THE IMPACTS OF DEREGULATION ON RAILROAD LABOR

John D. Bitzan

Upper Great Plains Transportation Institute
North Dakota State University
P.O. Box 5074
Fargo, ND 58105

August 1997

Acknowledgments

This report has been prepared with funds provided by the United States Department of Transportation to the Mountain Plains Consortium (MPC). A special thanks to Gene Griffin and the MPC in obtaining this funding.

This report was written in partial fulfillment of the requirements for a PH.D. in Economics at the University of Wisconsin-Milwaukee. The author would like to thank James Peoples, John Heywood, Dale Belman, William Holahan, and Richard Perlman of the University of Wisconsin-Milwaukee, for their invaluable comments and suggestions at various stages of this research. I would also like to thank Denver Tolliver and Doug Benson at the Upper Great Plains Transportation Institute for useful comments and suggestions related to this research. However, any errors that remain are, of course, my own.

the sponsorship of the Department of Transportation, University Transportation Centers Program, in the interest of information exchange. The U.S. Government assumes no liability for the contents or use thereof.

ABSTRACT

This study examines the impacts that railroad and trucking deregulation had on rail labor earnings and employment. Although the impacts that deregulation has had on pricing, service, profits, and productivity are fairly well understood, its impacts on rail wages and employment have not been well understood. In examining the impacts of deregulation on rail labor earnings, the study finds that the real earnings of operating employees in the rail industry, which were steadily declining prior to deregulation, have steadily increased following deregulation. Similarly, the earnings premiums of rail operating employees over similar employees in manufacturing have also increased at a steady rate following deregulation. These results are not surprising in light of the fact that railroad profits and productivity have also increased steadily since deregulation. In examining the impacts of deregulation on employment, the study finds a sharp decline in operating employment as a result of deregulation, and a considerable increase in the productivity of labor.

TABLE OF CONTENTS

LIST OF TABLES

INTRODUCTION

Railroad deregulation has had a major impact on railroad pricing, profitability, productivity, and service. Several studies have examined these impacts of deregulation and found positive results, in general. Findings have included an overall decrease in rail rates, increases in railroad profitability and productivity, and innovations in the types and number of services provided.

However, while there is general agreement over these positive effects of railroad deregulation, the overall impacts that deregulation has had on labor are relatively unknown. Two recent studies examining the impacts of deregulation on the weekly earnings of unionized railroad workers provide conflicting results. One finds a sharp decrease in weekly earnings following deregulation, while the other finds an increase in railroad earnings relative to those in other industries following deregulation. Furthermore, in citing the impacts of deregulation on railroad employment, one study finds a sharp decrease while another in reviewing the available evidence claims that railroad deregulation has had no impact on employment.

The recently passed bill eliminating the Interstate Commerce Commission and Congress' stated intent of further removing any regulations that it perceives to be unnecessary and burdensome suggest that further regulatory changes may take place in the rail industry. Before such changes take place, it is essential to have a better understanding of the entire effects that past changes in regulation have had on shippers, carriers, and labor. This study further examines the impacts of railroad deregulation on labor, focusing both on employment and weekly earnings effects.

REVIEW OF THE IMPACTS OF DEREGULATION ON LABOR

There have been several recent studies assessing the impacts that deregulation in the transportation industries has had on labor earnings and employment. Most of the studies have used individual data on earnings from the Current Population Survey (CPS), while a few have used aggregate data on employment and earnings. A few of the studies with the most applicability to the current study are reviewed in the following paragraphs.

Hendricks (1994) examines the impacts of deregulation on earnings in 5 different industries: airline transportation, bus transportation, railroad transportation, telephone services, and motor carrier transportation. In discussing the previous work examining the impacts of deregulation on earnings in these industries, he cites three reasons why it is necessary to examine both union-nonunion wage differentials and changes in earnings relative to other industries in order to assess the impacts of deregulation on earnings: (1) earnings could change relative to other industries, while the union-nonunion wage differential remains unchanged, (2) for industries that are mostly unionized (e.g. railroads), focusing on the union-nonunion wage differential will miss most of the impact of deregulation, and (3) without looking at the general level of wages, it is difficult to distinguish between theories of regulation impacts that focus on union rent sharing from those that focus on management incentives. Hendricks uses three sources of data on wages in order to assess the impacts of deregulation on labor: (1) monthly average wages for production workers from the *Monthly Labor Review*, (2) the annual demographic file of the CPS, and (3) the outgoing rotation group of the CPS. In examining the impact of deregulation on wages, he estimates yearly wage equations from 1966 through 1988 for all production workers in manufacturing and in the 5 industries studied, using industry dummy variables to assess wage differentials between the deregulated industries and other industries. When estimating wage

differentials without considering individual characteristics, he finds that workers in all of the industries except buses enjoyed wage premiums relative to other industries over the entire period (the highest average differential over the period was for railroads at more than 38 percent higher than other industries). Moreover, after deregulation the wage premium increased in the telephone and railroad industries, declined in the trucking industry, and showed mixed results in the other industries. When estimating wage differentials and controlling for individual worker characteristics, he finds that wage premiums in the railroad, airline, and telephone industries are high on average for the period, while the premium in trucking is zero over the period. The effect of deregulation is still shown to be an increase in the wage premium for the railroad and telephone industries, and a decrease in the trucking industry. Finally, when estimating the wage differentials while controlling for union density and individual characteristics, he finds that railroad and trucking premiums vanish, while airline and telephone wage premiums vanish when controlling for individual characteristics, union density, and concentration ratios. Hendricks concludes that for most industries (with the exception of trucking), regulation did not reduce union power through its impact on competition within the industry. Rather, he suggests that deregulation removed constraints on management that prevented it from using labor efficiently.

Another study of the impact of deregulation on labor using individual worker data is performed for the rail industry by Tally and Schwarz-Miller (1996). The authors provide an excellent review of union bargaining in the rail industry and then use 1973-1993 CPS data to estimate wage equations for locomotive engineers and conductors in an attempt to assess the impacts of deregulation. The authors point to several changes in the industry that could impact rail labor following deregulation, including the adoption of labor saving technologies, union concessions in train crew composition, changing intraindustry competition, and changing

interindustry competition. The first two changes are likely to increase productivity, and consequently wages, while the last two are likely to decrease industry rents and wages. In estimating the impact of deregulation on the weekly earnings of male locomotive engineers and conductors after controlling for individual characteristics and region of residence, they find a significant negative impact from deregulation on real earnings of approximately 11 percent. When they add unemployment rate to control for business cycle trends, they find essentially the same results. Finally, in order to ensure that the measured drop in earnings from deregulation is not spurious due to some unexplained decrease in all wages during the same time period, they estimate the same equation for non-transport workers. They find that the deregulation indicator is not significant in this estimation, suggesting that there indeed was a negative earnings effect in the rail industry from deregulation. They conclude that railroads have been able to press more effectively for work and pay-rule changes because of railroad deregulation, trucking deregulation, and a less union-friendly political environment.

In comparing the results of the first two studies reviewed, there are at least two unresolved issues that are immediately apparent. First, Hendricks finds that rail workers have realized wage gains relative to workers in other industries following deregulation, while Talley and Schwarz-Miller provide evidence that earnings of railroad workers have declined following deregulation and that the decline does not appear to be the result of an overall decrease in wages. These two findings are in direct conflict with each other, and beg further analysis. Second, the two studies discuss the impacts of increased productivity and increased competition on railroad earnings in general, but the relative impacts of each has not been identified.

Two studies that used aggregate data on earnings and employment to examine the impacts of deregulation on labor are Card's 1986 analysis of the impact of air carrier deregulation

on the earnings and employment of airline mechanics, and Hsing and Mixon's 1994 analysis of the impacts of railroad deregulation on railroad employment. The aggregate studies provide additional insight into the impacts of deregulation because of their analysis of the impacts on employment.

Card (1986) uses annual data on employment, wages, and output for eleven of the largest U.S. airlines to analyze the impacts of deregulation on the employment and earnings of airline mechanics. He focuses on the one occupation within the industry for several reasons, including: (1) different occupations may be affected asymmetrically from deregulation, (2) mechanics training and skills are easily transferred out of the airline industry, (3) their services are relatively easily replaced through outsourcing, and (4) employment conditions of mechanics resemble those of other industrial workers. Card argues that these characteristics make mechanics most similar to other unionized workers in the U.S. In examining the impact of deregulation of wages in the industry he does a visual comparison that shows no apparent impact. Specifically, prior to deregulation and persisting through the first two rounds of negotiation after deregulation mechanics wage rates are very uniform across firms, and the wage rates relative to aircraft assembly mechanics and maintenance workers in other industries don't change. In 1985, there was a greater dispersion in wages between the eleven firms, but at the time of the study it was unclear whether the change was a permanent structural change due to deregulation or whether it was merely a reflection of general economic conditions. In examining employment, the data show that there was an overall decrease in airline employment over time and a shift of maintenance employment from the major trunk airlines to the smaller airlines. Card finds that the trunk lines accounted for 93 percent of the total airline maintenance employment in 1970, 87 percent in 1978 (the year of deregulation), and 80 percent in 1984. In addition to the shift of employment to the smaller airlines at an increasing rate since deregulation, there also was an

increase in overall industry productivity between 1970 and 1984. Card estimates general employment functions to examine whether productivity increases have changed with deregulation. Specifically, he estimates employment of the four largest trunk airlines as a function of lagged employment, flight activity, trend growth, and a shift in trend growth from deregulation. He finds an increase in productivity growth from deregulation of between .7 percent and 1.4 percent per year. However, the increase is not statistically significant at conventional levels. Card suggests that the main effect of deregulation for mechanics was a shift of employment from the trunk airlines to the smaller airlines due to a shift in output between the two. He contends that because of the small wage differential between the trunk airline mechanics and the small airline mechanics the shift may have reduced the average hourly earnings of airline mechanics by 5 percent.

