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THE IMPACT OF DEREGULATION ON THE EMPLOYMENT AND WAGES OF AIRLINE MECHANICS

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ABSTRACT

This paper describes the effects of deregulation on negotiated wage rates and employment levels of aircraft mechanics in the scheduled airline industry. Firm-specific data for the incumbent trunk airlines show relatively small changes in real wage rates since deregulation, and only recent increases in interfirm wage differentials. Employment growth rates, on the other hand, have varied widely among the incumbents, and between the incumbent trunks and the local service and new-entrant airlines. The data suggest that deregulation resulted in a transfer of 5000-7000 maintenance jobs from the incumbent trunks to the smaller airlines. This shift in employment reduced mechanics' earnings in the industry by as much as 5 percent.

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I. Introduction

The recent experience of the airline industry provides a remarkable case study for the analysis of wage and employment outcomes under trade unions. Since passage of the Airline Deregulation Act in 1978, the industry has witnessed steady erosion in the relative output of the incumbent trunk airlines, and steady increases in the relative importance of new entrants and former local service carriers. These changes have been associated with substantial reductions in employment at the trunks, and widely publicized contract renegotiations, often involving wage concessions or two-tiered wage schedules.

This paper describes the impact of deregulation on the wage rates and employment of airline mechanics at the former trunk airlines between 1978 and 1984.[1/] The analysis is necessarily preliminary since many of the effects of deregulation are ongoing, and mechanics' wages are established in long term contracts that adjust slowly to external shocks. Nevertheless, the experience of airline mechanics in the first six years of deregulation yields a number of insights into the response of trade unions to an increase in product market competition.

Among the three major groups of skilled employees in the airline industry (pilots, flight attendants, mechanics) airline mechanics are atypical. First, their training and skills are relatively easily transferred out of the airline industry. Second, the services of mechanics are relatively easily replaced: many airlines purchase all or part of their maintenance services from outside contractors. Third, employment conditions for many mechanics resemble those of industrial workers: roughly one-half of airline mechanics work at maintenance depots on conventional work schedules. For these reasons, however, airline mechanics

are most similar to unionized workers elsewhere in the economy. It is natural, therefore, to look to the experiences of the mechanics in attempting to draw general conclusions from the deregulatory experience of the airline industry.

II. Wages and Employment of Airline Mechanics

The data for this study consist of annual observations on employment, wages, and output at eleven of the largest airline firms in the U.S.: American, Braniff, Continental, Delta, Eastern, Northwest, PanAm, Transworld, United, USAir, and Western. Mechanics at seven of these airlines are represented by the Machinists' union (IAM). Mechanics at American and PanAm are represented by the Transport Workers Union (TWU), while mechanics at Western are represented by the Teamsters (IBT), and mechanics at Delta are unorganized. The Machinists and Teamsters also represent mechanics at several smaller airlines and contract maintenance firms.[2/]

a. Wages

Table 1 presents a wage chronology for ten incumbent trunk airlines over the period 1966 to 1985.[3/] The table contains wage rates for certified mechanics at the signing date of each new contract. For comparative purposes, the table also presents contract wage rates for certified aircraft mechanics at Boeing, and average wage rates of maintenance mechanics and production workers in manufacturing industries.

A striking feature of the table is the uniformity across airlines in mechanics' wage rates. This uniformity persisted through two rounds of contract negotiations after 1978: the 1978-79 round (in row 6 of

Table 1), and the 1982-83 round (in row 7 of the Table). Very recently, wage differentials have opened up in the industry, with significantly lower wage rates at several of the financially-troubled airlines. Wage rates at the financially-sound airlines have maintained the pattern of equality established in the industry prior to deregulation.[4/]

Several explanations have been offered for the long delay between passage of the Airline Deregulation Act in 1978 and the breakdown of pattern wage bargaining for airline mechanics. On one hand, entry of the new carriers and expansion of the former local-service airlines occurred slowly after 1978. On the other hand, product market competition and downward pressure on labor costs reached an unprecedented level during the 1982 recession, when two of the incumbent trunks (Braniff and Continental) underwent bankruptcy and all the trunks incurred large operating losses.[5/] Some observers have interpreted the recent movement away from a uniform industry wage as a permanent structural change engendered by deregulation. Others have argued that airline-specific wage concessions reflect the interaction of economic conditions and a newly competitive product market structure, and that improving economic conditions will renew pressure for uniform wages among the carriers. At this stage, however, it is unclear whether wage dispersion will persist, or whether the industry will return to a more uniform wage structure.

