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Wages in Rail Markets: Deregulation, Mergers, and Changing Networks Characteristics

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The Staggers Act of 1980 largely deregulated the Class I Railroad industry and has had profound effects on labor. Between 1978 and 1994, employment in the industry decreased by about 60%, while real wages (average compensation) increased by over 40%. Earlier research examined employment effects; in this article, we develop and estimate compensation effects using firm-level data. By using firm-level data, we are able to identify the effects of partial deregulation, an accompanying and massive consolidation movement, as well as changes in firm operating and network characteristics. Our estimates suggest that mergers contributed 5–15%, partial deregulation contributed about 20%, and changes in firm operating and network characteristics contributed 4–5% to the overall increase in wages.

1. Introduction

Over the last 25 years, there has been significant regulatory reform in key infrastructure industries, including airlines, motor carriage, telecommunications, electricity, and railroad markets. Regulation is commonly thought to benefit labor employed in those markets (Rose 1987; Hendricks 1994; Card 1998). In such research, it is commonly held that regulation creates rents, a portion of which is appropriated by labor unions in the form of higher wages and, perhaps, employment. With deregulation, rents dissipate along with wages and possibly employment. Indeed, there is considerable evidence suggesting that deregulation reduces rents and, as a result, wages and employment have fallen in many of these industries.[1] However, as noted by Hendricks (1977, 1994), the effects of regulation and deregulation are market specific and depend critically on the regulatory process. Indeed, unlike other industries, partial deregulation of the railroad industry likely reduced inefficiencies and increased the level of rents available.[2]

In our previous study, we found that employment levels have decreased due to partial deregulation, mergers, and changing operating and network characteristics of firms (Davis and Wilson 1999). In this study, we examine average hourly earnings (total per hour compensation) for railroad workers and partial deregulation, finding that compensation rates have increased dramatically despite

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[1] See, for example, Cappelli (1985), Card (1986), Rose (1987), Hirsch (1988), Hendricks (1994), MacDonald and Cavalluzzo (1996), Hirsch and Macpherson (1998), Peoples (1998), Davis and Wilson (1999), and Talley (2001).

[2] As noted in Winston (1998), industry return on equity was less than 3% prior to partial deregulation, rising to 8% under partial deregulation.

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large decreases in employment. One hypothesis for this finding is that, under regulation, there were serious inefficiencies embedded in the industry, some of which were directly related to labor (e.g., inefficient work rules) while still other inefficiencies affected rail labor.[3] Under partial deregulation, both labor and regulatory impediments to efficiency were reduced, increasing labor productivity and resulting in the loss of employed labor. Thus, partial deregulation may have allowed for increased rents, some of which were shared with the labor that remains.

Partial deregulation of the railroad industry by the Staggers Act of 1980 allowed firms greater freedom to adjust rates, to merge with other firms, and to abandon or sell unprofitable lines. These freedoms allowed firms to change the structure of the industry and to alter their operating characteristics. There is now quite a lot of research on rates and costs in the industry resulting from these freedoms.[4] Generally, it is now widely held that costs have fallen dramatically as a result of partial deregulation and that rates are much lower due to partial deregulation, costs savings, and changes in the network and operating characteristics of firms.

Since partial deregulation, there have been associated and major effects on labor in the industry. From 1978 to 1994, industry employment decreased by 60%, while average firm employment increased by 33%. Accompanying these changes are a 43% increase in real average compensation and a reduction in the number of firms from 41 in 1978 to 12 in 1994 (American Association of Railroads, 1983–1994). The contraction of firms is largely the result of a massive consolidation movement since partial deregulation. Many studies have documented how partial deregulation affected industry costs, efficiency, and profits. Some studies have also examined the effects of these changes on the industry's labor markets (Hendricks 1994; MacDonald and Cavalluzzo 1996; Peoples 1998). Generally, these studies use either aggregate wage data or Consumer Population Survey data, which do not allow characteristics of the firm(s) to be embedded in the estimation. In this research, we extend previous research by identifying industry and firm-level variables, directly or indirectly associated with partial deregulation, that affect firm-level wages. These variables allow the effects of mergers, partial deregulation, and changes in firm characteristics/networks to be empirically identified. We find that mergers generally result in higher compensation, with an average marginal effect ranging from 7.5 to 15%, and that mergers contribute 5 to 15% of the overall increase in wages. Our estimates suggest partial deregulation accounts for about 20 to 23% of the increase in average compensation between 1978 and 1994. We find evidence that firm operating characteristics matter in the determination of average compensation. In particular, output, size of network, average length of haul, and the percentage of unit train traffic (i.e., bulk movements) each have effects on average compensation.

2. Background

Through the range of our data (described below), all firms with the exception of the Florida East Coast were governed by union work rules. Faced with coordinating a large industrial enterprise with workers who were often inexperienced and undisciplined, early railroads developed a system of

[3] For example, rate regulations pertaining to both the levels and form of volume rates reduced the proportion of traffic shipped over long hauls. Further, exit restrictions on unprofitable branch lines as well as merger restrictions likely increased the amount of labor employed.

[4] See Keeler (1983), Caves et al. (1985), McFarland (1989), Winston et al. (1990), Berndt et al. (1993), and Wilson (1994, 1997).

stringent and well-defined work rules. Subsequently, these work rules became, and remain, a central feature of railroad negotiations with unions.[5] These work rules govern the type of work that members do and dictate the number of workers in many jobs. Work rules mandate the number of crew members required to operate a train (Peoples 1998; Talley 2001). Work rules have also established the number of miles a train must travel to constitute a full workday (Peoples 1998; Talley 2001). Historically, unions have seen work rules as tools for maintaining job security, while firms have seen them as costly impediments to productivity.

Many studies have examined the impact of deregulation for unionized labor markets. Hendricks (1994) offers a concise description of several mechanisms that may be at work in regulated markets. He suggests that deregulation can have contrasting effects. For example, deregulation may introduce increased competition between firms, decreasing prices, and put downward pressure on wages. At the same time, deregulation may allow management a more efficient use of labor, increasing labor productivity. Improvements in productivity may be associated with increases in wages. In his study, Hendricks finds that, on average, rail earnings were positive relative to other manufacturing industries before and after deregulation. However, this differential vanished when worker characteristics and union density were included as explanatory variables in an earnings regression. Furthermore, Hendrick's plots of annual observations on rail earnings differentials suggest differentials were higher in the early 1980s than in the later 1980s.

MacDonald and Cavalluzzo (1996) examine railroad wages and regulation and find that rail wages followed a complex pattern after partial deregulation. The authors find that wage premiums initially increased after partial deregulation as unions successfully bargained for higher wages. The authors suggest that firms and unions expected increased profits after partial deregulation as firms were expected to raise rates. However, as firms customized their rates to conform to the cost structure of shipments, traffic shifted, labor demand fell, and negotiations turned less favorable to unions. Other researchers explicitly examine labor productivity in the railroad industry. Hsing and Mixon (1995) find that labor productivity accelerated after partial deregulation. They also suggest that employment become more wage elastic after partial deregulation. These results suggest that large employment declines should be associated with relatively small wage increases.