Hsing and Mixon (1994) examine the impact of deregulation on the railroad demand for labor. Specifically, they estimate labor for the entire railroad industry as a function of output, the hourly wage rate for non-supervisory production workers, a time trend, deregulation, and interaction terms between deregulation, wages, and output. When estimating the basic model with interaction terms they obtain a positive and significant effect of deregulation on labor, but attribute this effect to collinearity between the deregulation dummy and its interaction terms with wages and output. As a result, the authors estimate a similar model with the Box-Cox transformation performed on all continuous variables and without interaction terms. They find a negative impact of deregulation on rail labor and increasing wage and output elasticities (in absolute value) over time. They argue that deregulation has shifted bargaining power away from unions as evidenced by the increasing elasticity of demand for labor with respect to wages. However, there are at least three potential problems with this study. First, the study uses employment for the entire Class I railroad industry as a dependent variable. Thus, in trying to

explain the impact that deregulation had on unionized labor, the study is using data that include railroad executives and professionals. This non-unionized group accounted for nearly 25 percent of the entire Class I railroad labor force in 1960. Second, the study contends that deregulation caused an increase in wage elasticity, although the model does not provide a mechanism to show the impact of deregulation on wage elasticity. It only shows that it has been increasing over time. Finally, previous theoretical work suggests that a change in product market structure should not affect the elasticity of demand for labor (Heywood, 1990). As Heywood shows, any impact of a change in product market structure on union wages is suggestive of a labor union that is not constrained by the firm's labor demand function.

TRADE UNION BEHAVIOR

There are two general models of trade union behavior - each with substantially different implications.[1] The oldest, and most often assumed, model of trade union behavior is that of the union setting the wage rate, with employment determined by the intersection of that wage with the firm's labor demand curve. Specifically, the trade union maximizes some function (e.g. expected utility of the median member, the sum of each member's utilities, or the wage bill) where there is some tradeoff between the wage rate and the level of employment. Based on the union's objective function, it then chooses a point on the firm's labor demand curve that maximizes the function. In the case of maximizing the wage bill, the union chooses the point on the firm's labor demand curve where the elasticity of labor demand is -1 (i.e. a one percent increase in the wage rate will lead to a one percent decrease in employment - on the inelastic portion of the labor

[1]A good discussion of both of these models is present in Oswald (1985). Much of the theory presented in this section of the paper is adapted from Oswald.

demand curve the wage bill could be increased by an increase in the wage rate, while on the elastic portion of the labor demand curve the wage bill could be increased by a decrease in the wage rate). In the case of maximizing expected utility of the median member or the utility of all members, the wage/employment level is determined by the tangency of the union indifference curve with labor demand.

Mathematically, the tangency between the union utility function and the firm's labor demand curve can be obtained by maximizing union utility subject to labor demand. If we assume that the union maximizes the total utility of all its members, the utility function can be represented as follows:

$$Max\ U = n(w_u, r_o, q)\ u(w_u) + (m - n(w_u, r_o, q))\ u(b)$$

where: n = number of union members employed
m = number of union members
w_u = union wage
b = unemployment wage
r_o = other input price
q = output

By maximizing the utility function above with respect to the wage rate, the tangency between union indifference curves and the firm's labor demand can be shown (notice that the firm's conditional demand function for labor is substituted into the union utility function).

$$\frac{\delta U}{\delta w_u} = \frac{\delta n}{\delta w_u}\, u(w_u) + \frac{\delta u}{\delta w_u}\, n(w_u, r_o, q) - \frac{\delta n}{\delta w_u}\, u(b) = 0$$

$$\rightarrow \frac{\delta u}{\delta w_u}\, n(w_u, r_o, q) = [u(b) - u(w_u)]\, \frac{\delta n}{\delta w_u}$$

This optimization just shows that the union increases the wage rate until the marginal benefit of doing so equals its marginal cost. The marginal benefit is the increase in utility for those that are employed times the number employed, while the marginal cost is the increase in the number of people that are unemployed times the loss in utility from being unemployed.

More recently, the efficient bargains model of union behavior has been studied. The efficient bargains model notes that from the firm and union perspectives the wage-employment outcome of the labor demand model is not pareto optimal. In other words, it is possible for one or both parties to be better off without making the other worse off (the union can be on a higher indifference curve while the firm achieves the same level of profit, the firm can achieve a higher level of profit while the union achieves the same level of utility, or both the union and the firm can be better off). The contract curve can be obtained by maximizing firm profit (pf(n) - w_u(n), assuming only one factor of production) subject to union utility (these forms of profit and utility were also used in Oswald, 1985).

$$\mathcal{L} = pf(n) - w_u(n) + \lambda[u(w_u)n + (m-n)u(b) - U^*]$$

$$\frac{\delta \mathcal{L}}{\delta n} = pf'(n) - w_u + \lambda u(w_u) - \lambda u(b) = 0$$

$$\frac{\delta \mathcal{L}}{\delta w_u} = -n + \lambda u'(w_u)n = 0$$

$$\mathcal{L}_n \text{ and } \mathcal{L}_{w_u} \rightarrow w_u - pf'(n) = \frac{u(w_u) - u(b)}{u'(w_u)}$$

The contract curve represented by the final equation is just where there is a tangency between union utility curves and firm isoprofit curves. One notable difference of this model from the labor

demand model of union behavior is that this model predicts a positive relationship between the wage rate and employment levels. This can be shown by taking the total derivative of the contract curve equation, while holding factors other than wage and employment constant:

$$[w_u - pf'(n)]\, u'(w_u) = u(w_u) - u(b)$$

$$[[w_u - pf'(n)]\, u''(w_u) + u'(w_u)]\, dw_u - pf''(n)\, u'(w_u)\, dn = u'(w_u)\, dw_u$$

$$\rightarrow \frac{\delta w_u}{\delta n} = \frac{pf''(n)\, u'(w_u)}{[w_u - pf'(n)]\, u''(w_u)} > 0$$

The positive sign on the above expression follows from diminishing marginal product of labor ($f''(n)<0$), diminishing marginal utility of income ($u''(w_{u)}<0$), and a wage that is greater than the value of marginal product ($w-pf'(n)>0$, this follows from the initial contract curve equation). Thus, one ad hoc way to examine whether the labor demand curve model or the efficient bargains model is appropriate would be to look at the relationship between union wages and employment over time after controlling for factors that could shift the labor demand function or the contract curve (e.g. output, productivity). However, such a test is strictly an exploratory test and since it is difficult to control for productivity changes it may not show anything meaningful. For example, one may observe a negative relationship between wages and employment over time and conclude that the union must be constrained by the firm's labor demand curve. If, however, decreasing employment has been leading to increased labor productivity and wages (as may have been the case in the rail industry), the observer would still see a negative wage-employment relationship, even though it was due to changes in productivity and not labor constrained by the labor demand curve. Moreover, without firm level cost and employment data there is no good way to test

empirically for the correct model of bargaining. However, given the theoretical evidence presented by Heywood (1990), any empirical evidence of an increasingly competitive market structure having a negative influence on wages is suggestive of the rent sharing / efficient bargains model.

REGULATION, EARNINGS, AND EMPLOYMENT

Theory does not provide a unique prediction of the effects of regulation on unionized labor. The effects of regulation on unionized worker employment and earnings are not clear because of the wide array of conflicting forces. On the one hand, regulation may create economic rents for firms by restricting entry into the industry and by price setting. Such economic rents provide an opportunity for increased union wages, through rent sharing, and increased employment. On the other hand, regulation may limit the firms' ability to make productivity gains through various restrictions on pricing and service. An inability to make productivity gains will limit the growth in the marginal product of labor, and therefore limit earnings and employment. Other potential effects of regulation result from requiring regulated firms to serve markets that are not profitable. Such a requirement is likely to enhance employment, but to reduce productivity and wages. The following paragraphs discuss the various effects of railroad deregulation, and the predicted impacts on earnings and employment.

Legislative acts altering the regulations placed on U.S. railroads occurred in 1976 and in 1980. In 1976, Congress passed the Railroad Revitalization and Regulatory Reform Act (4-R Act). The Act gave the railroads more pricing flexibility and eased restrictions on mergers and abandonments. However, significant regulatory changes did not occur until 1979 (MacDonald, 1989). The Interstate Commerce Commission (ICC) introduced confidential contract rates,

exempted some commodities from regulation, and began to encourage rail track rationalization in 1979. Finally, Congress passed the Staggers Rail Act in 1980 - an act that in many ways validated actions already taken by the ICC (MacDonald, 1989). In order to make hypotheses on the impacts that such regulatory changes may have had on rail labor it is necessary to review the conditions in the industry prior to the changes. A discussion of pre-deregulation industry trends follows.

Prior to deregulation, the rail industry was experiencing several problems. First, the industry was in extremely poor financial condition beginning in the early 1970s. The rail industry had seen a consistent decline in profitability and market share, with return on investment hovering between 1.2 and 2.7 percent throughout the 1970s and with market share of intercity freight ton-miles dropping to 39 percent in 1970 from a high of nearly 69 percent in the 1940s.[2] The poor financial condition of the industry was further manifested through the imminent bankruptcy of six of the nation's major railroads (most notably the Penn Central) in the early 1970s. Second, several studies suggested that regulation was imposing a heavy burden on society, in general. Friedlaender (1969) and Moore (1972) estimated the welfare losses resulting from surface freight regulation to be between $1.7 and $2.4 billion. They estimated three types of losses resulting surface freight regulation, including: welfare losses due to the various modes (rail and truck) operating inefficiently, welfare losses due to traffic moving by the mode that is less efficient than the other, and welfare losses due to traffic not moved at all.

The U.S. Department of Transportation cited the following list of adverse regulatory policies that were contributing to the decline of the rail industry (MacAvoy and Snow, 1977):

---

[2]Association of American Railroads, *Railroad Facts.*

Lengthy abandonment hearings - The rail industry was suffering from overcapitalization, as it was forced to maintain rail mileage that had very low traffic densities. (This overcapitalization was due to the common carrier status of the railroads, as they were not allowed to adjust their capital stock to permanent changes in demand). This resulted in high costs and low profitability for many of the nation's railroads.