Further evidence on the distribution of wage rates within the scheduled airline industry is presented in Table 2. This table presents wage data for airline mechanics from BLS industry wage surveys conducted

in 1970, 1975, 1980 and 1984. Average wage rates in the industry are closely linked to the contract rates reported in Table 1. There is a downward shift in the industry average wage rate relative to the contractual rate at United Airlines after 1975. Wage dispersion within the industry also increased in the most recent survey. The coefficient of variation of wage rates, presented in the last column of Table 2, doubled between 1980 and 1984. The 1984 wage distribution shows a small concentration of wage rates some 20-40 percent below the industry mean wage, whereas the earlier distributions are unimodal and highly concentrated.

Tables 1 and 2 also present evidence on time-series variability of real and relative wage rates of airline mechanics. Outside of the air transport industry , the aircraft and parts industry is a major employer of aircraft mechanics.[6/] The wage chronology for mechanics at Boeing suggests that wage rates have been very similar in the two industries. Relative wage rates between the aircraft assembly and scheduled airline industries did not change between 1978 and 1983. The same conclusion emerges from a comparison of mechanics' wage rates and average wage rates of maintenance mechanics or production workers in manufacturing. Relative to either rate, airline mechanics' wages have been more or less constant since the 1969 round of contract negotiations. Relative to the Consumer Price Index, airline mechanics' average wage rates have been approximately constant since 1975.

The similarity between contract provisions at the major airlines extends to most aspects of compensation, including pensions, vacations,

and health plans. In addition, the major airlines that have not negotiated wage concessions since 1982 (American, Northwest, United, USAir) have all introduced two-tiered wage schedules.[7] Two-tiered schedules have also recently spread among the smaller unionized carriers in the industry.[8]

The pattern of the wage data in Table 1 contrasts sharply with the pattern of the firm-specific employment data in Table 3.[9] While wages remained relatively constant across firms from 1966 to 1983, employment growth varied substantially. Between 1970 and 1978, for example, mechanics' employment fell about 10 percent at American, Continental, and Transworld, while employment fell about 20 percent at United. During the same period, employment grew or remained approximately constant at the other airlines. In spite of this variation across firms in employment demand, airline mechanics were remarkably successful in maintaining a homogeneous wage structure. There is no indication that mechanics historically adjusted contractual wage rates in response to firm-specific factors.

The implication of this homogeneous industry wage structure is that a firm-by-firm analysis of wage determination for airline mechanics is likely to be misleading. Several authors have recently estimated models in which unions determine wages at the firm level subject to the constraint imposed by the firm's labor demand function.[10] While such a model may turn out to be useful in describing post-1983 wage developments in the industry, it gives few insights into the homogeneous wage structure that prevailed in the industry before 1983.

b. Employment

Table 3 summarizes employment levels and growth rates between 1970 and 1984 at 11 major airlines and in the industry as a whole. In 1970, the trunk airlines accounted for 93 percent of total industry employment. Between 1970 and 1978, maintenance employment at the trunks fell by about 12 percent. During the same period employment at the local service airlines increased by 70 percent, causing the share of employment at the trunks to fall to 87 percent in 1978. This trend persisted after 1978, with some increase in the relative growth rate of maintenance employment at the non-trunk airlines. In 1984, the incumbent trunks' share of industry employment was 80 percent.

To place these trends in perspective, Table 4 provides an overview of flight activity in the industry. The relative pattern of growth rates in employment and output is similar, although industry output grew during the last decade while employment fell. Consequently, measured output per maintenance employee has increased. Much of this increase in output per worker, particularly at the smaller airlines, is attributable to changes in type of aircraft and route flown. Since 1978, the non-trunk airlines have increased the length of their routes and size of their aircraft, and in many cases have switched from turboprop to jet-engine aircraft. These changes have been associated with rapid increases in ton-miles and seat-miles per departure and per employee.[11/]

Although output and employment shares of the incumbent trunks have both declined sharply since 1970, the drop in output share occurred after 1978 while the drop in employment share started earlier. In 1984,

the trunks' employment share exceeded their output share by 6 percent. In part this may reflect the contracting-out of maintenance services by the smaller airlines--often to the trunks themselves.[12/] On balance, however, the output and employment data suggest that most of the relative decline in maintenance employment at the trunks is attributable to the decline in their relative output. This hypothesis is tested in the next section using data from four major trunk airlines: American, Eastern, Transworld, and United.