Present in these studies is the notion that partial deregulation allowed firms the freedom to adapt, to change or avoid work rules, and to respond to competition from other modes of transportation. For example, partial deregulation allowed firms unprecedented freedom to customize rate structures. Adjusting rates allowed firms to offer shippers incentives enticing them to consolidate shipments over longer distances in labor-saving unit trains, which allowed railroads to exploit unrealized economies of traffic density and service.[6] Mergers between firms, whether parallel or end-to-end, allowed for a more efficient network of track and improvements in efficiency and traffic density. Furthermore, partial deregulation allowed firms unprecedented freedom to abandon high-cost lines, again allowing for a more efficient track network.

These changes clearly affected labor, as several industry characteristics, especially employment, changed dramatically after partial deregulation. Total industry output increased modestly, and employment fell dramatically, translating into large increases in labor productivity (see Table 1). In the unionized railroad industry, the relationship between labor productivity and wages is not straightforward. Regulation required firms to service a number of unprofitable lines, and work rules

[5] As noted by Peoples (1998), "Railroad negotiations during the period of regulation were characterized by the unions' emphasis on work-rules" (p. 117).

[6] These effects are well documented. See, for example, MacDonald and Cavalluzzo (1996) for an excellent discussion.

Table 1. Industry Employment and Annual Industry Means

Year	Total Industry Employment	Mean Firm Employment	Wage	RTM (bill.)	Miles of Road	%UT	ALH	APL[a]	Alt. Wage	Equip. Price	Fuel Price	Mat. and Sup. Price	Number of Unions
1978	456,450	12,679	14.85	23.46	5065	5.89	326	925.18	8.81	15,693	0.54	105.99	11
1979	465,678	12,935	14.49	25.15	5030	7.50	322	972.21	8.48	14,994	0.71	116.20	10
1980	443,392	12,668	13.01	26.15	4994	9.54	313	1032.24	8.10	16,341	0.92	133.44	10
1981	415,621	11,875	13.74	25.98	4976	10.77	315	1093.74	8.15	19,829	1.04	143.34	9
1982	349,322	10,586	15.79	24.04	5176	7.97	324	1135.67	8.49	19,731	0.97	144.09	9
1983	302,613	11,208	17.19	30.51	6238	8.74	377	1360.98	8.74	17,866	0.84	138.68	9
1984	308,578	11,868	17.92	35.28	6338	9.96	383	1486.11	8.84	19,200	0.82	138.06	8
1985	298,084	13,549	17.50	39.84	7298	11.82	407	1470.23	9.26	21,803	0.76	143.25	8
1986	263,156	14,620	18.66	48.21	8638	14.17	403	1648.69	9.73	19,080	0.50	141.50	7
1987	239,979	14,116	19.71	55.44	8601	15.41	437	1963.82	9.62	20,697	0.52	134.31	6
1988	228,717	15,248	20.58	66.41	9384	15.67	450	2177.77	9.52	22,753	0.47	140.31	6
1989	219,213	14,614	20.62	67.59	9167	16.93	457	2312.41	9.36	24,644	0.50	148.01	6
1990	204,564	14,612	20.48	73.86	9514	19.14	448	2527.26	9.34	23,976	0.59	153.90	6
1991	193,194	13,800	20.54	74.21	9274	20.57	454	2688.69	9.56	26,724	0.58	175.30	6
1992	161,380	14,671	21.16	89.58	10,443	21.46	485	3052.88	9.79	27,266	0.54	187.17	5
1993	182,651	16,605	20.78	99.60	11,090	20.27	492	2999.21	9.87	29,283	0.53	189.28	5
1994	181,461	16,496	21.24	107.74	10,947	23.46	498	3265.55	10.05	31,158	0.51	194.94	5
Sample	289,062	13,069	16.98	42.93	6854	11.94	378	1599.00	8.92	20,117	0.73	140.89	8.21

[a] Average product of labor measured as revenue ton-miles per employee hour.

maintained employment levels arguably higher than the efficient level. If, in addition, unions kept wages artificially high, partial deregulation may have simply allowed firms to improve productivity to match wages. In this study, we investigate the magnitude and direction of the relationship between real compensation and firm characteristics associated with partial deregulation and labor productivity.[7]

3. Model

To model firm wages in this industry, we follow Martinello (1989), wherein firms minimize costs, subject to a union utility constraint. The firm's minimum nonlabor cost function is (i.e., the cost function given a level of employment)

$$K(r, Q \mid L) = \min_x [rX \mid L] \quad \text{s.t. } Q = Q(X, L), \tag{1}$$

where L = employment, X = a vector of inputs, r is a vector of input prices, Q is a vector of output, and $Q(X, L)$ is the technology. Unions derive utility from wages and employment, $U = U(w, L)$. We assume unions require wages sufficient to provide a level of utility superior to the level of utility received in alternative opportunities, $U(w, L) = \theta U(w_a, L)$. Inverting this utility function allows L to be expressed in terms of the alternative wage (w_a) and the bargaining parameter (θ). Substituting the result into Equation 1 results in

$$\min_w C = wL(w \mid w_a, \theta) + K[r, Q \mid L(w \mid w_a, \theta)]. \tag{2}$$

The first-order condition for this equation is

$$wL_w + L(w \mid w_a, \theta) + K_L[r, Q \mid L(w \mid w_a, \theta)]L_w = 0. \tag{3}$$

Solving Equation 3 for w gives a reduced-form equation for firm-level wages. The reduced form, written in general form, is

$$w = w(w_a, \theta, Q, r), \tag{4}$$

where w represents real firm wages, w_a is an alternative wage opportunity, θ is an index of union bargaining strength, Q is firm output, and r is a vector of nonlabor input prices.

Equation 4 is the basis for formulating our empirical work. The equilibrium wage is a location on the contract curve defined by tangency points of union utility functions and firm isocost lines. A change in the alternative wage, the bargaining power parameter, output, input prices, regulatory regime, innovation, network size, and operating characteristics changes the position of one or both of the functions defining the contract curve and the equilibrium wage observed. Many of the changes in our analysis can arguably be embedded in both equations and may have differential effects across the equations, yielding the comparative statics largely ambiguous.

[7] In the railroad industry, negotiations between firms and unions occur at the national level. While individual firms may negotiate on minor issues, most major points are bargained nationally. In this study, we use firm-level data. Although contracts, including wage increases, are negotiated on a national basis, this does not break the linkage between individual firms and wages. Individual firms still have different abilities and incentives to change their operating characteristics (haul lengths, unit train usage, employment, etc.) in response to common wage increases. Of course, general improvements in labor productivity can also justify general wage increases.