Lack of flexibility in rate making - Facing stiff competition from truck and waterway traffic, railroads faced great delays in changing rates and had little flexibility in doing so. Most rates were set by rate bureaus, eliminating competition between railroads. This discouraged innovation in pricing and service, and may have resulted in lost traffic to competing modes. Moreover, rate ceilings based on fully allocated costs (variable costs plus some arbitrary allocation of fixed costs based on the estimated percent of total costs that are variable) eliminated railroad incentives for efficiency, as any efficiency gains would reduce rate ceilings.

Lengthy merger proceedings - Merger proceedings were long and drawn out, possibly slowing down some of the eventual benefits of mergers. To the extent that economies of density, scale, and scope are present in rail operations, mergers may have had a positive impact on societal welfare through a reduction in overall costs. However, they may also have had a negative impact to the extent that merged railroads foreclosed other carriers out of markets. To the extent that regulation was slowing the occurrence of mergers, and to the extent that mergers produce positive results, a cost was imposed on society.

Prohibition of joint usage - Regulation did not allow joint usage and control of common trackage between two carriers. This most likely led to duplication of service, and higher costs.

Other problems in the industry included inflexible management, outdated operating procedures, and a lack of intermodalism and innovation in the industry. These problems also appeared to have regulatory underpinnings.

As mentioned previously, the first change in regulation aimed at solving some of these problems was the 4-R Act of 1976. The 4-R Act was created as a specific reaction to the poor financial condition of the industry, as the name suggests. Specifically, the Act reduced the ICC's regulatory responsibility to markets where effective competition was weak or where regulation was not considered necessary for national transportation policy, and directed the ICC to develop standards for determining revenue adequacy (General Accounting Office, 1990). Because the continued poor health of the rail industry in 1980, Congress further pushed to deregulate with the

Staggers Act of 1980. The Staggers Act directed the ICC to consider revenue adequacy when setting maximum reasonable rate standards, eliminated rate bureaus and restricted collective rate making to joint movements of goods, allowed railroads to increase rates in line with changes in costs without being challenged, allowed railroads that did not earn adequate revenues to increase rates further and to add surcharges to low traffic lines, allowed railroads to enter into confidential contracts with shippers, set time limits on abandonment proceedings, allowed differential pricing, and set time limits on the consideration of merger applications (General Accounting Office, 1990 and National Economic Research Associates, 1986).

In general, the evidence of studies examining the impacts of deregulation has been positive. Most studies examining the direct impacts of deregulation on railroad rates have shown a reduction in rates. Moreover, most studies suggest that increasing shipment sizes, length of haul, and system density have reduced rates. Thus, to the extent that deregulation has caused an increase in shipment size, length of haul, and/or system density, the impacts of deregulation would be much larger. The extensive abandonment of light density lines since deregulation, Moore's contention that long-haul rail rates were held at inefficiently high levels under regulation, and the widespread introduction of unit train rates after 1980 lend support to the notion that system density, shipment length of haul, and shipment size have increased as a result of deregulation. In one of the most comprehensive studies of the impact of railroad deregulation on railroad rates, Wilson (1992) finds that while the initial effects of deregulation were to increase rail rates for most of the 34 commodities studied, deregulation caused a decrease in rates for nearly all commodities by 1988. Further, increases in productivity have been great. Dooley, Wilson, Benson, and Tolliver (1991) estimate that prior to railroad deregulation productivity growth led to approximately a one percent decrease in costs per year, while following deregulation the rate of

cost reductions resulting from productivity growth ranged from 5 to 7 percent until 1987 when the growth rate fell somewhat. Third, there has been widespread abandonment of rail lines since the Staggers Act of 1980. Bitzan, Honeyman, Tolliver, and Casavant (1995) estimate that more than 33,000 miles of rail line were abandoned between 1980 and 1992. This represents approximately 18 percent of the total miles of road operated by Class I and II railroads at the end of 1979. Fourth, railroad profitability has increased since deregulation. Bitzan (1994) estimates that railroad return on investment has risen by more than 2 percent as a result of railroad deregulation.

As shown in the literature review, studies assessing the impacts of rail deregulation on labor have shown mixed results. However, some of the other industry trends can be examined to assess the potential impacts of transport deregulation on labor. First, the overall reduction in rail rates resulting from the increased competition between railroads and from increased competition between modes suggests that rail union bargaining power and railroad-union rent sharing may have declined as a result of rail and truck deregulation. Such a decline in union bargaining power and rent sharing would suggest a decline in rail union wages and employment as a result of deregulation. Second, the large increases in productivity resulting from deregulation may suggest an increased desire for labor by railroads. This would suggest increased wages and employment. However, the increases in productivity resulting from deregulation may be endogenous to the determination of rail union employment and wages. That is, the productivity improvements following deregulation were probably the result of changes in employment and wages as well as the causes of such changes. Third, the widespread rail abandonment that occurred as a result of railroad deregulation suggests that regulation was forcing railroads to operate in unprofitable markets. Eliminating such obligations is likely to have a negative effect on employment, but a

positive effect on wages through its positive effect on productivity. This is an example of a productivity improvement being endogenous to the change in rail union employment.

DATA AND EMPIRICAL METHODS

This study uses three different estimations to examine the impacts of deregulation on rail labor. First, an ad hoc employment function is estimated in order to assess the impacts of deregulation on the employment of rail union workers. Talley and Schwarz-Miller suggest that railroad deregulation has lead to a decrease in Class I railroad employment, but provide no analysis other than an examination of total Class I employment numbers before and after deregulation, while Winston (1993) suggests that deregulation has had no effect on railroad employment. As stated earlier, Hsing and Mixon's results are interesting, but their use of executives along with blue collar labor is questionable. In order to have a broad understanding of the impacts of railroad deregulation on rail labor, the impact on employment is essential. Second, the impacts of railroad deregulation on individual union workers are assessed.[3] This approach, similar to the one used by Talley and Schwarz-Miller will provide an estimation of the impacts of deregulation on weekly earnings of unionized rail workers, while taking into account differences in individual characteristics of workers. However, because these approaches could measure spurious relationships between deregulation and employment/earnings due to business cycle fluctuations or some other economic phenomenon affecting U.S. workers, a third approach of comparing wages of unionized rail workers to those in similar occupations in manufacturing is also

[3]Although there has been some formations of short-line railroads with non-union labor, the impact on the portion of the industry that is unionized has been minimal. According to Talley and Schwarz-Miller, the percent of the railroad industry that was unionized fell from 83.2 in 1974 to 80.5 in 1988. Because of the high portion of the industry that is unionized, union/non-union wage differentials are not examined.

performed. Moreover, an attempt to reconcile the findings of the weekly earnings analysis and the railroad/manufacturing differentials analysis is made.

In order to examine the impacts of deregulation on rail union employment, an ad hoc employment function is estimated. Specifically, employment of railroad transportation workers, maintenance of way workers, and maintenance of equipment workers are hypothesized to be functions of factor demand prices, output, a time trend, and a new time trend following deregulation. The model is specified (with all variables in natural logarithms) as:

$$N_{it} = f(Q_t, w_{it}, r_{ft}, r_{mt}, t, d, d*t)$$

where: N_{it} = *Class I employment of worker type i at time t*
Q_t = *Class I railroad output at time t in revenue ton-miles*
w_{it} = *Class I annual compensation per worker for worker type i at time t*
r_{ft} = *price of fuel for Class I railroads at time t*
r_{mt} = *price of materials and supplies for Class I railroads at time t*
t = *time*
d = *deregulation dummy* (0 = *before* 1980, 1 = 1980 *and after*)

Class I railroad employment and compensation in transportation, maintenance of way, and maintenance of equipment occupations from 1960-1992 are obtained from *Moody's Transportation Manual*. Revenue ton-miles, price of fuel, and price of materials and supplies for Class I railroads are obtained from *Railroad Facts.*

Because wages and employment are determined simultaneously in the efficient bargains model and wage/employment determination would be observationally simultaneous in the monopoly model, an instrumental variables approach is used under the assumption that annual

compensation is endogenous.[4] Moreover, since the determination of employment and earnings of transportation, maintenance of way, and maintenance of equipment employees are likely to be similar processes, it is likely that omitted variables and therefore errors are correlated. Thus, a three-stage least squares instrumental variable estimator is used.[5] In this estimation, the three variables of interest are the time variable, the deregulation indicator variable and the time/deregulation interaction term. The time variable will show the trend in changes in employment over time that may be the result of changes in productivity, changes in industry rents, or changes in union bargaining power. The deregulation variable will show if there was a shift in employment resulting from deregulation. The time/deregulation interaction term will show if the time trend has changed due to deregulation. If, for example, the rate of labor productivity growth has changed from deregulation, then the output elasticity of employment will be changing at a different rate following deregulation. Consequently, the relationship between time and employment will have changed.

In addition, a second model is estimated with the aggregate data in order to assess the relative changes in employment resulting from labor productivity changes that may have resulted from deregulation, and those that may have resulted from decreased rents or decreased union bargaining power resulting from increased intermodal competition. The model is formulated as:

---

[4]Annual compensation is used rather than wages, because a significant portion of railroad compensation is independent of hours as Talley and Schwarz-Miller point out.

[5]Instruments used to estimate the natural log of annual compensation in the first stage include average length of haul, ton miles per freight train hour, miles of road, industrial production, average truck rate, 4-firm concentration, a deregulation dummy, fuel price, materials price, revenue ton-miles, a load factor, and a time/deregulation interaction.

$$N_{it} = f(Q_t, w_{it}, r_{jt}, r_{mt}, t*Q_t, d*Q_t, t*d*Q_t, P_{\Pi})$$

where: P_{Π} = *average revenue per ton-mile for Class I and II trucking firms with 75% or more of revenues coming intercity transportation of general commodities*

In this model, the interaction terms between output and time, output and deregulation, and output, time, and deregulation will show the effects of changing productivity on employment. If the elasticity of employment with respect to output is decreasing over time, then labor productivity is increasing over time. The output, time, and deregulation interaction term will show whether the trend in productivity growth for Class I railroads has changed as a result of deregulation. The output-deregulation term will show if there was a one-time shift in productivity resulting from deregulation. Average trucking rates are included to proxy the changes in intermodal competition resulting from trucking deregulation. Presumably, any increased competition resulting from deregulation would be expected to lower rail rates, and to reduce industry rents available for sharing with labor.