III. Changes in Productivity of Maintenance Employees

Between 1978 and 1984, the combined output of the four largest incumbent trunk airlines (American, Eastern, Transworld, and United) increased by 14 percent. During the same period, their combined maintenance employment fell 10 percent. Although some of this improved productivity represents a longer-term trend, it is interesting to ask whether deregulation contributed to the rate of growth of maintenance productivity at the incumbent airlines. Several recent changes associated with deregulation may have lead to an increase in trend productivity growth after 1978. These include the shift toward hub-based routing systems, which permit more centralized line service maintenance, and negotiated changes in work rules and staffing requirements.

In order to investigate the rate of growth of maintenance productivity, I fit a variety of employment functions for mechanics at the four major trunks.[13/] These functions express current maintenance employment in terms of airline-specific constants and trends, as well as lagged employment and current flight activity. The inclusion of lagged

employment captures the idea that employment adjusts slowly to output fluctuations. Flight activity is modelled in two alternative ways. In the first case, I represent airline output by departures, and control for the composition of aircraft and routes by including measures of seats per aircraft and flight length. In the second case, I control for aircraft and route composition by including a measure of ton-miles per departure. The latter specification permits maintenance employment to depend on arbitrary combinations of output as measured by departures or available ton-miles.

A preliminary investigation revealed no systematic wage effects on employment levels at the four airlines. In view of the stability of real wage rates over time, however, and in the absence of data on prices of substitutes for mechanics' services, it is not surprising that the estimated wage effects are small and imprecise. I therefore concentrate on the link between employment and output, and changes in output per worker over time.

The estimated employment demand functions are presented in Table 5. The employment functions are fitted as a four-equation seemingly-unrelated regression, with equality restrictions on the coefficients of lagged employment and output.[14/] Test results presented in row 7 of Table 5 indicate substantial conformity with the hypothesis of constant returns to scale in maintenance activities, after controlling for partial-adjustment.[15/] This restriction is therefore imposed on the estimated employment functions in Table 5.

The first two columns of the table present employment functions

with no allowance for changes in productivity growth after 1978. The overall fit of the employment function is similar for the two specifications, and there is no strong basis to choose between them. The estimated coefficients suggest that a 10 percent increase in output brings about a 6-7 percent increase in employment within the year, and a proportional change in employment within three years.

The implied decompositions of employment changes between 1978 and 1984 are presented in Table 6. For each airline, two decompositions are presented, depending on the choice of output specification. The decompositions show a declining demand for maintenance employment at all four airlines attributable to secular productivity growth. The productivity component is relatively large at United Airlines, and is roughly similar between the two specifications for all the airlines except Transworld. Productivity effect are partially offset by increases in the size of aircraft and length of flight, or alternatively by increases in ton-miles per departure. Changes in employment attributable to changes in output are large and negative at Transworld and United, and relatively small at American and Eastern.

Columns (3) and (4) of Table 5 present employment functions that permit airline-specific shifts in the rate of growth of maintenance productivity after 1978. The trend shifts are imprecisely measured, and the hypothesis that they are jointly equal to zero is easily accepted at conventional significance levels.[16/] The estimates differ somewhat between the two specifications, although they suggest that the largest increase in trend productivity growth occurred at United. The point

estimates of the change in productivity at United imply that maintenance employment was approximately 20 percent lower in 1984 than it would have been in the absence of a shift in trend, although the estimated cumulative effect is imprecise, and insignificantly different from zero by conventional standards.[17/] Apart from the distinction between secular and post-1978 productivity trends, the decompositions of employment changes associated with the specifications in columns (3) and (4) are very similar to those presented in Table 6.

Finally, the last two columns of Table 5 present employment functions estimated under the hypothesis of a uniform shift in trend productivity growth at all four airlines. Again, the estimated trend shifts are imprecise and differ somewhat depending on specification. Controlling for flight length and aircraft size, the estimated shift in productivity growth is .7 percent per year, implying a cumulative effect in 1984 of about 6 percent. Controlling for ton-miles the estimated shift is slightly larger, implying a cumulative effect of about 10 percent in 1984. These estimates suggest that maintenance employment at the four largest trunks in 1984 was 5-10 percent lower than would have been predicted on the basis of pre-deregulatory trends. Because of the short time period since deregulation, however, it is difficult to obtain a precise estimate of the trend change in 1978, and the data are statistically consistent with no change in productivity growth rates.