Specification and Variables

We estimate two general models using a double-log specification of Equation 4. The two general models differ by the inclusion or exclusion of firm-specific controls for unobserved heterogeneity. Following Equation 4, we include variables to control for a variety of firm-specific, union, and regulatory effects. In both sets, we include a linear trend variable (TRND) to capture the long-term trend in wages. The trend variable takes a value of 1 in 1978, 2 in 1979, ... , and 17 in 1994. The effects of the Staggers Rail Act are captured through the introduction of a dummy variable (STAG) and a nonlinear adjustment variable (STAGADJ). The dummy variable takes a value of zero for years prior to 1981 and a value of one for years after 1980. The nonlinear adjustment variable follows a similar treatment by Wilson and Wilson (2001).[8] This variable is defined as

$$\text{STAGADJ} = \text{STAG} * \frac{\text{YSS}}{(1 + \text{YSS})} \tag{5}$$

where YSS is the number of years since passage of Staggers (i.e., 1981 = 0, 1982 = 1, ...). This treatment allows the effects of partial deregulation to affect wages gradually and to dissipate with time since passage. The total effect of partial deregulation then is given by:

$$\frac{w^{PD} - w^R}{w^R} = \left[\exp\left(\beta_{STAG} + \beta_{STAGADJ}\left(\frac{\text{YSS}}{1 + \text{YSS}}\right)\right) - 1\right] \times 100 \tag{6}$$

where w^{PD} and w^{R} represent partially deregulated and regulated wage levels, respectively.

With this nonlinear specification of the effects of Staggers, there is a shift in the intercept along with an effect that dissipates with time, that is, as YSS increases, the effect of the second term dissipates with time, reaching an asymptote of $\beta_{STAG} + \beta_{STAGADJ}$, which can then be used to calculate the long-term effect of the legislation.

A key element in our analysis is the modeling of mergers. As discussed earlier, partial deregulation reduced the requirements necessary for firms to merge, and over the time period of our data, there were 13 mergers. Our treatment of merger effects mirrors our treatment of the effects of the Staggers Rail Act. In specifications without firm effects, we identify merger effects with two separate variables. First, we include a dummy variable, MERGE, taking a value of zero in years before a merger and one in years following a merger. Second, we use a nonlinear adjustment variable to control for a nonlinear postmerger trend wherein the largest effects of a merger are felt immediately after a merger and dissipate with time. This variable (YSMADJ) is defined as

$$YSMADJ = \frac{YSM}{(1 + YSM)}, \tag{7}$$

where YSM is the number of years since a merger took place, taking a value of one in the first year following a merger, two in the second year, and so on until the firm merges again or the sample ends. Similar to our modeling of regulatory regime, the effects of a merger are given by

[8] The qualitative results of the article are robust to alternative treatments of the adjustment patterns. In an earlier version of the article, we reported results using a linear interaction term. As noted by a referee, such a treatment allows the effect of partial deregulation and, as discussed below, mergers to change at a constant rate through time. The procedure used and reported here allows the effects of deregulation and mergers to dissipate with time.

$$\frac{w^{\mathrm{M}} - w^{\mathrm{N}}}{w^{\mathrm{N}}} = \left[\exp\left(\beta_{\mathrm{MERGE}} + \beta_{\mathrm{YSMADJ}}\left(\frac{\mathrm{YSM}}{1+\mathrm{YSM}}\right)\right) - 1\right] \times 100 \qquad (8)$$

where M and N indicate merge and not merged.[9]

In specifications with firm controls for unobserved heterogeneity, we include the adjustment variable for mergers (YSMADJ). However, the inclusion of a merge dummy introduces singularity with the firm controls. Instead, the intercept effects of a merger are embedded in the firm dummy variables. For firms that are not involved in a merger, we specify a simple firm-specific dummy variable over the entire sample. For firms that are involved in a merger, we create a new firm dummy variable for the new merged firm. We discuss our approach to modeling the effects of a merger below.

We also include a variety of other control variables, including the percentage of traffic carried via unit trains (%UT) and average length of haul (ALH). Unit trains carry only a single commodity from a single source and to a single destination. Such movements require much less switching of cars and much less labor. We expect as unit train traffic increases, compensating differentials paid for dealing with the less arduous unit trains will decrease. In contrast, we expect, as average haul length increases, compensating differentials paid for this more arduous task to increase.

Our dependent variable is real average compensation per hour (w). Real compensation is defined as labor expenses (total wages and salaries of all railroad occupations plus fringe benefits), divided by labor hours, deflated by the producer price index.[10] Average compensation grew 43%, from $14.85 in 1978 to $21.24 in 1994. In contrast, real manufacturing wages, our measure of alternative wage opportunities (w_a) grew only 13%, from $8.81 to $10.05, from 1978 to 1994.

As a measure of changing union bargaining strength, the model includes the number of unions representing workers in the industry (NUN).[11] Historically, different classes of rail workers have been represented by different unions. However, as employment has fallen in the industry, workers have consolidated their bargaining efforts through fewer unions. Our hypothesis is that this represents a shifting of bargaining strength. The *a priori* expected effect of this variable is ambiguous because a reduction in unions could indicate an increase in union bargaining strength or could result from a decrease in bargaining strength.[12]

Other firm variables follow from previous literature. Output is defined as revenue ton- miles (RTM), while miles of road (MOR) controls for network size. We also control for the price of nonlabor inputs, equipment (P_{equip}), materials and supplies ($P_{\mathrm{mat\&sup}}$), and fuel (P_{fuel}). The price of

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[9] As with the effects of partial deregulation, we experimented with a variety of specifications for adjustment patterns. These include the typical approach of a broken trend, suppression of the intercept effect, broken quadratic trends, etc. The qualitative results of the article are unaffected and, following the suggestion of an earlier reader, we used this approach because of the intuition that the effects of the legislation and mergers would be expected to be largest soon after passage or completion of a merger and to become smaller over time.

[10] Because maintenance of way labor expenses are expenditures on capital improvements, we treat them as capitalized expenditures.

[11] We experimented with other treatments. These are exclusion of the NUN variable and an alternative proxy variable. We were able to calculate, at the industry level, the percentage of employment that is covered by union agreements. Using this proxy variable or excluding NUN leaves the qualitative results identical and the numerical results quite similar to those we report. The proxy variable we used was the ratio of maintenance of way, maintenance of equipment, and transportation employment to total employment. The data are available in Moody's *Transportation Manual* (1997).

[12] Unions merging is frequently the result of declining union membership, which in the railroad industry is the result of declining employment in many worker classes. Nonetheless, a declining number of unions may indicate a strategy to consolidate bargaining power, as suggested by Williamson (1995, pp.18–9), "Unions also merge to address mutual concerns and increase lobbying power, improve the expertise or experience of their staffs, and in some cases strengthen their strike funds."

fuel is measured as the average price for fuel paid by carriers. It was calculated from Schedule 410 and 750 of the R-1 reports. The former contains the fuel expenditures, while the latter contains the number of gallons. Equipment price is a weighted price of railroad equipment (i.e., owned and leased locomotives and cars). It was calculated from Schedule 415 of the R-1 reports and reflects the costs of both owned and leased equipment. A net investment base was calculated for locomotives and cars. The Uniform Rail Costing System (URCS) cost of capital was used to embed an opportunity cost. Leased equipment expenditures were added to owned equipment costs to arrive at a total equipment cost. The weighted price was calculated by using cost shares and per unit costs of owned and leased locomotives and cars. Complete details are available in Benson, Tolliver, and Dooley (1991). The price of materials and supplies is an American Association of Railroads index and is commonly used in studies of railroad costs.