A third approach to examining the impacts of deregulation on unionized rail employment is to estimate the impacts that competition, productivity, and obligations to serve markets have had on employment directly. A recursive system of equations is estimated with the aggregate data in order to assess the direct and indirect impacts of deregulation on unionized rail employment. This model will shed additional light on the various factors resulting from deregulation that in turn influenced rail employment. The recursive system is specified as:

$$Y_{jt} = f(t, d, t*d, IP_t)$$

where: $Y_{jt} = Q_t, MOR_t, CONC_t, ALH_t, LOAD_t, P_{rt}$

$$N_{it} = f(Q_t, w_{it}, r_{jt}, r_{mt}, MOR_t, CONC_t, ALH_t, LOAD_t, P_{rt}, t, d)$$

where: MOR_t = Class I Miles of Road at time t

$CONC_t$ = 4-Firm Concentration Ratio at time t

ALH_t = average length of haul at time t

$LOAD_t$ = average weight per train at time t

IP_t = the Federal Reserve's Index of Industrial Production at time t

In the recursive system, each variable measuring an indirect effect of deregulation on unionized rail employment is regressed on time, deregulation, a time/deregulation interaction term, and industrial production.[6] The total effect of deregulation on unionized railroad employment can then be determined by taking the total derivative of the employment equation with respect to deregulation, as follows:

$$\frac{d\,N_{it}}{d\,d} = \frac{\delta N_{it}}{\delta d} + \frac{\delta N_{it}}{\delta Q_t} * \frac{\delta Q_t}{\delta d} + \frac{\delta N_{it}}{\delta CONC_t} * \frac{\delta CONC_t}{\delta d} + \frac{\delta N_{it}}{\delta ALH_t} * \frac{\delta ALH_t}{\delta d} + \frac{\delta N_{it}}{\delta LOAD_t} * \frac{\delta LOAD_t}{\delta d} + \frac{\delta N_{it}}{\delta P_{rt}} * \frac{\delta P_{rt}}{\delta d}$$

As discussed previously, one of the ways in which deregulation is expected to impact unionized railroad employment is through its impact on competition. Increases in industry concentration resulting from deregulation would be expected to increase employment through the increased pricing power resulting from such concentration and the ensuing rents. On the other hand, the increased competition with the trucking industry and lower trucking rates resulting from

[6]This simple specification is used in order to obtain consistency across equations. The industrial production index is included to account for business cycle effects.

rail and truck deregulation would be expected to decrease unionized railroad employment through a reduction in rents.

Another way in which deregulation is expected to impact unionized railroad employment is through a reduction in obligations to serve unprofitable markets. Decreases in miles of railroad resulting from deregulation would be expected to decrease employment in the railroad industry, causing an increase in productivity and increased wages.

Finally, deregulation is expected to impact employment through its impacts on the efficiency of train operations. The flexible pricing structure resulting from deregulation has allowed railroads to employ innovative pricing schemes that have resulted in increased lengths of haul and weights per train. When the total number of ton-miles are held constant, both of these factors would be expected to result in a decrease in unionized railroad employment.

The next model estimated examines the impact of deregulation on individual unionized workers in the rail industry, while controlling for the effects of human capital accumulation, other personal characteristics, and region of residence. The model is estimated for prime aged white males, who work at least 30 hours per week, and who are members of a labor union. The focus on this specific group allows a more precise estimation, by eliminating problems associated with estimating groups who have different returns to human capital or other characteristics in the same equation. The estimation uses current population survey data from the 1973-1981 may files and

1983-1991 yearly files in order to assess the impacts of deregulation on the weekly earnings of rail workers in transportation occupations.[7] [8] [9] The general specification is as follows:

$$lnw_{it} = f(ed_{it}, exp_{it}, exp^2_{it}, married_{it}, smsa_{it}, region_{it}, time_t, dereg_t, dereg_t * time_t)$$

This specification uses the traditional human capital variables, but also adds variables for an effect of changing wages over time, an effect of deregulation, and a changing effect of time on wages after deregulation.[10] The specification of including time in addition to the intercept shift variable used by Talley and Schwarz-Miller appears to be an important consideration. Based on the extensive history of collective bargaining within the industry that was detailed by Talley and Schwarz-Miller, the large amount of negotiating sessions and agreements provide the potential for several changes in wages over time.

Finally, because of the potential for either of the above two estimations to measure a spurious relationship between deregulation and union earnings or employment, yearly wage differentials between rail industry workers and those with similar occupations in manufacturing are estimated, in a similar fashion to that done by Hendricks. Specifically, yearly wage equations are estimated for prime aged white male union members in the railroad and manufacturing

---

[7]1982 data are not used because they do not include a union identifier variable.

[8]weekly earnings are used rather than hourly wages, because much of the compensation given to railroad workers is not based on hours of work as pointed out by Talley and Schwarz-Miller.

[9]Transportation occupations include engineers, conductors, brakemen, and switchmen. Talley and Schwarz-Miller examine a subset of this group (engineers and conductors). Because it is difficult to identify maintenance of way and maintenance of equipment occupations in the CPS, only the transportation occupations are examined.

[10]One important note about the estimation is that observations are not available for the same individuals over time. Thus, fixed or random individual effects are not included.

industries, working in operating occupations.[11] An intercept shift variable is included for railroad workers in order to obtain a railroad/manufacturing wage differential. The weighted average differentials before deregulation are compared to the weighted average differentials after deregulation, as was done by Hendricks. However, in addition, the yearly differentials are included in a final regression as a function of time, deregulation, and the interaction between time and deregulation. This estimation is included as an attempt to reconcile the differences in findings between Hendricks and Talley/Schwarz-Miller.

EMPIRICAL RESULTS

Table 1 presents the three-stage least squares estimation of ad-hoc employment functions for railroad maintenance of way labor, maintenance of equipment labor, and transportation labor. As the table shows, much of the variation in railroad employment is explained by this estimation, and most variables have their expected signs. Earnings per worker are shown to have a negative signs for two of the types of labor. However, this does not necessarily provide support for the notion that rail labor bargains along the firm's labor demand function. It could merely be representative of employment cuts increasing productivity and wages due to a reduction of railroad obligations to serve unprofitable markets. Moreover, the parameter estimates for

[11]Most of those included in the non-transport operating occupations are machine operators. The occupational codes used for manufacturing operators are 601-695 prior to 1983 and 703-795 for 1983 and after.

Table 1: 3sls Estimation of Employment in the Class I Railroad Industry (1960-1992)

	ln Maintenance of Way Employment	**ln Maintenance of Equipment Employment**	**ln Transport. Employment**
Intercept	5.3028 (5.0911)	-7.5301 (5.0140)	8.1004** (3.5358)
ln Earnings per worker (for that type of worker)	0.1836 (0.1253)	-0.1585 (0.1362)	-0.0638 (0.0730)
ln Fuel Price	0.0524 (0.0609)	-0.0209 (0.0565)	0.0177 (0.0438)
ln Materials and Supply Price	0.5846* (0.1901)	0.7065* (0.1799)	0.1920 (0.1367)
ln Revenue Ton-Miles	0.0559 (0.1580)	0.6612* (0.1494)	0.1535 (0.1127)
Time	-0.0169* (0.0055)	-0.0398* (0.0056)	-0.0275* (0.0036)
Deregulation (1980=1,...1992=1)	-0.1495* (0.0483)	-0.0953* (0.0440)	-0.1341* (0.0343)
(Time-20)*Deregulation	-0.0210** (0.0092)	-0.0366* (0.0099)	-0.0348* (0.0063)
DW Statistic [12]	1.45	1.60	1.32

System weighted $R^2 = 0.9907$
System weighted MSE = .8922
standard errors in parentheses
*significant at the 1% level, **significant at the 5% level, *** significant at the 10% level

[12]The DW statistic is in the inconclusive range for autocorrelation for all three types of labor.

earnings per worker are not significant at conventional levels. Fuel price has mixed signs in the three equations, but is not significant at conventional levels. Materials and supply price is positive and nearly significant for all of the three types of workers, suggesting that labor and materials are substitutes in the production of railroad services. Revenue ton-miles are positive as expected, and nearly significant for two of the three types of labor. The lack of significance of revenue ton-miles in the maintenance of way equation may be partially due to collinearity with time. Moreover, it may also partially represent the fact that railroad track and structures must be maintained to certain standards regardless of traffic levels. Finally, the variables of interest in this estimation, time, deregulation, and time*deregulation, show that rail employment of all three categories has been declining over time, realized a large decline from deregulation, and it has declined at a faster rate since deregulation. For example, after controlling for the effects of changes in input prices and output, employment of maintenance of way workers declined by 1.7 percent per year before deregulation, dropped 13.9 percent from deregulation, and declined at a rate of 3.7 percent per year following deregulation. Overall, the results suggest that employment of maintenance of way and equipment workers were 33.1 and 41.4 percent lower, respectively in 1992 than they would have been without deregulation. Further, the employment of transportation workers was more than 42 percent lower in 1992 than it would have been in the absence of deregulation. However, to the extent that revenue ton-miles were increased from deregulation the impacts may have been smaller. Table A1 of the appendix shows ordinary least squares estimation results of the same equation. The results of the impacts of deregulation on employment are very similar.[13] The increased rate of decline of rail employment following

[13]Table A2 introduces a correction for autocorrelation using the Cochrane-Orcutt procedure. The results are nearly identical to the estimation without such a correction. Moreover, corrections for second and third order autocorrelation did not alter the results, either.