The estimates in Table 5 and the decompositions in Table 6 suggest two conclusions. First, if deregulation has caused an increase in productivity growth rates, the effect has been relatively small. Second,

the major components of employment change for the four largest trunk airlines are declining departure activity (for Transworld and United) and secular productivity growth. These effects have been partially offset by increases in aircraft size and flight length, with relatively small net changes in employment at two of the trunks (American and Eastern).

On the basis of these conclusions, it is possible to estimate the effect of deregulation on maintenance employment at the incumbent trunks by calculating their relative output losses since 1978. Between 1978 and 1984, the growth rates of departures and ton-miles for the industry as a whole exceeded their respective rates at the trunks by 17 and 18 percent.[18/] Assuming a unitary elasticity between employment and output, as suggested by the estimates in Table 5, employment would have been 15-20 percent higher at the trunks in 1984 if they had retained their pre-deregulatory share of industry output. If, in addition, deregulation increased the rate of growth of maintenance productivity as suggested by the point estimates in Table 5, then employment would have been at most 20-30 percent higher at the trunks in the absence of deregulation.

Combining these estimates with an estimate of the wage gap between the incumbent trunks and the smaller airlines yields an estimate of the effect of deregulation on the earnings of mechanics in the airline industry. Evidence from industry wage surveys and union contracts at the smaller airlines suggests that the wage gap between the incumbent trunks and other airlines is relatively small: perhaps no more than 25 percent.

This gap is consistent with the difference between new-hire rates and established rates in two-tiered contracts recently introduced at many of the trunks, and with the magnitude of wage concessions recently negotiated at several of the trunks. It also represents the historical gap between mechanics' wage rates at the incumbent trunks and average hourly earnings of maintenance mechanics in manufacturing industries. Assuming a maximum 25 percent wage differential, employment losses at the trunks attributable to deregulation have reduced total earnings of maintenance workers in the industry by approximately 5 percent.

Summary and Conclusions

Deregulation of the airline industry has had a strong impact on the level of flight activity and the profitability of the incumbent trunk airlines.[19/] For airline mechanics at these airlines, however, the main effect of deregulation has been to reduce employment. While contracts at several of the trunks cut wages at the end of 1983, mechanics' real and relative wage rates were remarkably stable in the first five years of deregulation. Wage stability across firms and over time is consistent with the behavior of mechanics' wages prior to deregulation. Data from 1970 to 1978 indicate that wages were historically insensitive to firm-specific employment conditions. This pattern persisted after 1978, with only recent evidence of a breakdown in the homogeneous industry wage structure.

Reductions in maintenance employment at the incumbent trunks since 1978 can be attributed to several different factors including secular productivity growth and changes in output. An analysis of the

employment-output relationship reveals small but imprecisely measured increases in the rate of growth of productivity following deregulation. An analysis of output shares, on the other hand, reveals a 10 percentage point drop in the share of flight activity at the incumbent trunks since 1978. This loss in output share is equivalent to a 15-20 percent reduction in maintenance employment at the incumbent trunks, or a transfer of 5000-7000 maintenance jobs from the incumbent trunks to the smaller airlines. Because the wage gap between the incumbent trunks and the other airlines in the industry is small, the effect of this transfer on the earnings of mechanics in the industry is small--at most 5 percent.

In contrast to this effect for airline mechanics, the affect of deregulation on pilots' earnings may have been larger.[20/] Compared to mechanics, however, historical differentials between pilots' earnings at the incumbent trunks were relatively large. By the same token, pilots have relatively few employment opportunities outside the airline industry. This raises an important hypothesis for further research: is the effect of product market deregulation on wages or earnings related to the historical structure of wages in the industry or the gap between wage rates for similar workers in other industries? The experience of the airline mechanics suggests that the impact is small when inter-firm and inter-industry wage differentials are small. More detailed comparisons between pilots, flight attendants, and mechanics could provide useful evidence on this hypothesis.

Footnotes

1/ There is a growing literature on the effect of deregulation on industrial relations in the airline industry. See in particular the papers by Hendriks, Feuille and Szerszen (1980), Northrup (1983), and Capelli (1985). Cordes, Goldfarb and Johnson (1984) describe the likely effect of job loss compensation provisions of the Airline Deregulation Act. Bailey, Graham and Kaplan (1985) give an overview of deregulation's effect on the industry as a whole.

2/ Based on 1984 employment figures for 92 percent of maintenance workers in the industry, the IAM represents 63 percent of airline mechanics, the TWU represents 22 percent of mechanics, and the IBT represents 5 percent of mechanics.