Data Sources

The data are firm-level data from the annual R-1 reports that Class I railroads file with the Interstate Commerce Commission (ICC)[13] and from ICC wage form A-300. The producer price index used to deflate compensation and other variables is from the Bureau of Labor Statistics. We proxy for union strength by including the number of unions representing workers in the industry. We construct this variable from reports in the *Monthly Labor Review*, published by the Bureau of Labor Statistics. In these data, there are a possible 386 observations. We delete 10 because of missing or questionable values for some variables.[14] The final data set provides an unbalanced panel consisting of 376 observations from 1978 through 1994.[15] In Appendix A, we summarize the observations across firms, years, and mergers.

Table 1 presents descriptive statistics for the sample over time. As discussed above, real compensation has increased and increased faster than wages in alternative sectors. Associated with this change are a number of factors, summarized in Table 1. Total industry employment measured by our data point to the decline in employment, falling from 456,450 employees in 1978 to 181,461 employees in 1994,[16] a decline of 60%. However, average firm size (measured by employees) has been growing over the time period, increasing from 12,679 in 1978 to 16,496 in 1994, an increase of 30%. More striking than the increase in the average number of employees per firm is the increase in revenue ton-miles. In 1978, the average firm moved 23.46 billion ton-miles. In 1994, this number had grown by a factor of 4.59 to 107.74 billion. We also note that firm size as measured by average network size (i.e., miles of road) has also increased but by a smaller amount. In 1978, the average network size was about 5065 miles, increasing to 10,947 miles in 1994. The increase in output and average firm size coupled with smaller increases in firm-level employment lead to dramatic increases in output per worker. The average product per employee hour increased by a factor of over 3.5, pointing to tremendous productivity gains.

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[13] The responsibilities of the ICC are now undertaken by the Surface Transportation Board (STB).

[14] We delete observations for 1978–1984 for the Pittsburgh, Lake Erie because of negative prices for equipment. We delete the Boston & Maine for 1987 because it lacks an equipment price and Conrail for 1992 because it lacks an equipment price and Chicago, Rock Island & Pacific for 1978 because it was a consistent outlier.

[15] A complete list of railroads in the data set can be found in Davis and Wilson (1999).

[16] Employees in our data are total labor hours divided by 2000 to give full-time equivalents. We compared this measure against the American Association of Railroad's total employment (*Railroad Facts*, various years). *Railroad Facts* is more inclusive and therefore slightly larger than the R-1 data for Class I railroads. However, the differences are small over time and the correlation between the two measures is 0.9968.

In addition to major employment and firm size changes are changes in the operating characteristics of firms. Associated with partial deregulation was the ability of railroads to put in place pricing practices that encourage multiple and long-distance movements. This is clearly evident in Table 1. The percentage of unit train traffic increased from about 6% in 1978 to over 23% in 1994. Average lengths of haul increased from 326 miles in 1978 to nearly 500 miles in 1994. Such changes dramatically increase the productivity of labor and may help explain changes in average compensation discussed in the next section.

In Table 2, we represent average firm compensation in firms that merged, including average hourly compensation in the year prior to a merger and in the year after a merger. We also include a measure of firm size and revenue ton-miles pre- and postmerger. In a surprising number of cases (six), the smaller firms pay a higher premerger wage than the larger firms with which they merged. In most cases, the postmerger wage is also higher than in any of the premerged firms.

4. Empirical Results

We form our empirical application on the basis of Equation 4. All continuous variables except %UT are measured in logs and results are reported from estimating several specifications of Equation 4 in Table 3.[17] The first three columns of Table 3 represent specifications without firm-specific dummy variables (fixed effects) included, while the next three columns include firm fixed effects. F-tests suggest the unrestricted model including the firm fixed effects to be the appropriate specification. We also test for first-order serial correlation by constructing Durbin–Watson statistics for each cross-section of the data. Many of these statistics suggest the presence of first-order serial correlation. To address this issue, we quasi-difference the data using a consistent estimate of the autocorrelation parameter for each cross-section of data derived. After this correction, the errors are no longer serially correlated but remain heteroskedastic. We correct for groupwise heteroskedasticity using weighted least squares, weighting each cross-section by the inverse of the estimated variance from a second ordinary least squares (OLS) regression on the quasi-differenced data.[18] The final regression, reported in columns marked by a superscript "a" in Table 3, denotes estimates corrected for first-order serial correlation and groupwise heteroskedasticity. The first two columns and the fourth and fifth columns in Table 3 represent OLS regressions, while the third and sixth columns represent two-stage least squares (2SLS) regressions.[19] For the instrumental variables (IV) estimates, we instrument for revenue ton-miles, average length of haul, and percent unit train traffic.[20] A

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[17] One rationale for the number of specifications is to point to the sensitivity of results to variables included or excluded along with differences in estimation procedure. The %UT is not measured in logs due to the large number of zeros early in the time series.

[18] This estimation method follows from Greene (1993, pp. 455–7).

[19] It is likely that output and traffic choices are made endogenously by the firm. Given this, employment and wage decisions are likely made simultaneously with these choices.

[20] As instruments, we use fitted values of the endogenous variables from first-stage regressions using firm-specific demand variables as independent variables. These demand variables are national gross output of key products carried by each railroad. For each railroad, we rank total tons of products shipped by Standard Transportation Commodity Classification (STCC) category to determine each firm's three key products. We regress each potentially endogenous variable on these national gross outputs and use the fitted values as instruments in the second-stage regressions reported in columns 3 and 6 of Table 3 (and Appendix B). The gross output data are from the Bureau of Economic Analysis, National Accounts Data, Gross Product by Industry.

Table 2. Wages in Merged Firms

	Premerger		Postmerger	
RR Abbr.[a]	Wage	RTM (mil.)	Wage	RTM (mil.)
SLSF	14.41	16,810.49		
BN	12.56	123,729.01	12.75	155,642.94
CS	12.20	8484.75		
FWD	12.61	9836.58		
BN	13.71	156,619.42	15.31	157,714.88
WM	14.77	1626.65		
BO	14.79	20,095.17	17.42	22,129.82
CCO	16.22	4104.68		
LN	18.47	33,809.97		
SCL	13.81	31,501.35	16.98	73,927.98
CO	8.77	32,213.15		
BO	19.12	25,276.03		
SCL	18.00	76,573.32		
CSX			19.41	127,501.72
DTI	24.14	1365.04		
GTW	19.40	3633.13	24.80	5581.45
MILW	16.15	12,509.71		
SOO	15.44	9961.43	17.16	18,342.15
AGS	17.22	3842.31		
SOU	11.42	28,762.69		
CGA	17.67	5556.15		
CNTP	17.43	5545.05		
SRS			16.54	42,696.17
NW	17.24	43,766.21		
SOU	18.12	46,010.38		
NS			18.69	91,754.63
MP	20.50	51,370.52		
WP	24.80	5785.80		
UP	18.62	74,612.30	21.36	136,096.76
MKT	19.43	9713.84		
UP	21.64	157,219.39	22.64	183,647.12
SSW	24.27	17,025.73		
SP	20.27	69,382.28	24.75	86,096.43
DRGW	19.28	16,037.92		
KCS	22.72	12,183.84		
SP	27.10	110,274.57	26.70	118,517.52

[a] Railroad names and abbreviations are provided in Appendix A.