deregulation may be the result of increased productivity (since output is controlled for in the estimation), reduced bargaining power by rail labor unions due to the increased intensity of competition realized by railroads, and/or the result of a reduction in the obligation of railroads to serve unprofitable markets. In order to gain further understanding of the deregulatory impacts influencing rail labor, a similar model is estimated that allows for changing output elasticity of employment over time and measures the effects of changing intermodal competition on employment. Table 2 shows the estimation of employment of maintenance of way workers, maintenance of equipment workers, and transportation workers with this new specification. As the table shows, the estimation suggests that the output elasticity of labor has been decreasing over time suggesting improvements in labor productivity over time. The table also shows that deregulation caused a large one-time increase in productivity, as output elasticity of labor to decreased greatly in 1980. Moreover, this rate of labor productivity growth increased with deregulation, as the rate of decline of output elasticity accelerated. Finally, the average truck rate of intercity carriers is shown to have a positive influence on railroad employment in all three equations. This suggests that to the extent that trucking deregulation had a negative influence on truck rates, railroad employment was reduced even further. This is not unexpected as a reduction in intercity truck rates would heighten the level of intermodal competition experienced by railroads, and in turn reduce rents available to railroads for sharing with labor. An ordinary least

Table 2: 3sls Estimation of Employment in the Class I Railroad Industry (1960-1992)

	ln Maintenance of Way Employment	**ln Maintenance of Equipment Employment**	**ln Transport. Employment**
Intercept	-3.4555 (6.4347)	-18.0562* (5.5154)	-2.6347 (3.5124)
ln Earnings per worker (for that type of worker)	0.2506*** (0.1301)	-0.0640 (0.1266)	0.0079 (0.0597)
ln Fuel Price	0.0136 (0.0620)	-0.0608 (0.0524)	-0.0288 (0.0352)
ln Materials and Supply Price	0.8155* (0.2136)	0.9738* (0.1807)	0.4779* (0.1207)
ln Revenue Ton-Miles	0.2610 (0.1807)	0.9093* (0.1532)	0.4074* (0.1010)
ln Rev. Ton-Miles*Time	-0.0008* (0.0002)	-0.0017* (0.0002)	-0.0012* (0.0001)
ln Rev. Ton-Miles*Deregulation	-0.0070* (0.0019)	-0.0052* (0.0015)	-0.0067* (0.0010)
ln Rev. Ton-Miles*(Time-20) *Deregulation	-0.0002 (0.0004)	-0.0006 (0.0004)	-0.0005** (0.0002)
ln Truck Rate	0.5025* (0.2339)	0.5526* (0.1930)	0.6140* (0.1321)
DW Statistic[14]	1.87	2.27	2.38

System weighted $R^2 = 0.9946$
System weighted MSE = .8926
standard errors in parentheses
*significant at the 1% level, **significant at the 5% level, *** significant at the 10% level

[14]The DW statistic is in the inconclusive range for autocorrelation for all three types of labor.

squares estimation of this equation in Table A3 shows similar results.[15] In summary of the two aggregate estimations, the results suggest that rail employment has in fact been reduced by railroad and trucking deregulation. Moreover, the impacts of deregulation on railroad labor have been large. The first estimation showed that employment in the three types of occupations in the rail industry was between 33 and 43 percent lower in 1992 as a result of deregulation. Furthermore, the second estimation showed that deregulation resulted in large gains in labor productivity as is evident in examining the interaction terms between deregulation and revenue ton-miles, and deregulation, revenue ton-miles, and time. Table 3 shows the estimated rate of growth of marginal product of labor (using employment as the input rather than hours) for 1960-1992. Marginal product of labor is estimated as:

$$MPL = \left[\frac{\delta \ln N}{\delta \ln Q} * \frac{N}{Q} - 1\right]$$

$$\frac{\delta \ln N}{\delta \ln Q} = \beta_1 + \beta_2 * Time + \beta_3 * Deregulation + \beta_4 * (Time - 20) * Deregulation$$

β_1 = *parameter estimate for revenue ton-miles*

β_2 = *parameter estimate for RTM/time interaction term*

β_3 = *parameter estimate for RTM/Dereg interaction term*

β_4 = *parameter estimate for RTM/time/dereg interaction term*

[15] As Table A4 shows, the correction for autocorrelation using the Cochrane-Orcutt procedure does not change these results.

Table 3: Estimated Annual Rate of Growth of the Marginal Product of Labor

Period	Maintenance of Way Workers	Maintenance of Equipment Workers	Transportation Workers
1960-1979	4.2%	5.6%	5.6%
1980-1992	8.6%	10.3%	9.7%
1960-1992	6.0%	7.5%	7.2%

As the table shows, the marginal product of labor has grown at an increasing rate since deregulation. Finally, a third estimation is performed with the aggregate data, so that the indirect effects of deregulation on unionized rail employment can be highlighted. Table 4 shows the results of the last stage of the estimation of the recursive system.[16] As the table shows, with the exception of average length of haul, all variables measuring the indirect effects of deregulation on unionized railroad employment have the expected signs, and many are significant at conventional levels. Miles of road has a positive sign in all three employment equations and is significant at conventional levels for two of the equations. This suggests that an increase in obligations to serve markets increases employment, as expected. The average truck rate per ton-mile is positive and significant in all three equations. This suggests that a decrease in intermodal competition increases rail employment, presumably through its effect of increasing industry rents. The 4-firm concentration ratio has a positive sign and is nearly significant in the three equations. This is as expected, since increased industry concentration is likely to create increased industry rents leading to increased employment and earnings for unionized workers.

[16]The previous estimated stages of the recursive system are shown in Table A5 of the appendix. Table A6 shows the final stage of the recursive system with the Cochrane-Orcutt correction for autocorrelation. Again, the results are very similar.

Table 4: OLS Estimation of Employment in the Class I Railroad Industry (1960-1992) - Final Stage of a Recursive System of Equations

	ln Maintenance of Way Employment	ln Maintenance of Equipment Employment	ln Transport. Employment
Intercept	-12.5127***	-22.4122*	-9.0032***
	(7.2021)	(5.9817)	(4.3983)
ln Earnings per worker (for that type of worker)	0.1792***	0.0947	0.0355
	(0.1016)	(0.0931)	(0.0508)
ln Fuel Price	0.0567	0.0127	0.0119
	(0.0670)	(0.0547)	(0.0400)
ln Materials and Supply Price	0.7297*	0.9074*	0.4679*
	(0.1947)	(0.1595)	(0.1165)
ln Revenue Ton-Miles	0.1672	0.9287*	0.4374*
	(0.1561)	(0.1276)	(0.0933)
ln Miles of Road	0.6179***	0.4613	0.5428*
	(0.3176)	(0.2754)	(0.1886)
Deregulation	-0.1578**	-0.1017**	-0.1486*
	(0.0566)	(0.0463)	(0.0336)
Time	-0.0278**	-0.0442*	-0.0298*
	(0.0098)	(0.0081)	(0.0059)
ln Truck Rate	0.5001**	0.3914**	0.5583*
	(0.2224)	(0.1850)	(0.1339)
ln 4-Firm Concentration	0.2204	0.2275	0.1452
	(0.1668)	(0.1360)	(0.0994)
ln Average Length of Haul	0.9900***	0.2629	0.1463
	(0.5332)	(0.4360)	(0.3185)
ln Weight per Train	-0.2471	-0.7100**	-0.3645
	(0.3768)	(0.2998)	(0.2276)
DW Statistic[17]	1.90	2.46	2.32
Adjusted R-Square	.9828	.9959	.9971
S.E.E.	.0383	.0314	.0229

standard errors in parentheses
*significant at the 1% level, **significant at the 5% level, *** significant at the 10% level

[17]The DW statistic is in the inconclusive range for autocorrelation for all three types of labor.

Average weight per train has a negative sign and is significant at conventional levels for one of the equations. Increased efficiencies resulting from increased train sizes would be expected to decrease employment when total output is held fixed. Average length of haul has an unexpected sign, but is only significant for maintenance of way employment. While average length of haul would definitely be expected to have a negative sign for operating workers, reflecting the reduced number of crew members needed to provide a given number of ton-miles the longer the distance hauled, the sign of average length of haul is not so clear cut for maintenance of way employees. An increased length of haul may increase the need for high-speed tracks, creating increased maintenance needs and increased maintenance of way employment.

Table 5 summarizes the estimated direct and indirect effects of deregulation on unionized railroad employment from this recursive system of equations. The table shows the total effects of deregulation on railroad employment to be slightly lower than the previous estimation. However, part of this is due to the fact that the indirect effect of deregulation on employment through revenue ton-miles was not considered in that estimation. Another reason for this is that deregulation's impacts on productivity over time are not fully captured by this estimation.[18] Table 5 shows that the reduced obligation to serve unprofitable markets that accompanied deregulation had a large negative impact on unionized railroad employment, ranging between 14 percent for maintenance of

[18]A time/deregulation interaction term is not included in the estimation in Table 4 because of severe collinearity between the interaction term and the variables of interest. Nonetheless, the estimation sheds light on the various factors influenced by deregulation that in turn influenced employment in the railroad industry.

Table 5: Estimated Direct and Indirect Effects of Deregulation on Employment in the Class Railroad Industry (Percent Change in Employment Due to Deregulation)

	Maintenance of Way Employment		ln Maintenance of Equipment Employment		ln Transport. Employment	
	1980	1992	1980	1992	1980	1992
Revenue Ton-Miles	-0.3%	2.1%	-1.7%	11.6%	-0.8%	5.5%
Miles of Road	-3.0%	-18.3%	-2.2%	-13.7%	-2.6%	-16.1%
Truck Rate	4.8%	-9.5%	3.8%	-7.4%	5.4%	-10.6%
4-Firm Concentration	0.1%	10.8%	0.1%	11.2%	0.1%	7.1%
Average Length of Haul	0.9%	8.9%	0.2%	2.4%	0.1%	1.3%
Weight per Train	-2.3%	-4.1%	-6.5%	-11.8%	-3.3%	-6.0%
Deregulation	-14.6%	-14.6%	-9.7%	-9.7%	-13.8%	-13.8%
Total Direct and Indirect	-15.3%	-24.7%	-16.0%	-17.4%	-14.9%	-32.6%

equipment employees to 18 percent for maintenance of way employees. The table also shows that increasing train size and decreased truck rates resulting from deregulation had large negative impacts on unionized railroad employment. Indirect effects of deregulation on employment that were positive included the impacts of increasing industry concentration, increasing industry output, and increased average length of haul.