3/ The wage data in Table 1 was assembled from a variety of sources, including contracts on file at the National Mediation Board, and published reports in the Bureau of Labor Statistics' Current Wage Developments and the Bureau of National Affair's Daily Labor Report. I am grateful to the Airline Division of the IBT for supplying me with copies of the Western Airlines contracts from 1966 to 1981.

4/ The pattern of wages in Table 1 extends to many of the smaller unionized carriers in the industry. For example, the mechanics' wage rate was 16.25 in September 1983 in the Ozark Airlines--Airline Mechanics Fraternal Association contract; 15.91 in April 1983 in the Piedmont Airlines-IAM contract; 15.59 in September 1983 in the Pacific Southwest Airlines-IBT contract; and 15.91 in June 1983 in the

Republic Airlines-IAM contract. Concessionary contracts were subsequently signed at Pacific Southwest and Republic, while Ozark and Piedmont have retained wage parity with the more profitable trunk airlines.

5/For the economy as a whole, the 1982 recession was deeper but shorter-lived than the 1973-74 recession. In the airline industry, sales as measured by revenue passenger miles were more or less constant between 1973 and 1975, and between 1980 and 1982 (compared with an average annual growth rate of revenue passenger miles of 6.4 percent per year over the 1971-84 period). Real average passenger fares fell about 5 percent between 1974 and 1975, and about 10 percent between 1981 and 1982.

6/According to 1980 Census data, 52 percent of aircraft mechanics are employed in the air transportation industry, of which roughly two-thirds are employed in the certified airline industry. Some 20 percent of aircraft mechanics are employed in the aircraft and parts industry, while another 20 percent are employed in the military.

7/The schedule at American Airlines, for example, provides approximately 25 percent lower discounted earnings for new hires during their first 12 years with the firm than for incumbent workers with similar qualifications. Two-tiered schedules were introduced in the February 1983 contract at American; in the July 1984 contract at United; in the April 1985 contract at USAir; and in the July 1985 contract at Northwest.

8/Two-tiered wage schedules were introduced in April 1982 at

Piedmont; in June 1982 at Ozark; and in June 1983 at Republic.

9/ The employment data in Table 3 is taken from Schedule P-10 of the Form 41 reports filed by the airlines with the Civil Aeronautics Board. The figures represent fourth quarter employment in 1970 and year-end employment in 1978 and 1984 for maintenance and related workers. A comparison of maintenance employment with employment of mechanics and inspectors recorded in the industry wage surveys suggests that some 70-80 percent of maintenance employees are mechanics or inspectors.

10/ See for example Dertouzos and Pencavel (1981) or Pencavel (1984).

11/ For example, Piedmont Airlines increased their available ton-miles and available seat miles at a rate of approximately 28 percent per year from 1978 to 1984. Over the same period, maintenance employment and scheduled departures grew at only 8 percent per year. The increase in capacity came from the replacement of turbo-prop aircraft by two-and three-engine jet aircraft, and associated increases in seats per aircraft (from 86 in 1978 to 126 in 1984) and flight length (from 181 miles in 1978 to 347 miles in 1984).

12/ People's Express, for example, employs none of its own airline mechanics.

13/ The choice of the four major trunks is somewhat arbitrary. Most of the other incumbent trunks were affected by mergers, forced reorganization, or prolonged strikes in the period 1970-84.

14/ Tests for coefficient equality were insignificant at 20 percent significance levels in all cases.

15/ The fitted employment demand functions have the form

$$\log E_{it} = a_i + b_i t + \lambda \log E_{it-1} + \theta \log F_{it} + \gamma x_{it} + \epsilon_{it}$$

where E_{it} represents maintenance employment at airline i in period t, a_i and b_i are airline-specific constants and trends, F_{it} represents departures at airline i in period t, x_{it} represents a control for aircraft and routes, and ϵ_{it} is an error term. The hypothesis of a one-to-one employment-output relation is represented by $\theta = 1-\lambda$.

16/ The probability values of the test statistics for no shift in trend after 1978 are .46 and .35 respectively, for the employment functions in columns (3) and (4).

17/ In a first-order autoregressive model with a coefficient of λ on the lagged dependent variable, the effect of a change in trend of δ percent at some reference period yields a cumulative effect of $\delta(t + (t-1)\lambda + (t-2)\lambda^2 + \ldots + \lambda^{t-1})$ t periods later. Over a six year interval, the cumulative effect is 7.2δ if $\lambda = 0.2$ and 8δ if $\lambda = 0.3$. A rough estimate of the standard error for the cumulative effect can be obtained by multiplying the standard error of the estimated trend shift (δ) by the appropriate cumulative factor.

