811	0.01809	0.03748	461.00000	10.36439
-0.00058	0.03966	399.00000	-0.29210	0.01637	0.03744	462.00000	9.39729
-0.01009	0.03967	400.00000	-5.08652	0.02187	0.03741	463.00000	12.58066
-0.00946	0.03968	401.00000	-4.77388	0.02722	0.03737	464.00000	15.69174
-0.00353	0.03968	402.00000	-1.78390	0.02073	0.03733	465.00000	11.97466
0.01006	0.03964	403.00000	5.09435	0.02585	0.03729	466.00000	14.96416
0.00620	0.03962	404.00000	3.14565	0.01404	0.03726	467.00000	8.14210
0.02077	0.03957	405.00000	10.56276	0.01899	0.03723	468.00000	11.03570
0.02537	0.03952	406.00000	12.93341	0.01190	0.03720	469.00000	6.92799
0.02863	0.03948	407.00000	14.63110	0.02321	0.03716	470.00000	13.54044
0.02687	0.03943	408.00000	13.76503	0.02029	0.03713	471.00000	11.86087
0.02602	0.03938	409.00000	13.36178	0.01900	0.03709	472.00000	11.12875
0.03834	0.03934	410.00000	19.73610	0.01358	0.03706	473.00000	7.96864
0.03279	0.03929	411.00000	16.92037	0.00966	0.03704	474.00000	5.67830
0.03174	0.03924	412.00000	16.41842	0.00856	0.03702	475.00000	5.04014
0.04959	0.03920	413.00000	25.70866	0.00917	0.03699	476.00000	5.40947
0.06674	0.03919	414.00000	34.65265	0.00437	0.03697	477.00000	2.58131
0.06493	0.03917	415.00000	33.76764	0.01290	0.03695	478.00000	7.63371
0.06198	0.03915	416.00000	32.29032	0.01255	0.03692	479.00000	7.43[illegible]
0.05472	0.03912	417.00000	28.56636	0.00610	0.03690	480.00000	3.6219[illegible]
0.05797	0.03909	418.00000	30.32132	0.01318	0.03687	481.00000	7.87[illegible]
0.04952	0.03905	419.00000	25.95832	0.01678	0.03684	482.00000	10.00031
0.04766	0.03901	420.00000	25.03908	0.00985	0.03681	483.00000	5.89026
0.03967	0.03896	421.00000	20.89044	0.00075	0.03680	484.00000	0.44837
0.03931	0.03892	422.00000	20.74955	0.01136	0.03678	485.00000	6.80251
0.03965	0.03887	423.00000	21.08383	0.01295	0.03675	486.00000	7.76817
0.03264	0.03883	424.00000	17.41610	0.01703	0.03672	487.00000	10.23[illegible]
0.03438	0.03878	425.00000	18.27586	0.01374	0.03669	488.00000	8.27[illegible]
0.03865	0.03874	426.00000	20.59370	0.02304	0.03665	489.00000	13.96[illegible]
0.02970	0.03869	427.00000	15.86192	0.02633	0.03662	490.00000	17.1[illegible]
0.02944	0.03865	428.00000	15.75971	0.02315	0.03658	491.00000	14.07[illegible]
0.03597	0.03860	429.00000	19.30028	0.02309	0.03655	492.00000	14.01444
0.03770	0.03856	430.00000	20.27548	0.02681	0.03651	493.00000	16.30[illegible]
0.03009	0.03851	431.00000	16.22015	0.03537	0.03647	494.00000	21.55[illegible]
0.02979	0.03847	432.00000	16.09574	0.02414	0.03644	495.00000	14.72[illegible]
0.02981	0.03842	433.00000	16.14363	0.00835	0.03641	496.00000	5.10[illegible]
0.02099	0.03838	434.00000	11.39207	0.00322	0.03640	497.00000	1.97[illegible]
0.02782	0.03834	435.00000	15.13335	-0.01951	0.03642	498.00000	-8.52304
0.03228	0.03830	436.00000	17.59902	-0.00779	0.03642	499.00000	-3.41[illegible]
0.03941	0.03825	437.00000	21.53600	-0.00148	0.03641	500.00000	-0.65[illegible]
0.03178	0.03821	438.00000	17.40447	0.00582	0.03639	501.00000	3.57954
0.03273	0.03817	439.00000	17.91761	0.01346	0.03636	502.00000	8.3053[illegible]