Hausman specification test suggests the instrumental variable estimator is appropriate for the fixed effects model.

In Table 3, we include input prices as independent variables. In Appendix B, we report results from estimating our model without input prices included. Some of these variables are heavily trended variables and highly collinear with many of the other variables in which we have primary interest.

Table 3. Coefficient Estimates

	Models without Fixed Effects			Models with Fixed Effects		
	OLS	OLS[a]	2SLS[a]	OLS	OLS[a]	2SLS[a]
C	1.2603	2.2671***	2.2164***	5.4332***	4.3544***	1.8099
	(1.3860)	(0.4511)	(0.4587)	(1.3422)	(0.7063)	(1.6664)
RTM	0.0619***	0.0251**	0.0246**	−0.0950*	−0.0677**	−0.0273
	(0.0202)	(0.0108)	(0.0114)	(0.0521)	(0.0269)	(0.0861)
MOR	−0.0923***	−0.0686***	−0.0675***	0.0201	0.0377	−0.0273
	(0.0206)	(0.0124)	(0.0130)	(0.0447)	(0.0247)	(0.0382)
ALTWAGE	−0.4271	0.0574	0.0631	−0.2307	0.0795	0.1625
	(0.5468)	(0.1788)	(0.1801)	(0.3503)	(0.1378)	(0.1515)
PEQUIP	0.0280*	0.0596***	0.0605***	0.0291**	0.0191**	0.0245**
	(0.0169)	(0.0076)	(0.0078)	(0.0147)	(0.0086)	(0.0104)
PFUEL	−0.3070***	−0.1162***	−0.1169***	−0.1795***	−0.1135***	−0.1011***
	(0.0980)	(0.0302)	(0.0304)	(0.0659)	(0.0232)	(0.0251)
PMATSUP	0.2146	−0.1079**	−0.1002**	−0.2293*	−0.2404***	−0.1216**
	(0.1718)	(0.0491)	(0.0495)	(0.1211)	(0.0496)	(0.0559)
%UT	−0.0250	−0.0412	−0.0589**	0.0211	0.0639	−0.5001*
	(0.0628)	(0.0254)	(0.0271)	(0.1347)	(0.0608)	(0.2569)
ALH	0.0331	0.0411***	0.0424***	0.1080	0.0665*	0.2959***
	(0.0257)	(0.0118)	(0.0127)	(0.0718)	(0.0351)	(0.1033)
TREND	−0.0073	0.0048	0.0041	0.0148	0.0163***	0.0073
	(0.0135)	(0.0040)	(0.0041)	(0.0094)	(0.0038)	(0.0050)
STAGADJ	0.2899***	0.2300***	0.2304***	0.1914***	0.1699***	0.1739***
	(0.0726)	(0.0248)	(0.0249)	(0.0472)	(0.0197)	(0.0286)
STAG	0.0435	0.0235*	0.0231*	0.0428	0.0352***	0.0340***
	(0.0435)	(0.0139)	(0.0139)	(0.0274)	(0.0096)	(0.0117)
YSMADJ	−0.0774	−0.0313**	−0.0287*	−0.0672	−0.0173	−0.0309*
	(0.0691)	(0.0152)	(0.0153)	(0.0526)	(0.0129)	(0.0176)
NUN	0.0002	−0.0010	−0.0108*	−0.0041	−0.0029	−0.0138*
	(0.0245)	(0.0065)	(0.0065)	(0.0155)	(0.0056)	(0.0070)
MERGE	0.1392***	0.0726***	0.0723***	NA	NA	NA
	(0.0501)	(0.0135)	(0.0137)			
R^2	0.55	0.99	NA	0.86	0.99	NA
F-(zero coef.)	31.69	15,751		32.39	10,716	
Hausman	0.520	1.004		1.95	1.74	

Note: Standard errors are in parentheses.
[a] Standard errors were corrected for autocorrelation and groupwise heteroskedasticity.
*, **, *** Statistical significance at the 10, 5 and 1% levels, respectively.

Comparing results in Table 3 with results in Appendix B reveals that most firm-specific variables are stable between specifications, as are the simulation effects we report below.

Partial deregulation lessened the impediments for firms to merge. In models without fixed effects (the first three columns of Table 3), we identify merger effects through a merger dummy variable (MERGE) and the merger adjustment term (YSMADJ). In these specifications, the merger dummy variable is positive and significant.[21] Parameter estimates suggest that, for merged firms, average

[21] We define the firm fixed effects so that a new firm dummy variable is created when two firms merge. The merger dummy variable is not identified for these specifications.

compensation was on average 7.5–14.9% higher (the marginal effects are $e^{\beta} - 1$). Prior research suggests mergers played a role in reducing costs (Berndt et al. 1993) and in reducing employment (Davis and Wilson 1999). While a reduction in employment associated with a decrease in labor demand is not consistent with a simultaneous increase in real wages, it is consistent with a theory of rent sharing in a model of union/firm contracting. Rational unions should be able to increase their utility by trading lower wages for higher employment. The results here, coupled with previous research (i.e., Davis and Wilson 1999), suggest that firms and unions reposition their settlement when faced with a new bargaining environment. The new settlement for merged firms results in higher wages but lower employment.[22] Estimates for YSMADJ suggest that working against these postmerger gains is a nonlinear declining trend in average compensation in the years following a merger. Combining the parameter estimates for MERGE and YSMADJ gives the long-term effect of mergers. For the first three columns in Table 3, the long-term merger effect is 6.37, 4.22, and 4.46%.

Table 3 also identifies the marginal and long-term effects of partial deregulation. Note the parameter estimate for STAGADJ identifies the adjustment in trend associated with partial deregulation. The parameter estimate for STAG suggests the marginal effect of partial deregulation ranges from 2.33 to 4.44%. Adding the Stagger's adjustment parameter to the STAG parameter and subtracting one from their exponent give the long-term effect of partial deregulation, which ranges from 23.1 to 39.6%.

Average haul lengths (ALH) and percent unit train (%UT) capture the effects of a change in traffic characteristics under partial deregulation. The parameter estimates for ALH suggest that increased haul lengths are associated with higher average compensation. In contrast, changes in %UT are associated with lower average compensation in the instrumental variable models. MacDonald and Cavalluzzo (1996) hypothesize that partial deregulation allowed firms greater freedom to set rates and that firms used this freedom to induce shippers into labor-saving shipping behaviors. Firms were able to entice shippers to consolidate shipments and allowed firms to channel those shipments onto more densely traveled track, the likely result being more cargo shipped via unit trains over longer distances. Annual averages show average haul lengths increased and that traffic shipped via unit trains also increased. Prior research suggests (MacDonald and Cavalluzzo 1996; Davis and Wilson 1999) these practices reduced employment. The results in this research suggest that, as partial deregulation allowed firms the freedom to exploit unrealized efficiencies, workers benefited from the efficiencies associated with longer average haul lengths. More unit trains translated into lower average compensation.