18/ Industry scheduled departures were 50403000 in 1978 and 56162000 in 1984. Scheduled departures at the 11 incumbent trunks were 3509000 in 1978 and 3195000 in 1984.

19/ For example, Delta Airlines earned operating losses for the first time in its history in 1982. Braniff, Continental, Eastern and Western, which all earned positive operating profits from 1970 to 1978, earned large operating losses from 1980-1983. By comparison, USAir earned significantly higher operating profits after 1978 than before.

20/ According to BLS industry wage surveys administered in 1975, 1980, and 1984, average gross monthly earnings of captains and the corresponding coefficients of variation of captains' earnings were $4314 and .15 in 1975; $6877 and .19 in 1980; and $8154 and .29 in 1984. In 1967 dollars, these average earnings levels were $2676 in 1975, $2786 in 1980, and $2621 in 1984.

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Table 1

Wage Rates for Airline Mechanics at the Signing Dates of New Contracts: 1966-85[1/]

	Incumbent Trunks									Comparison Wages		
	American[2/] (TWU)	Braniff[3/] (IAM)	Continental[4/] (IAM)	Eastern[5/] (IAM)	Northwest (IAM)	Transworld[6/] (IAM)	United (IAM)	USAir (IAM)	Western[7/] (IBT)	Boeing[8/] (IAM)	Maintenance Mechanics in Manufacturing[9/]	Production Workers in Manufacturing[10/]
1. 1966	3.78 (5-66)	3.70 (6-66)	3.70 (6-66)	3.70 (6-66)	3.70 (6-66)	3.70 (6-66)	3.70 (6-66)	3.70 (6-66)	3.90 (12-66)	3.58 (3-64)	3.43	2.74
2. 1969	4.60 (3-69)	4.55 (4-69)	4.70 (9-69)	4.55 (4-69)	4.85 (11-69)	4.82 (1-70	4.90 (10-69)	4.85 (8-69)	4.60 (8-69)	4.40 (10-68)	3.77	3.05
3. 1972	5.75 (5-71)	6.20 (9-72)	6.20 (9-72)	6.20 (10-72)	6.20 (9-72)	6.20 (12-72)	6.20 (8 72)	6.20 (9-72)	6.07 (8-72)	5.19 (11 71)	4.56	3.66
4. 1974	7.10 (5-74)	6.80 (1-73)	7.40 (8-74)	7.30 (7-74)	7.30 (6-74)	7.50 (3-75)	7.30 (5-74)	7.30 (8-74)	7.25 (5-74)	6.68 (10-74)	5.22	4.25
5. 1976	8.27 (6-76)	8.23 (3-76)	8.34 (1-76)	7.89 (1-76)	8.21 (12-75)	8.65 (9-76)	8.23 (2-75)	8.65 (8 76)	9.48 (6-77)	8.70 (11-77)	6.54	5.02
6. 1979	9.75 (2-78)	10.90 (4-79)	11.43 (9-79)	11.10 (4-79)	11.64 (10-79)	11.20 (10-78)	11.10 (11-78)	11.20 (5-79)	11.44 (6-79)	12.20 (10-80)	8.41	6.43
7. 1983	15.69 (2-83)	-----	-----	15.90 (3-83)	14.60 (6-82)	15.90 (1-83)	14.73 (3-82)	15.00 (8-82)	15.62 (8 82)	15.60 (10-83)	12.00	8.51
8. Most Recent	17.79 (9-85)	9.50 (3-84)	13.45 (4-85)	15.85 (5-85)	17.15 (7-85)	15.25 (8-85)	16.65 (7-84)	17.25 (4-85)	12.60 (9-84)	-----	-----	

Notes:

1/Signing dates are in parentheses. Wage rates are for experienced mechanics, exclusive of line service and license differentials.

2/American and TWU also negotiated a contract in August 1980 that provided a wage rate of 11.79 at the signing date.

3/In March 1981 Braniff and IAM negotiated a pay cut that established a wage rate of 12.00 through 1982. Braniff declared bankruptcy in August 1982 and returned to operations in March 1984. The newly negotiated mechanics' contract specified a wage rate of 9.50.

4/Continental filed for bankruptcy in September 1983 and announced a policy of rehiring its mechanics at their old wage rate (13.45). This policy initiated a strike that was called off April 1985.