A final observation regarding these three estimations is that some mild support is shown for the efficient bargains model of unions in these estimations. While examining the relationship between earnings and employment in these estimations is not a great test for bargaining structure, the findings (no negative/significant parameter estimates on earnings in any equation and a positive/significant sign on earnings for maintenance of way workers in Tables 2 and 4) do not support the expected strong negative wage/employment relationship predicted by the monopoly bargaining model.

The next model examines the impacts of deregulation on individual worker earnings. Table 6 shows the results of an estimation of the variation in weekly earnings of white male union railroad workers in transportation occupations. As the table shows, the initial effect of deregulation is positive, but not statistically significant. However, while the initial effect of deregulation is not statistically significant, the negative trend in weekly earnings that was occurring prior to deregulation turned into a statistically significant positive trend following deregulation. For all transport operating occupations, the results suggest that by 1991, the weekly earnings of transport operating employees were more than 26 percent higher than they would have been without deregulation, and only 1.1 percent lower in real terms than they were in 1973, when controlling for personal characteristics.[19] A step function estimation of the weekly earnings of transport operating employees is shown in Table A7 of the appendix.[20] As the table shows, while the trend in the weekly earnings of operating employees is not completely consistent, the results still support the idea that weekly earnings have increased since

[19]1991 weekly earnings relative to 1973 earnings are e**[(-.0136*18) +(.0377) + (.0178*11)]-1.

[20]The precision of the step function estimates is limited by the small portion of observations falling in a given year. However, the null hypothesis that the restrictions imposed by the time trend model are appropriate is rejected at the 5 percent level.

$$F = \frac{(247.10568 - 244.12559)/14}{244.12559/2043} = 1.78$$

Thus, some caution must be used in interpreting the time-trend results.

Table 6: Weekly Earnings of Railroad Transport Operators

Variable	All Transport Operating Occ.	Engineers and Conductors	Brakemen and Switchmen
Intercept	6.0782* (0.0805)	6.2613* (0.1106)	6.0324* (0.1174)
Education	0.0091*** (0.0049)	-0.0013 (0.0063)	0.0132*** (0.0075)
Experience	0.0187* (0.0034)	0.0238* (0.0048)	0.0097** (0.0049)
Experience Squared	-0.0003* (0.00006)	-0.0005* (0.00009)	-0.0002*** (0.0001)
Married	0.0149 (0.0218)	0.0003 (0.0289)	0.0376 (0.0320)
Northeast	-0.1321* (0.0247)	-0.1428* (0.0304)	-0.1681* (0.0436)
South	-0.0243 (0.0200)	-0.0109 (0.0269)	-0.0288 (0.0289)
West	0.1170* (0.0205)	0.1165* (0.0274)	0.1351* (0.0299)
SMSA	-0.0536* (0.0161)	-0.0515** (0.0212)	-0.0603** (0.0239)
Time (Year-1973)	-0.0136 (0.0090)	-0.0248*** (0.0132)	-0.0048 (0.0117)
Deregulation (1980=1,...1991=1)	0.0377 (0.0468)	0.0639 (0.0679)	0.0151 (0.0618)
(Time-7)* Deregulation	0.0178*** (0.0097)	0.0303** (0.0139)	0.0032 (0.0129)
	N=2069 Adjusted R^2 = .0799 S.E.E. = .3466 DW = 2.03	N=1279 Adjusted R^2 = .0842 S.E.E. = .3579 DW = 2.01	N=790 Adjusted R^2 = .0897 S.E.E. = .3154 DW = 1.99

standard errors in parentheses
*significant at the 1% level, **significant at the 5% level, *** significant at the 10% level

deregulation and that they have increased over time since deregulation.[21]

For engineers and conductors, the impact of deregulation was even larger. Table 6 shows that white male union workers in these occupations had weekly earnings that were nearly 49 percent higher in 1991 than they would have been in the absence of deregulation. Furthermore, weekly earnings in these occupations were only 4.8 percent lower in 1991 than they were in 1973. Table A7 shows the estimation of engineer and conductor earnings using a step function.[22] Like the estimation for all transport operating occupations, the step function estimates show a general increase in weekly earnings of engineers and conductors from deregulation and an increase over time after deregulation, although the trend does not show a steady increase.[23]

In the case of brakemen and switchmen, there are no significant impacts on weekly earnings from deregulation.[24] These differences in the impacts of deregulation on different

---

[21]Weekly earnings were nearly 21 percent lower in 1979 than they were in 1973, 14.4 percent lower in 1980 than in 1973, and only 1.2 percent lower in 1989 than in 1973 (although they decreased to 8 percent lower than 1973 in 1991). Further, on average weekly earnings were 8.8 percent lower than in 1973 from 1974 to 1979, and only 6.7 percent lower than in 1973 from 1980 to 1991.

[22]In the case of engineers and conductors, an F-test fails to reject the null hypothesis that the restrictions imposed by the time trend model are appropriate.

$$F = \frac{(162.24726 - 159.35852)/14}{159.35852/1253} = 1.62$$

[23]Weekly earnings were more than 25 percent lower in 1977 and 1979 than they were in 1973, 15.8 percent lower in 1980 than in 1973, 6.8 percent lower in 1989 than in 1973, and 10.2 percent lower in 1991 than in 1973. On average, weekly earnings were 13.4 percent lower than in 1973 from 1974 to 1979, and 10.6 percent lower than in 1973 from 1980 to 1991.

[24]Table A7 also shows a step function estimation of the weekly earnings for brakemen and switchmen. The F-test rejects the null hypothesis that the restrictions imposed by the time

occupations suggest that deregulation has had a broader impact on rail labor than through its effect on union bargaining power and rent sharing. As Talley and Schwarz-Miller's review of collective bargaining in the rail industry suggests, the major rail unions have generally negotiated as a group with the major representative of the railroads (the National Railway Conference). If deregulation's only impact on labor was through its impact on rent sharing and union bargaining power, such a comprehensive union bargaining structure would suggest that the impacts of deregulation on earnings should be fairly uniform across occupations. However, deregulation's potentially asymmetric effects on productivity across occupations suggests the potential for asymmetric effects on earnings. Moreover, the direction of the asymmetric effects appears plausible. Brakemen's and switchmen's earnings are not affected much by deregulation, while engineer's and conductor's earnings show a strong positive influence from deregulation. In many cases, technological innovations put into use since deregulation have allowed the engineers and conductors to perform the duties previously performed by brakemen and switchmen, while still performing their own duties.[25] Thus, the large productivity gains realized by engineers and conductors relative to brakemen and switchmen suggest a much larger increase in earnings resulting from deregulation.

Finally, while the estimation for all transport operating occupations showed a change in the trend of weekly earnings following deregulation, it is possible that such impacts could be a reflection of business cycle fluctuations or some other economic phenomenon that similarly impacted the earnings of workers outside the rail industry. In order to test whether the

---

trend model are appropriate in this case at the 5 percent level.

[25]These innovations have included remote control units, push and pull service to eliminate switching, dynamic braking systems, and others.

deregulation-earnings relationship is spurious, yearly wage equations are estimated for white male union workers in operating occupations in the railroad and manufacturing industries with an intercept shift term to measure the railroad weekly earnings premium. The inverse of the variance of each estimation is used to weight these premiums in calculating a pre-deregulation and post-deregulation weighted average premium.[26]

Table 7 shows the weighted average premium before and after deregulation. As the table shows, the weekly earnings premium in the rail industry was high for the entire 1973-1991 period, at 37 percent. Moreover, the earnings premium increased from approximately 32.3 percent before deregulation to nearly 41 percent after deregulation, although the change is not statistically significant at conventional levels.[27] These findings are consistent with those of Hendricks, and are also potentially consistent with the estimated wage equation for railroad transport operators in Table 6. In order to examine the consistency of the weekly earnings equation shown in Table 6 with the estimated rail-manufacturing differential, the yearly differentials are regressed on time, deregulation, and (time-7)*deregulation. As Table 8 shows, the results are remarkably similar to those for the weekly earnings equation. However, the deregulation shift variable is now significant at the 10 percent level. These findings suggest that the initial impact of deregulation was a 10.4 percent increase in railroad operator wage premiums when compared to manufacturing operators. Moreover, wage premiums were more than 60

---

[26]This same procedure was used by Hendricks (1994).

$$t = \frac{Diff_{dereg} - Diff_{reg}}{[VAR_{dereg} + VAR_{reg}]} = 1.32$$

[27]

percentage points higher in 1991 than they would have been in the absence of deregulation. These findings suggest that while the general pattern of changes of weekly earnings of railroad workers was similar to that of changes in the railroad-manufacturing differential, the weekly

Table 7: Estimated Wage Premiums for Railroad Operating Workers Over Workers in Operating Occupations in Manufacturing

Period	Estimated Differential	Percentage Differential
1973-1979	0.2796 (0.0364)	32.3%
1980-1991	0.3424 (0.0308)	40.8%
1973-1991	0.3146 (0.0333)	37.0%

- Estimated differentials are the variance weighted average differentials estimated in yearly wage equations (yearly average differentials are .3210, .2811, .3226, .3110, .2290, .3343, .1052, .2602, .2470, .3231, .3526, .4005, .3337, .3890, .3412, .4034, .3825, and .3646 for 1973 through 1991, respectively)
- The standard errors in parentheses are also the variance weighted average standard errors
- Yearly wage equations use Ed, Exp, Exp^2, Married, SMSA, Region, and a RR dummy
- Sample is prime aged, white male union workers

Table 8: Estimation of Wage Premiums of Railroad Workers Over Manufacturing Workers (1973-1991)

Variable	Parameter Estimate
Intercept	0.3400* (0.0351)
Time	-0.0227** (0.0097)
Deregulation (1980=1,...1991=1)	0.0986*** (0.0532)
(Time-7)* Deregulation	0.0339* (0.0107)

Adjusted R^2 = 0.5033
S.E.E. = 0.0515
standard errors in parentheses
*significant at the 1% level, **significant at the 5% level, *** significant at the 10% level

earnings equation may understate the earnings increases felt by railroad workers following deregulation.