Controlling for firm heterogeneity makes a difference when evaluating the effects of changes in network size (MOR) and changes in output (RTM). MOR is negative and significant in the first three columns of Table 3, representing specifications without fixed effects, but not significant in the final three columns, representing specifications with fixed effects. An F-test clearly suggests that firm effects matter. When averaged over all firms, smaller network sizes are associated with increased compensation. However, when controlling for heterogeneity between firms, including differences in network configurations and management between firms, the relationship between network size and compensation is no longer significant. This implies that it is differences across firms rather than changes over time that drive this result. Partial deregulation allowed firms to abandon track, and total industry network size has fallen over time. Within this total, some firms decreased their network size

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[22] This result is consistent with a leftward shift of the union/firm efficient contract curve.

by abandoning track while some increased in size through merger. These data do not suggest that track abandonment or merger growth affected compensation. Instead, it suggests that, *ceteris paribus,* firms with smaller network sizes paid higher wages throughout the period under examination. Work rules were originally devised as methods to coordinate workers over large rail networks (Cappelli 1985). These results suggest that firms with large networks are more able to deal with their consequences. In this sense, when discussing work rules, network sizes, and real wages, there are returns to size.

In contrast, coefficient patterns for RTM suggest firms were able to increase productivity, reduce labor demand, and decrease compensation over time. In the first three columns of Table 2 without firm fixed effects, RTM is always positive and significant. In the final three columns, RTM is negative and significant in two of the three cases. When averaged over all firms, compensation and output increase together. However, when controlling for firm heterogeneity, a negative relationship is apparent. While firms with relatively high output pay higher wages than do firms with relatively low RTM, increases at the firm level in RTM are, over time, associated with decreases in compensation.

The results for MOR and RTM point to the importance of firm differences and the ability of firms to adapt to changes in environment in determining compensation levels. Given that, holding all else constant, firms with smaller network sizes paid more, it is not surprising that abandoning track was not a meaningful way for firms to decrease labor demand and compensation levels. Instead, an important determinant was the ability of firms to exploit efficiencies and increase productivity with regard to output, no matter the network size.

5. Merger, Traffic Mix, and Deregulation Effects

We now decompose average compensation changes into three sources, including partial deregulation, mergers, and changing network/firm characteristics. Simulations for each of these sources are presented in Table 4 for three different empirical specifications. We also include in Appendix C results for specifications without other factor prices.[23]

Mergers

The first column in Table 4 pertains to merger effects. To calculate the merger effects, we first predict compensation for the average firm in 1978 using the average firm intercept and mean values of right-hand side variables. For subsequent years, annual compensation is calculated with all variables held constant at the values used to predict compensation in 1978. Changes in compensation are generated only through changes in the average firm intercept. Intercept estimates vary from year to year from two sources. First, when firms merge, a new intercept shift is identified for the new firm.

[23] Our method to identify the effects of changes in variables is somewhat restrictive. For example, a less restrictive method to decompose the effect of partial deregulation would estimate separate equations for the before and after deregulation periods. This technique allows all parameters to vary between subsamples and measures the constant effect of deregulation as the difference between constants in both equations. We are prevented from fully implementing this method because several variables are not identified in both subsamples. However, a less restricted model could be estimated by allowing parameters to vary between subsamples on all variables that are identified. While this method frequently improved the fit of the overall model, most parameter estimates were individually not significant, and the simulations reported later were not materially affected.

Table 4. Annual Change in Average Wage, by Source of Change

Year	Merger (%)	Traffic Mix (%)	Deregulation (%)	Other (%)
OLS estimates				
1978	NA	NA	NA	NA
1979	0.00	−0.10	0.00	−4.86
1980	0.39	−0.25	0.00	−5.38
1981	0.00	0.10	4.38	−1.47
1982	0.34	0.25	10.05	2.27
1983	2.63	1.64	3.24	1.30
1984	−0.06	0.21	1.61	0.35
1985	−1.34	0.71	0.96	−0.32
1986	−0.41	−0.06	0.64	6.67
1987	2.82	0.91	0.46	1.05
1988	2.25	0.30	0.34	0.84
1989	0.00	0.20	0.27	−0.83
1990	2.30	−0.15	0.21	−3.37
1991	0.00	0.16	0.17	−1.73
1992	6.23	0.74	0.15	−0.53
1993	0.00	0.13	0.12	0.35
1994	0.00	0.21	0.11	0.47
Total	15.16	4.99	22.70	−5.20
OLS estimates, corrected				
1978	NA	NA	NA	NA
1979	0.00	0.02	0.00	−4.17
1980	0.26	−0.05	0.00	−5.03
1981	0.00	0.13	3.58	−0.65
1982	0.04	0.01	8.87	3.23
1983	1.65	1.04	2.87	3.13
1984	−0.67	0.19	1.43	1.45
1985	−2.18	0.53	0.85	1.74
1986	−0.37	0.08	0.57	6.50
1987	2.67	0.62	0.41	1.77
1988	1.20	0.20	0.30	0.89
1989	0.00	0.19	0.24	−0.69
1990	1.45	0.02	0.19	−1.70
1991	0.00	0.17	0.15	−1.08
1992	3.74	0.50	0.13	0.64
1993	0.00	0.02	0.11	1.10
1994	0.00	0.29	0.09	1.09
Total	7.78	3.96	19.79	8.23
IV estimates, corrected				
1978	NA	NA	NA	NA
1979	0.00	−1.18	0.00	−2.61
1980	0.56	−1.81	0.00	−4.20
1981	0.00	−0.40	3.47	0.63
1982	−1.07	2.25	9.09	2.02
1983	1.10	4.11	2.94	1.34
1984	−1.03	−0.11	1.46	2.01
1985	−4.96	0.93	0.87	1.06
1986	1.30	−1.47	0.58	5.94

Table 4. Continued

Year	Merger (%)	Traffic Mix (%)	Deregulation (%)	Other (%)
1987	2.23	1.82	0.42	1.78
1988	1.05	0.69	0.31	0.36
1989	0.00	−0.17	0.24	−0.83
1990	2.54	−1.64	0.19	−1.95
1991	0.00	−0.34	0.16	−0.10
1992	3.18	1.55	0.13	1.60
1993	0.00	1.01	0.11	0.42
1994	0.00	−1.20	0.10	1.04
Total	4.90	4.03	20.07	8.50

Second, some firms disappear from our sample from bankruptcy or declassification as a Class I railroad. However, the latter effect is a relatively minor consideration.