5/The Eastern-IAM contract negotiated January 1976 instituted profit sharing and a one year wage freeze, with raises in 1977 based on the profitability of the company in 1976. The agreement was modified in July 1977, and re-established wage parity with the industry by the end of 1978. Eastern and IAM negotiated on 1 percent wage cut in December 1983 that remained in effect through March 1985.

6/In August 1985 TWA and IAM announced a three year wage cut program that reduced wages by 15 percent effective September 1985.

7/In August 1982 Western and IBT negotiated a one year extension of their contract signed in June 1981. That contract established a rate of 14.20. In November 1983, they negotiated a 10 percent wage cut that reduced wages to 14.40. In September 1984 they negotiated a further 12.5 percent wage cut.

8/Wage rate for airline mechanics under contract negotiated by Boeing (Washington State) and IAM.

9/Average wage rate for maintenance mechanics in manufacturing, from the BLS Area Wage Survey.

10/Average straight time hourly earnings of production workers in manufacturing.

Table 2

Employment and Wage Rates of Airline Mechanics at Scheduled Airlines[1]

	Date	Number of Airlines in Industry[2]	Number of Mechanics & Inspectors	Mechanic's Average Wage Rates[3/] Current Dollars	1970 Dollars	Relative to Contract Rate at UAL	Coefficient of Variation of Mechanics Wage[4]
1.	August 1970	27	38074	5.37	5.37	.98	.039
2.	August-November 1975	26	37362	8.20	5.92	1.02	.042
3.	September 1980	30	39278	12.43	5.86	.97	.061
4.	June 1984	39	36252	16.04	6.00	.96	.144

1/Reported in BLS Industry Wage Surveys: Scheduled Airlines (various issues).

2/Excludes intra-Alaska and intra-Hawaii carriers.

3/Wage rates include license premiums and line-service premiums. The contract wage rate at United Airlines includes the maximum of two license premiums.

4/Author's calculations based on reported wage distributions.

Table 3

Employment of Airline Mechanics: 1970-84[1/]

	American[2/]	Braniff[3/]	Continental[4/]	Delta[5/]	Eastern	Northwest[6/]	PanAm National	Transworld	United[8/]	US Air[9/]	Western[10/]	Total 11 Airlines	Total All Carriers[11/]	Share 11 Airlines
1. Employment 1970	6666	1013	1189	3367	6237	1597	6442	6570	10447	1078	1320	45926	49331	.93
2. Employment 1978	6211	1006	1078	3564	6516	1351	4257	5752	8193	1178	1374	40480	46302	.87
3. Employment 1984	6071	343	942	3812	6608	1547	3082	4372	6840	1464	955	36036	45263	.80
4. Growth Rate of Employment 1970-78 (percent/year)	-.9	-.1	-1.2	.7	.5	-2.1	-5.0	-1.6	-3.0	1.1	.5	-1.6	-.8	---
5. Growth Rate of Employment 1978-84 (percent/year)	-.4	-16.4	-2.2	1.1	.2	2.3	-5.2	-4.5	-3.0	3.7	-5.9	-1.9	-.4	

Notes:

1/Employment of maintenance and related workers in domestic and international services. 1970 figures are fourth quarter totals. 1978 and 1984 figures are year end totals. Employment is taken from Civil Aeronautics Board Form 41 Reports, Schedule P-10.

2/Employment total in 1984 is estimated by the author from published employment totals in the 1984 AMR Annual Report. Schedule P-10 shows employment in 1984 of 4706 workers.

3/Braniff closed down in 1982 and resumed operations in March 1984. Employment total for 1984 is taken from a report in the Daily Labor Report (1984 DLR:A4). Schedule P-10 shows no employment of maintenance workers in 1984.

4/Continental filed for bankruptcy and resumed operations at a reduced scale in September 1982.

5/Delta merged with Northeast Airlines in August 1972. 1970 employment total includes both airlines.

6/Northwest was on strike in 1970 and 1978. 1970 employment total represents the average of employment for first two quarters of 1970. Schedule P-10 employment at the end of 1970 was 62 workers. 1978 employment total represents the average of year-end employment totals in 1977 and 1979. Schedule P-10 employment in 1978 was 898 workers.

7/PanAm and National merged in 1979. Previous employment totals include both airlines.

8/Employment totals in 1978 and 1984 are estimated by the author on the basis of reported employment in maintenance category and aircraft servicing category. Schedule P-10 maintenance employment was 6811 workers in 1978 and 5800 in 1984.

9/Formerly Allegheny. Allegheny and Mohawk merged in April 1972. 1970 employment total includes both airlines.