January 1981 - May 1981

CAR		df	t-score	CAR		df	t-score
0.01857	0.03e73	503.00000	11.47816	0.07235	0.03e31	566.00000	47.37[illegible]
0.01[illegible]	0.03e31	504.00000	[illegible]	0.07285	0.03e34	567.00000	47.75[illegible]
0.01[illegible]	0.03e28	505.00000	[illegible]	0.07091	0.03[illegible]	568.00000	46.24[illegible]
0.02415	0.03e25	506.00000	14.98[illegible]	0.06444	0.03e31	569.00000	42.31[illegible]
0.03146	0.03e21	507.00000	20.19432	0.07581	0.03e33	570.00000	49.[illegible]
0.02757	0.03e18	508.00000	17.17[illegible]	0.09579	0.03e35	571.00000	62.6401[illegible]
0.01745	0.03614	509.00000	10.91018	0.10186	0.03e4[illegible]	572.00000	66.[illegible]
0.02811	0.03611	510.00000	17.56[illegible]	0.09420	0.03e52	573.00000	61.78[illegible]
0.04067	0.03e08	511.00000	25.48[illegible]	0.09449	0.03e07	574.00000	61.[illegible]
0.04041	0.03e04	512.00000	25.[illegible]	0.09928	0.03e03	575.00000	64.[illegible]
0.03225	0.03e01	513.00000	20.71054	0.09420	0.03e68	576.00000	61.62[illegible]
0.02993	0.03597	514.00000	18.[illegible]	0.08965	0.03e72	577.00000	58.75[illegible]
0.03318	0.03594	515.00000	20.[illegible]	0.07994	0.03674	578.00000	52.31[illegible]
0.04214	0.03591	516.00000	26.65894	0.07171	0.03674	579.00000	46.[illegible]
0.05439	0.03589	517.00000	34.46121	0.07789	0.03675	580.00000	51.04957
0.05573	0.03587	518.00000	35.36250	0.08239	0.03e76	581.00000	54.01[illegible]
0.05129	0.03584	519.00000	32.59807	0.08731	0.03679	582.00000	57.24516
0.05754	0.03583	520.00000	36.62[illegible]	0.09026	0.03683	583.00000	59.49614
0.05396	0.03581	521.00000	34.39648	0.07958	0.03685	584.00000	52.19444
0.05492	0.03579	522.00000	35.06109	0.07444	0.03685	585.00000	48.8016[illegible]
0.05391	0.03577	523.00000	34.46914	0.06880	0.03684	586.00000	45.20[illegible]
0.04799	0.03574	524.00000	30.73651	0.05296	0.03682	587.00000	34.85196
0.04926	0.03571	525.00000	31.61553	0.04829	0.03679	588.00000	31.83000
0.05641	0.03570	526.00000	36.24197	0.05110	0.03676	589.00000	33.7342[illegible]
0.05421	0.03568	527.00000	34.88143	0.04769	0.03673	590.00000	31.534e[illegible]
0.05353	0.03566	528.00000	34.49693	0.05381	0.03671	591.00000	35.6349[illegible]
0.05835	0.03564	529.00000	37.65441	0.06108	0.03669	592.00000	40.50240
0.05114	0.03562	530.00000	33.054[illegible]	0.05463	0.03667	593.00000	36.27[illegible]
0.05993	0.03561	531.00000	38.78[illegible]	0.05682	0.03665	594.00000	37.78[illegible]
0.06125	0.03559	532.00000	39.68[illegible]	0.06001	0.03663	595.00000	39.96[illegible]
0.06907	0.03560	533.00000	44.7953[illegible]	0.06111	0.03661	596.00000	40.74760
0.08082	0.03563	534.00000	52.4214[illegible]	0.06442	0.03660	597.00000	43.00595
0.08867	0.03568	535.00000	57.48484	0.06390	0.03659	598.00000	42.71043
0.08673	0.03572	536.00000	55.95181	0.07615	0.03659	599.00000	50.93382
0.08325	0.03576	537.00000	53.97945	0.07297	0.03659	600.00000	48.84838