As is evident in Table 4, merger effects, identified by changes in the average intercept, vary across specification. Using OLS estimates, the intercept effect is 15.16%; using the corrected OLS estimates, the intercept effect is 7.78%; and using the corrected IV estimates, the intercept effect is 4.9%. These effects are calculated using only changes in the intercept. The empirical results suggest that there is a negative adjustment effect working through YSMADJ. In particular, the largest gains to labor accrue in the period immediately following a merger and dissipate with time. We first calculate the effect of the YSMADJ variable on annual average compensation using mean values of YSM for each year in the sample, holding all other variables and intercept terms constant at their 1978 values. Estimates of the cumulative negative effect for the YSMADJ adjustment variables are −5.78% using the OLS estimates, −1.5% using the corrected OLS estimates, and −2.67% using the corrected 2SLS estimates. Combining these with the intercept effect yields values of 9.38% using OLS estimates, 6.28% using corrected OLS estimates, and 2.23% using corrected 2SLS estimates.

Traffic Mix

In the second column of Table 4, we calculate the effect of changing traffic mix variables for annual average compensation. Traffic mix variables include average length of haul (ALH) and percent unit train (%UT). These variables are proxies for the effect of the changes in commodities roads carried. To measure the effect of changes in these variables for annual average wages, we again simulate annual average compensation for each year in the sample. We do this for each of the traffic mix variables, ALH and %UT, then sum the effect for both variables to get the traffic mix effect. The 1978 annual average compensation is calculated using 1978 mean values for all continuous variables and 1978 actual values for all discrete variables. For each subsequent year, we hold all variables constant at their 1978 value, allowing only the variable under investigation to vary according to its annual mean. We report annual percentage changes in Table 4 (i.e., for each annual mean variable, i = ALH, %UT, the annual percent change reduces to $(x_{i,t}^{\beta i}/x_{i,t-1}^{\beta i}) - 1$). The cumulative compensation effect from changes in these variables ranges from 3.96 to 4.99%.

Deregulation

In the third column of Table 4, we present results from simulating the change in compensation associated with partial deregulation using the parameter estimates from the specifications that include fixed effects. We calculate annual average compensation by holding constant all fixed effect parameter estimates and all nonderegulation variables constant at their 1978 values. For each subsequent year, we calculate annual means allowing only the value for the partial deregulation variables STAG and STAGADJ to vary. We calculate annual percentage changes and sum the annual percentage changes in each year to get the total effect. For the STAG variable, this method reduces to calculating $((e^{\beta_{STAG} STAG_t}/e^{\beta_{STAG} STAG_{t-1}}) - 1)$ for each available year in the sample.

The effect of partial deregulation is stable across specifications, and each model suggests partial deregulation had a large impact on compensation over the range of the data. The effect ranges from 22.7% using the OLS estimates to 19.79% using the corrected OLS estimates to 20.07% using the corrected 2SLS estimates.

6. Conclusions

Partial deregulation of the Class I railroad industry sparked a return to financial viability. It ushered in an era of eased merger requirements, increased rate flexibility, and increased line abandonment. In this era, firms were able to exploit efficiencies and change their behavior to increase productivity, reduce labor demand, and avoid or change work rules. We estimate a reduced-form equation for average compensation, allowing us to identify the effect of changes in firm and industry characteristics. We find that, for mergers, traffic mix variables, and partial deregulation, the effect on compensation was positive.

Each of these factors should reduce labor demand. In fact, earlier research (MacDonald and Cavalluzzo 1996; Davis and Wilson 1999) shows a reduction in employment associated with these factors. A reduction of labor demand should also imply a reduction in wages, given a constant labor supply. We suggest the increase in compensation observed in our data can be explained from two primary sources. First, while each of these factors affects labor demand, they also influence the bargaining environment. As already noted, the theoretical implications for wages are ambiguous given this formulation. For example, an increase in rents after a merger may allow wages to rise, even though employment falls. Second, the composition of workers that earn the salaries in our data is likely changing postderegulation. These workers are likely more skilled and more productive as railroads become more automated. Thus, we expect these workers to command higher compensation levels.

We focused our analysis on the effects of mergers, partial deregulation, and changing firm operating and network characteristics on average compensation levels. By using firm-specific data, we were able to identify these effects separately. Partial deregulation tends to have a large effect. The effect seems to be relatively stable across a wide variety of models and estimation procedures. Changes in operating and network characteristics also have an effect, albeit somewhat smaller than for mergers. These effects again seem to be relatively stable across a wide variety of models and estimation procedures. While the magnitudes of the effects of mergers are somewhat sensitive to specification and estimation procedure, they are positive and large for a wide range. Our conclusion is that mergers increased average compensation to railroad employees.

Appendix A
Railroad Names, Abbreviations, Years Observed

Railroad	Abbreviation	Years Observed in the Data
Atchison, Topeka, & Santa Fe	ATSF	1978–1994
Chicago & Northwestern	CNW	1978–1994
Consolidated Rail Corp.	CR	1978–1994
Florida East Coast	FEC	1978–1991
Illinois Central Gulf	ICG	1978–1994
Kansas City Southern	KCS	1978–1991 (merged into SP)
St. Louis, Southwestern	SSW	1978–1989 (merged into SP)
Denver, Rio Grande, & Western	DRGW	1978–1992 (merged into SP)
Southern Pacific	SP	1978–1989
Southern Pacific I	SPI	1990–1991 (SP + SSW)
Southern Pacific II	SPII	1992–1994 (SP + KCS + DRGW)
Burlington Northern	BN	1978–1979
St. Louis, San Francisco	SLSF	1978–1979 (merged into BN)
Colorado Southern	CS	1978–1981 (merged into BN)
Fort Worth, Denver	FWD	1978–1981 (merged into BN)
Burlington Northern I	BN1	1980–1981 (BN + SLSF)
Burlington Northern II	BN2	1982–1994 (BN1 + CS + FWD)
Chesapeake & Ohio	CO	1978–1985 (merged into CSX)
Baltimore & Ohio	BO	1978–1985 ((merged into CSX)
Seaboard Coast Line	SCL	1978–1985 (merged into CSX)
Clinchfield & Ohio	CCO	1978–1982 (reported with SCL)
Louisville & Nashville	LN	1978–1982 (reported with SCL)
Western Maryland	WM	1978–1982 (reported with BO)
CSX	CSX	1986–1994 (CO + BO + SCL)
Grand Trunk & Western	GTW	1978–1983
Detroit, Toledo, & Ironton	DTI	1978–1983 (merged into GTW)
Grand Trunk & Western I	GTW1	1984–1994 (GTW + DTI)
Soo Line	SOO	1978–1984
Chicago, Milwaukee, & St. Paul	MILW	1978–1984 (acquired by Soo Line)
Soo Line I	SOO1	1985–1994 (SOO + MILW)
Norfolk & Western	NW	1978–1984 (merged with NS)
Southern Railway	SOU	1978–1982 (consolidated into Southern Ry)
Alabama & Great Southern	AGS	1978–1982 (consolidated into Southern Ry)
Central Georgia	CGA	1978–1982 (consolidated into Southern Ry)
Cincinnati & Texas Pacific	CNTP	1978–1982 (consolidated into Southern Ry)
Southern Railway System	SRS	1983–1984 (SOU + AGS + CGA + CNTP)
Norfolk Southern	NS	1985–1994 (SRS + NW)
Union Pacific Railway	UP	1978–1985
Missouri Pacific	MP	1978–1985 (merged into UP)
Western Pacific	WP	1978–1985 (merged into UP)
Missouri-Kansas-Texas	MKT	1978–1987 (merged into UP)
Union Pacific I	UP1	1986–1987 (UP + WP + MP)
Union Pacific II	UP2	1988–1994 (UP1 + MKT)
Bessemer & Lake Erie	BLE	1978–1984 (declassified as Class I)
Boston & Maine	BM	1978–1987 (declassified as Class I)
Chicago, Rock Island, & Pacific	ROCK	1978 (bankrupt)
Delaware & Hudson	DH	1978–1987 (declassified as Class I)
Duluth, Missabe, & Iron Range	DMIR	1978–1984 (declassified as Class I)
Pittsburgh, Lake Erie	PLE	1978–1984 (declassified as Class I)