10/1984 employment is estimated by the author on the basis of reported employment in maintenance category and aircraft servicing category. Schedule P-10 maintenance employment was 655 workers in 1984.

11/Total employment of all scheduled carriers including all-cargo carriers. 1970 figure is from the F.A.A. Statistical Handbook of Aviation (1971 edition). 1978 and 1984 figures are taken from the Air Transport Association Air Transport (1979 and 1985 editions). Totals for all carriers are adjusted for revised data for individual carriers.

Table 4

Growth Rates and Shares of Airline Output and Output per Employee: 1970-84

	Available Ton-Miles (Millions)			Available Ton Miles Per Maintenance Worker (Millions)	
	11 Major Airlines	All Carriers	Output Share-11 Major Airlines	11 Major Airlines	All Carriers
1. 1970	39407	43722	.90	.858	.886
2. 1978	50403	56869	.89	1.245	1.228
3. 1984	56162	75763	.74	1.558	1.674
4. Growth Rate 1970-80 (percent/year)	3.1	3.3	----	4.8	4.2
5. Growth Rate 1978-84 (percent/year)	1.8	4.9	----	3.8	5.3

Source: Output data are taken from Civil Aeronautics Board Air Carrier Traffic Statistics (various issues).

Table 5

Maintenance Employment Functions for Four Major Airlines: 1971-84
(Standard errors in parentheses)

	Dependent Variables: Logarithm of Maintenance Employment					
	No Trend Shift		Airline-Specific Trend Shift		Common Trend Shift	
	(1)	(2)	(3)	(4)	(5)	(6)
1. Logarithm of Lagged Employment	.36 (.07)	.30 (.07)	.33 (.08)	.23 (.09)	.36 (.07)	.25 (.09)
2. Logarithm of Departures	.64 (.07)	.70 (.07)	.67 (.08)	.77 (.09)	.64 (.07)	.75 (.09)
3. Logarithm of Flight Length	.10 (.13)	---	.18 (.18)	---	.17 (.14)	---
4. Logarithm of Average Aircraft Size	.31 (.20)	---	.49 (.26)	---	.51 (.23)	---
5. Logarithm of Ton-Miles per Departure	---	.28 (.13)	---	.40 (.17)	---	.41 (.15)
6. 1978 Trend Shift Estimates:						
(a) American	---	---	-.009 (.010)	-.010 (.010)	-.007 (.007)	-.014 (.008)
(b) Eastern	---	---	.005 (.011)	-.002 (.015)	-.007 (.007)	-.014 (.008)
(c) Transworld	---	---	-.003 (.014)	-.016 (.017)	-.007 (.007)	-.014 (.008)
(d) United	---	---	-.022 (.018)	-.029 (.022)	-.007 (.007)	-.014 (.008)
7. Probability value of test for unit output elasticity	.64	.32	.44	.97	.59	.96
8. Standard Error	.050	.058	.043	.057	.046	.059

Note: Regressions include unrestricted airline-specific constants, unrestricted airline-specific trends, and dummy variables for strikes at Transworld (1973) and United (1975, 1979). Coefficients on lagged employment, departures, and available ton-miles are restricted to be equal across airlines. The sum of the coefficients on lagged employment and departures is restricted to unity. The probability values of the test for this restriction are reported i row 7.

Table 6

Decomposition of Employment Changes 1978-84
Assuming No Change in Trend Productivity Growth

	Predicted Percentage Changes in Employment[1/]							
	American		Eastern		Transworld		United	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Source:								
1. Change in Departures	.4	.2	-2.5	-4.0	-33.6	-35.2	-10.8	-11.2
2. Change in Flight Length	1.4	---	2.8	---	1.5	---	2.7	---
3. Change in Seats per Aircraft	7.2	---	8.3	---	15.7	---	7.1	---
4. Change in Ton Miles per Departure	---	6.0	---	12.1	---	12.3	---	8.9
5. Trend Productivity	-6.7	-4.3	-6.3	-4.4	-11.4	-3.5	-15.0	-15.1
Total Predicted Change in Employment	2.3	1.7	2.3	3.7	-27.8	-26.4	-16.0	-17.4
Actual Change in Employment	-2.3		1.4		-27.4		-18.0	

Notes:

[1/] Predicted percentage changes based on estimated employment functions in Table 5. For each airline, the predicted changes in column (1) correspond to the estimated model in column (1) of Table 5, while the predicted changes in column (2) correspond to the estimated model in column (2) of Table 5.