In summary of the estimations with individual earnings data, the results suggest that the earnings of those in operating occupations were gradually declining prior to deregulation, but then began a gradual increase after deregulation. This type of pattern in earnings is not necessarily surprising. Given the large gains in railroad profitability, one would expect increased rent sharing by labor. Moreover, large productivity gains resulting from a reduction in obligations to serve unprofitable routes, increased pricing flexibility allowing greater shipment size and distance, and from eased merger restrictions created large gains in weekly earnings that have exceeded any reductions that may have been felt from increasing competitive pressures.

SUMMARY AND CONCLUSIONS

Several recent trends in policy and industry structure have drawn a renewed interest in the regulations governing the railroad industry. These trends have included the recent mega-mergers of the Burlington Northern and Sante Fe railroads and the Union Pacific and Southern Pacific Railroads, the Congressional focus on removing regulations that it perceives as burdensome and unnecessary, and the Surface Transportation Board's efforts to stream line regulations governing the railroads. Moreover, recent complaints before the Surface Transportation Board regarding pricing and service, and the recent formation of shipper groups seeking regulatory change suggest that interest in the regulations that affect the railroad industry is intense. A thorough understanding of the impacts of regulatory change will enable policy makers to consider such impacts before making further regulatory change.

This study is the first of a series of two that examines issues related to regulatory change in the rail industry. In examining the impacts of 1980 railroad and trucking deregulation on unionized railroad labor, the study finds decreased employment and increased earnings resulting from deregulation. Further, the study finds large weekly earnings premiums of unionized rail operating employees over unionized operating employees in manufacturing. Moreover, in contrast to the experience in the trucking industry, these premiums do not vanish as a result of deregulation.

The results of the study suggest that the increased flexibility provided to railroads as a result of deregulation, including a decrease in obligations to serve unprofitable markets, has resulted in increased labor productivity and earnings, although much of the increase in labor productivity was the result of a reduction in employees. Moreover, the study finds that the employment reductions from deregulation were the result of decreased obligations to serve unprofitable markets, decreased truck rates, and increased train sizes.

REFERENCES

Bitzan, J.D. "Railroad Deregulation: Impacts on Rates and Profitability." UPPER GREAT PLAINS TRANSPORTATION INSTITUTE Staff Paper No. 122. Upper Great Plains Transportation Institute, Fargo, 1994.

Bitzan, J., Honeyman, J., Tolliver, D. and K. Casavant. "The Impact of Railroad Restructuring on Rural and Agricultural America." Unpublished United States Department of Agriculture Report, 1995.

Card, D. "The Impact of Deregulation on the Employment and Wages of Airline Mechanics," *Industrial and Labor Relations Review*, 39(4): 527-38, 1986.

Dooley, F.J., Wilson, W.W., Benson, D.E., and D.D. Tolliver. "Post Staggers Productivity for Class I Railroads." MPC Report No. 91-6. Mountain Plains Consortium, Fargo, 1991.

Friedlaender, A.F. *The Dilemma of Freight Transport Regulation*. Washington, DC: The Brookings Institution, 1969.

Friedlaender, A.F. and R. H. Spady. *Freight Transport Regulation: Equity, Efficiency, and Competition in the Rail and Trucking Industries*. Cambridge, MA: The MIT Press, 1980.

General Accounting Office. *Railroad Regulation - Economic and Financial Impacts of the Staggers Rail Act of 1980: Report to Congressional Requesters*. Washington, DC: U.S. General Accounting Office, 1990.

Heywood, J. "Market Structure and the Demand for Unionized Labor," *Southern Economic Journal*, 56(3): 607-615, 1990.

Hendricks, W. "Deregulation and Labor Earnings," *Journal of Labor Research*, 15(3): 207-34, 1994.

Hsing, Y. and F.G. Mixon, Jr. "The Impact of Deregulation on Labor Demand in Class I Railroads," *Journal of Labor Research*, 16(1): 1-8, 1995.

Macavoy, P.W. and J.W. Snow, eds. *Railroad Revitalization and Regulatory Reform*. Washington, D.C.: American Enterprise Institute, 1977.

MacDonald, J.M. *Effects of Railroad Deregulation on Grain Transportation*. Washington, D.C.: United States Department of Agriculture, Economic Research Service, 1989.

Moore, T.G. *Freight Transportation Regulation, Surface Freight and the Interstate Commerce Commission*. Washington, D.C.: American Enterprise Institute, 1972.

National Economic Research Associates. *Lessons for Interstate Gas Pipelines from Railroad Deregulation*. White Plains, N.Y.: NERA, 1986.

Oswald, A.J. "The Economic Theory of Trade Unions: An Introductory Survey." *Scandinavian Journal of Economics,* 87(2): 160-93, 1985.

Talley, W.K. and A. Schwarz-Miller. "Railroad Deregulation and Union Labor Earnings," forthcoming in *Regulatory Reform & Labor Markets*, ed. by James Peoples, Kloewer Academic Publishers, Boston.

Wilson, W.W. "Asymmetric Effects of Deregulation." UPPER GREAT PLAINS TRANSPORTATION INSTITUTE Publication No. 92. Upper Great Plains Transportation Institute, Fargo, 1992.

Winston, C. "Economic Deregulation: Days of Reckoning for Microeconomists." *Journal of Economic Literature*, 31(3): 1263-89, 1993.

Winston, C., Corsi, T., Grimm, C., and J. Evans. *The Economic Effects of Surface Freight Deregulation*. Washington, D.C.: Brookings Institution, 1990.

APPENDIX

Table A1: OLS Estimation of Employment in the Class I Railroad Industry (1960-1992)

	ln Maintenance of Way Employment	**ln Maintenance of Equipment Employment**	**ln Transport. Employment**
Intercept	8.4213*** (4.7967)	-9.9200*** (4.9613)	8.5902** (3.4970)
ln Earnings per worker (for that type of worker)	0.0342 (0.1104)	-0.0483 (0.1320)	-0.0859 (0.0699)
ln Fuel Price	0.0517 (0.0586)	-0.0192 (0.0565)	0.0176 (0.0437)
ln Materials and Supply Price	0.5159* (0.1817)	0.7583* (0.1792)	0.1795 (0.1358)
ln Revenue Ton-Miles	0.0073 (0.1513)	0.6998* (0.1490)	0.1459 (0.1121)
Time	-0.0129* (0.0051)	-0.0430* (0.0056)	-0.0270* (0.0036)
Deregulation (1980=1,...1992=1)	-0.1264** (0.0459)	-0.1083** (0.0438)	-0.1302* (0.0340)
(Time-20)*Deregulation	-0.0296* (0.0084)	-0.0298* (0.0097)	-0.0362* (0.0061)
DW Statistic[28]	1.44	1.54	1.33
Adjusted R-Square	.9807	.9935	.9949

standard errors in parentheses
*significant at the 1% level, **significant at the 5% level, *** significant at the 10% level

[28]The DW statistic is in the inconclusive range for autocorrelation for all three types of labor.

Table A2: Estimation of Employment in the Class I Railroad Industry with the Cochrane-Orcutt Correction for Autocorrelation (1960-1992)

	ln Maintenance of Way Employment	**ln Maintenance of Equipment Employment**	**ln Transport. Employment**
Intercept	7.2247 (4.9785)	-10.2949*** (5.0684)	7.2659*** (3.6389)
ln Earnings per worker (for that type of worker)	0.0333 (0.1135)	-0.0199 (0.1354)	-0.0730 (0.0730)
ln Fuel Price	0.0691 (0.0581)	0.0020 (0.0557)	0.0226 (0.0415)
ln Materials and Supply Price	0.4834** (0.1847)	0.7263* (0.1828)	0.1947 (0.1363)
ln Revenue Ton-Miles	0.0554 (0.1597)	0.7062* (0.1562)	0.1868 (0.1191)
Time	-0.0147* (0.0052)	-0.0446* (0.0056)	-0.0286* (0.0037)
Deregulation (1980=1,...1992=1)	-0.1329** (0.0477)	-0.1210** (0.0455)	-0.1273* (0.0351)
(Time-20)*Deregulation	-0.0279* (0.0088)	-0.0266** (0.0100)	-0.0347* (0.0066)
DW Statistic[29]	1.61	1.79	1.68
Adjusted R-Square	.9802	.9929	.9935
S.E.E.	0.0406	0.0390	0294
Rho	-0.1660 (0.2013)	-0.1946 (0.2002)	-0.2824 (0.1958)

standard errors in parentheses
*significant at the 1% level, **significant at the 5% level, *** significant at the 10% level

[29]The DW statistic is in the inconclusive range for autocorrelation for all three types of labor.

Table A3: OLS Estimation of Employment in the Class I Railroad Industry (1960-1992)

	ln Maintenance of Way Employment	ln Maintenance of Equipment Employment	ln Transport. Employment
Intercept	1.3237 (5.8655)	-19.6134* (5.4059)	-1.4591 (3.4015)
ln Earnings per worker (for that type of worker)	0.0793 (0.1088)	-0.0021 (0.1190)	-0.0311 (0.0547)
ln Fuel Price	0.0189 (0.0586)	-0.0608 (0.0524)	-0.0275 (0.0347)
ln Materials and Supply Price	0.7050* (0.1984)	1.0082* (0.1791)	0.4477* (0.1178)
ln Revenue Ton-Miles	0.1752 (0.1682)	0.9365* (0.1520)	0.3862* (0.0989)
ln Rev. Ton-Miles*Time	-0.0006* (0.0002)	-0.0017* (0.0002)	-0.0012* (0.0001)
ln Rev. Ton-Miles*Deregulation	-0.0058* (0.0017)	-0.0054* (0.0015)	-0.0064* (0.0010)
ln Rev. Ton-Miles*(Time-20) *Deregulation	-0.0006 (0.0004)	-0.0004 (0.0004)	-0.0006* (0.0002)
ln Truck Rate	0.4204*** (0.2339)	0.5663* (0.1928)	0.5926* (0.1297)
DW Statistic[30]	1.76	2.27	2.34
Adjusted R-Square	.9824	.9949	.9971
S.E.E.	.0388	.0348	.0230

standard errors in parentheses
*significant at the 1% level, **significant at the 5% level, *** significant at the 10% level

[30]The DW statistic is in the inconclusive range for autocorrelation for all three types of labor.