0.07683	0.03577	538.00000	49.81367	0.06573	0.03658	601.00000	44.05[illegible]
0.07317	0.03578	539.00000	47.47156	0.06371	0.03657	602.00000	42.75022
0.07572	0.03580	540.00000	49.15057	0.06467	0.03655	603.00000	43.44568
0.08002	0.03582	541.00000	51.95342	0.06454	0.03654	604.00000	43.40974
0.07485	0.03584	542.00000	48.62425	0.05803	0.03652	605.00000	39.0850[illegible]
0.05927	0.03582	543.00000	38.55468	0.06411	0.03651	606.00000	43.23186
0.05541	0.03580	544.00000	36.09692	0.06060	0.03649	607.00000	40.91835
0.05570	0.03578	545.00000	36.33892	0.05502	0.03647	608.00000	37.20443
0.06676	0.03578	546.00000	43.59854	0.05590	0.03644	609.00000	37.85348
0.07658	0.03580	547.00000	50.03505	0.06012	0.03643	610.00000	40.76470
0.06827	0.03580	548.00000	44.64749	0.05924	0.03641	611.00000	40.22183
0.06580	0.03579	549.00000	43.03782	0.05473	0.03638	612.00000	37.21352
0.07017	0.03579	550.00000	45.97756	0.05433	0.03636	613.00000	36.99528
0.09257	0.03585	551.00000	60.61350	0.05511	0.03634	614.00000	37.58079
0.09753	0.03592	552.00000	63.75188	0.05010	0.03631	615.00000	34.21614
0.09749	0.03599	553.00000	63.69744	0.04791	0.03628	616.00000	32.77145
0.10234	0.03608	554.00000	66.76618	0.04307	0.03626	617.00000	29.50[illegible]
0.10445	0.03617	555.00000	68.03673	0.04400	0.03623	618.00000	30.19[illegible]
0.09341	0.03623	556.00000	60.80[illegible]	0.03e95	0.03620	619.00000	25.79[illegible]
0.09460	0.03628	557.00000	61.53[illegible]	0.02707	0.03617	620.00000	18.634e[illegible]
0.08258	0.03631	558.00000	53.72[illegible]	0.02664	0.03614	621.00000	19.74.[illegible]
0.08561	0.03634	559.00000	55.80944	0.04071	0.03611	622.00000	28.11[illegible]
0.07530	0.03635	560.00000	49.01[illegible]	0.03774	0.03609	623.00000	26.10418
0.07164	0.03636	561.00000	46.63358	0.03825	0.03606	624.00000	26.54871
0.07115	0.03637	562.00000	46.31452	0.03675	0.03e07	625.00000	25.5[illegible]
0.06585	0.03635	563.00000	43.05148	0.03914	0.03600	626.00000	27.20255
0.06540	0.03634	564.00000	42.74[illegible]	0.04778	0.03597	627.00000	33.25873
0.06456	0.03633	565.00000	42.[illegible]	0.04759	0.03595	628.00000	33.17[illegible]

APPENDIX E

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SUMMARY OF MAJOR EVENTS PRECEEDING MCA

1975 SEC ordered stock exchanges to end the practice of fixing brokerage fees.

1975 U.S. Senate passes the Cannon-Kennedy Bill substantially reducing the level of economic regulation of the airline industry.

1978 ICC rulings begin the deregulation of motor carriers.

1979 Motor carrier regulatory reform bill jurisdiction is assumed by Senator Cannon which is seen as step away from regulatory reform.

1980 In March Senate Commerce Committee reports bill intact.

1980 In May House panel approves bill thereby ending the ability of senators and congressmen to weaken the bill.

1980 In June the MCA clears both houses of Congress.