Appendix B
Coefficient Estimates

	Models without Fixed Effects			Models with Fixed Effects		
	OLS	OLS[a]	2SLS[a]	OLS	OLS[a]	2SLS[a]
Constant	−0.4440	0.1699	0.1412	2.3321**	1.6940***	0.9692
	(0.8058)	(0.2551)	(0.2610)	(1.1648)	(0.6130)	(1.6260)
RTM	0.0791***	0.0457***	0.0463***	−0.0780	−0.0799***	−0.0412
	(0.0195)	(0.0116)	(0.0121)	(0.0525)	(0.0258)	(0.0822)
MOR	−0.1096***	−0.0747***	−0.0737***	−0.0172	0.0335	−0.0099
	(0.0200)	(0.0137)	(0.0144)	(0.0453)	(0.0300)	(0.0387)
ALTWAGE	0.8987***	0.8880***	0.8952***	0.9514***	1.0122***	0.9682***
	(0.3083)	(0.0877)	(0.0872)	(0.1911)	(0.0686)	(0.0870)
%UT	−0.0074	0.0380	0.0296	−0.0104	0.0226	−0.3211
	(0.0629)	(0.0378)	(0.0439)	(0.1389)	(0.0704)	(0.2506)
ALH	0.0580**	0.0514***	0.0508***	0.1186	0.1107***	0.1530*
	(0.0239)	(0.0138)	(0.0151)	(0.0731)	(0.0312)	(0.0921)
TREND	−0.0053	−0.0061**	−0.0063**	−0.0059	−0.3566	−0.0022
	(0.0093)	(0.0027)	(0.0027)	(0.0064)	(0.0028)	(0.0032)
STAGADJ	0.2104***	0.2145***	0.2141***	0.1829***	0.1670***	0.1525***
	(0.0672)	(0.0233)	(0.0233)	(0.0441)	(0.0193)	(0.0258)
STAG	0.0022	0.0117	0.0121	−0.0145	0.0080	0.0150
	(0.0375)	(0.0117)	(0.0117)	(0.0234)	(0.0072)	(0.0108)
YSMADJ	−0.0655	−0.0180	−0.0182	−0.0509	−0.0078	−0.0273*
	(0.0700)	(0.0159)	(0.0154)	(0.0542)	(0.0114)	(0.0150)
NUN	−0.0134	−0.0146***	−0.0150***	−0.0292**	−0.0164***	−0.0169**
	(0.0226)	(0.0053)	(0.0053)	(0.0143)	(0.0046)	(0.0068)
MERGE	0.1346***	0.0701***	0.0699***	NA	NA	NA
	(0.0507)	(0.0156)	(0.0157)			
R^2	0.53	0.99	NA	0.85	0.99	NA
F-(zero coef.)	37.9	16,392		31.5	22,621	
Hausman	0.926	0.204		1.57	2.18	

Standard errors are in parentheses.
[a] Standard errors were corrected for autocorrelation and groupwise heteroskedasticity.
*, **, and *** significance at the 10, 5, and 1% levels, respectively.

Appendix C
Annual Change in Average Wage, by Source of Change

Year	Merger (%)	Traffic Mix (%)	Deregulation (%)	Other (%)
OLS estimates				
1978	NA	NA	NA	NA
1979	0.00	−0.17	0.00	−1.75
1980	0.32	−0.34	0.00	−5.30
1981	0.00	0.07	0.00	1.48
1982	0.46	0.36	9.58	3.72
1983	3.11	1.77	3.10	−0.55
1984	0.06	0.19	1.54	1.69
1985	−0.46	0.72	0.92	2.26
1986	0.13	−0.15	0.61	5.16
1987	2.91	0.96	0.44	−0.24
1988	2.46	0.32	0.33	−3.55
1989	0.00	0.17	0.25	−2.57
1990	2.49	−0.24	0.20	−1.82
1991	0.00	0.13	0.17	1.50
1992	5.91	0.79	0.14	2.80
1993	0.00	0.18	0.12	−0.91
1994	0.00	0.12	0.10	0.53
Total	17.39	4.89	17.48	2.46
OLS estimates, corrected				
1978	NA	NA	NA	NA
1979	0.00	−0.10	0.00	−3.10
1980	−2.78	−0.25	0.00	−5.26
1981	3.16	0.11	0.00	2.80
1982	0.09	0.25	8.71	4.56
1983	1.80	1.68	2.82	1.30
1984	−0.44	0.21	1.40	1.20
1985	−1.98	0.73	0.84	3.94
1986	0.20	−0.06	0.56	5.43
1987	2.82	0.93	0.40	−1.03
1988	1.69	0.31	0.30	−2.60
1989	0.00	0.20	0.23	−2.38
1990	1.81	−0.15	0.19	−1.20
1991	0.00	0.17	0.15	1.88
1992	3.57	0.76	0.13	2.70
1993	0.00	0.13	0.11	−0.28
1994	0.00	0.21	0.09	0.86
Total	9.94	5.13	15.92	8.81
IV estimates, corrected				
1978	NA	NA	NA	NA
1979	0.00	−0.71	0.00	−2.46
1980	0.40	−1.06	0.00	−4.81
1981	0.00	−0.29	0.00	3.59
1982	−0.58	1.34	7.92	3.98
1983	2.20	2.05	2.57	1.16
1984	−0.57	−0.13	1.28	1.61
1985	−1.99	0.36	0.77	3.51

Appendix C
Continued

Year	Merger (%)	Traffic Mix (%)	Deregulation (%)	Other (%)
1986	1.36	−0.91	0.51	5.28
1987	2.70	0.85	0.36	−0.43
1988	1.66	0.34	0.27	−2.28
1989	0.00	−0.17	0.21	−2.08
1990	2.29	−0.99	0.17	−0.98
1991	0.00	−0.27	0.14	1.98
1992	3.65	0.74	0.12	2.85
1993	0.00	0.59	0.10	−0.06
1994	0.00	−0.82	0.08	1.24
Total	11.13	0.94	14.51	12.10

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