Table A4: Estimation of Employment in the Class I Railroad Industry with the Cochrane-Orcutt Correction for Autocorrelation (1960-1992)

	ln Maintenance of Way Employment	ln Maintenance of Equipment Employment	ln Transport. Employment
Intercept	1.3530 (6.0084)	-20.8183* (5.2167)	-2.2110 (3.2311)
ln Earnings per worker (for that type of worker)	0.0773 (0.1115)	-0.0090 (0.1140)	-0.0222 (0.0512)
ln Fuel Price	0.0225 (0.0598)	-0.0880 (0.0516)	-0.0384 (0.0341)
ln Materials and Supply Price	0.6943* (0.2029)	1.0869* (0.1730)	0.4869* (0.1138)
ln Revenue Ton-Miles	0.1773 (0.1728)	0.9634* (0.1445)	0.3985* (0.0926)
ln Rev. Ton-Miles*Time	-0.0006* (0.0002)	-0.0017* (0.0002)	-0.0012* (0.0001)
ln Rev. Ton-Miles*Deregulation	-0.0058* (0.0018)	-0.0052* (0.0014)	-0.0066* (0.0010)
ln Rev. Ton-Miles*(Time-20) *Deregulation	-0.0006 (0.0004)	-0.0004 (0.0004)	-0.0006* (0.0002)
ln Truck Rate	0.4117*** (0.2252)	0.6504* (0.1811)	0.6504* (0.1219)
DW Statistic[31]	1.78	2.19	2.15
Adjusted R-Square	.9863	.9973	.9985
S.E.E.	.0396	.0347	.0229
Rho	-0.0240 (0.2085)	0.1701 (0.2055)	0.1871 (0.2048)

standard errors in parentheses
*significant at the 1% level, **significant at the 5% level, *** significant at the 10% level

[31]The DW statistic is in the inconclusive range for autocorrelation for all three types of labor.

Table A5: First Stages of Recursive System to Estimate the Direct and Indirect Effects of Deregulation on Employment in the Class I Railroad Industry (1960-1992)

	Dependent Variable					
	Miles of Road	**Revenue Ton-Miles**	**Truck Rate**	**4-Firm Concentration**	**Average Length of Haul**	**Weight per Train (Tons)**
Intercept	12.0903*	24.0637*	4.1700*	2.3508*	5.8266*	6.6762*
	(0.2548)	(0.4363)	(0.4924)	(0.7590)	(0.2257)	(0.2838)
Deregulation	-0.0489*	-0.0187	0.0921*	0.0044	0.0090	0.0875*
	(0.0154)	(0.0263)	(0.0297)	(0.0458)	(0.0136)	(0.0171)
Time	-0.0098*	-0.0118**	0.0104***	0.0066	0.0101*	0.0099*
	(0.0029)	(0.0050)	(0.0056)	(0.0086)	(0.0026)	(0.0032)
(Time-20)	-0.0252*	0.0114*	-0.0252*	0.0330*	0.0065*	0.0055**
*Dereg	(0.0020)	(0.0035)	(0.0039)	(0.0060)	(0.0018)	(0.0023)
Industrial	0.0443	0.8249*	-0.2741**	0.2662	0.0842	0.1731**
Production	(0.0688)	(0.1179)	(0.1330)	(0.2051)	(0.0610)	(0.0767)
Adjusted	0.9893	0.9608	0.6454	0.9489	0.9859	0.9882
R^2	0.0198	0.0339	0.0383	0.0590	0.0176	0.0221
SEE						

standard errors in parentheses
*significant at the 1% level, **significant at the 5% level, *** significant at the 10% level

Table A6: Estimation of Employment in the Class I Railroad Industry (1960-1992)
- Final Stage of a Recursive System of Equations (with Autocorrelation Correction)

	ln Maintenance of Way Employment	**ln Maintenance of Equipment Employment**	**ln Transport. Employment**
Intercept	-12.9964*** (7.3081)	-25.2917* (5.6849)	-10.3723** (4.2005)
ln Earnings per worker (for that type of worker)	0.1787*** (0.1033)	0.0770 (0.0888)	0.0339 (0.0482)
ln Fuel Price	0.0508 (0.0687)	-0.0173 (0.0544)	-0.0015 (0.0403)
ln Materials and Supply Price	0.7444* (0.1990)	0.9896* (0.1558)	0.5065* (0.1151)
ln Revenue Ton-Miles	0.1633 (0.1581)	0.9481* (0.1190)	0.4430* (0.0881)
ln Miles of Road	0.6288*** (0.3251)	0.5331*** (0.2752)	0.5541* (0.1880)
Deregulation	-0.1576** (0.0579)	-0.0890** (0.0458)	-0.1499* (0.0336)
Time	-0.0282** (0.0100)	-0.0455* (0.0075)	-0.0313* (0.0056)
ln Truck Rate	0.5154** (0.2276)	0.4551** (0.1831)	0.6042* (0.1335)
ln 4-Firm Concentration	0.2190 (0.1704)	0.2335*** (0.1331)	0.1498 (0.0980)
ln Average Length of Haul	1.0221*** (0.5456)	0.3680 (0.4321)	0.2089 (0.3180)
ln Weight per Train	-0.2238 (0.3831)	-0.6418** (0.2874)	-0.3080 (0.2202)
DW Statistic	1.89	2.36	2.21
Adjusted R-Square	.9893	.9981	.9986
S.E.E.	.0392	.0313	.0231
Rho	0.0275 (0.2235)	0.1746 (0.2202)	0.1620 (0.2207)

standard errors in parentheses
*significant at the 1% level, **significant at the 5% level, *** significant at the 10% level

Table A7: Weekly Earnings of Railroad Transport Operators

Variable	All Transport Operating Occ.		Engineers and Conductors		Brakemen and Switchmen	
	Parameter Estimates	Implied Step Size	Parameter Estimates	Implied Step Size	Parameter Estimates	Implied Step Size
Intercept	6.1202*		6.2955*		6.0918*	
	(0.0865)		(0.1198)		(0.1252)	
Education	0.0082***		-0.0006		0.0104	
	(0.0049)		(0.0064)		(0.0077)	
Experience	0.0180*		0.0231*		0.0090***	
	(0.0034)		(0.0048)		(0.0049)	
Experience Squared	-0.0003*		-0.0004*		-0.0002***	
	(0.0001)		(0.0001)		(0.0001)	
Married	0.0145		-0.0018		0.0364	
	(0.0218)		(0.0290)		(0.0320)	
Northeast	-0.1342*		-0.1492*		-0.1652*	
	(0.0247)		(0.0305)		(0.0436)	
South	-0.0262		-0.0173		-0.0318	
	(0.0201)		(0.0270)		(0.0291)	
West	0.1147*		0.1109*		0.1310*	
	(0.0206)		(0.0275)		(0.0299)	
SMSA	-0.0523*		-0.0505**		-0.0569**	
	(0.0162)		(0.0213)		(0.0239)	
D1974	-0.0687	-6.6%	-0.0633	-6.1%	-0.0831	-8%
	(0.0624)		(0.0889)		(0.0828)	
D1975	-0.0627	0.6%	-0.0511	1.2%	-0.0747	0.8%
	(0.0601)		(0.0874)		(0.0776)	
D1976	-0.0581	0.4%	-0.1754***	-11.1%	0.0410	11.4%
	(0.0631)		(0.0953)		(0.0788)	
D1977	-0.1292**	-6.5%	-0.2925*	-9.3%	0.0369	-0.4%
	(0.0606)		(0.0868)		(0.0795)	
D1978	-0.0032	11.8%	0.0138	26.8%	-0.0296	-6.7%
	(0.0577)		(0.0840)		(0.0747)	

Table A7: Weekly Earnings of Railroad Transport Operators

Variable	All Transport Operating Occ.		Engineers and Conductors		Brakemen and Switchmen	
	Parameter Estimates	Implied Step Size	Parameter Estimates	Implied Step Size	Parameter Estimates	Implied Step Size
D1979	-0.2320*	-20.4%	-0.2956**	-27.0%	-0.1761**	-13.2%
	(0.0800)		(0.1240)		(0.0985)	
D1980	-0.1552***	6.3%	-0.1715	9.8%	-0.1865	-0.9%
	(0.0813)		(0.1113)		(0.1135)	
D1981	-0.1579**	-0.2%	-0.1588	1.1%	-0.1838**	0.2%
	(0.0790)		(0.1110)		(0.1058)	
D1983	-0.0888***	6.1%	-0.1350***	2.1%	-0.0684	10.2%
	(0.0489)		(0.0696)		(0.0656)	
D1984	-0.0553	3.1%	-0.1330***	0.2%	0.0112	7.7%
	(0.0486)		(0.0688)		(0.6557)	
D1985	-0.0059	4.8%	-0.0579	6.8%	0.0144	0.3%
	(0.0497)		(0.0706)		(0.0664)	
D1986	-0.0745	-7.0%	-0.1209***	-5.8%	-0.0791	-9.1%
	(0.0496)		(0.0697)		(0.0682)	
D1987	-0.0210	5.1%	-0.0905	2.7%	0.0263	10.3%
	(0.0502)		(0.0698)		(0.0706)	
D1988	-0.0535	-3.1%	-0.0939	-0.3%	-0.0544	-8.0%
	(0.0504)		(0.0707)		(0.0694)	
D1989	-0.0122	4.0%	-0.0705	2.2%	-0.0103	4.3%
	(0.0512)		(0.0713)		(0.0721)	
D1990	-0.0501	-3.7%	-0.0870	-1.5%	-0.0663	-5.4%
	(0.0523)		(0.0732)		(0.0716)	
D1991	-0.0820	-3.0%	-0.1074	-1.9%	-0.1353**	-6.2%
	(0.0526)		(0.0730)		(0.0737)	
	N=2069		N=1279		N=790	
	Adjusted R^2 = .0848		Adjusted R^2 = .0905		Adjusted R^2 = .1031	
	S.E.E. = .3457		S.E.E. = .3566		S.E.E. = .3130	
	DW = 2.06		DW = 2.04		DW = 2.06	

standard errors in parentheses
*significant at the 1% level, **significant at the 5% level, *** significant at the 10% level