Earnings, Rents, and Competition in the Airline Labor Market

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Abstract

Transformation of the airline labor market continues long after deregulation. Airline wages changed little immediately following deregulation, implying either the absence of regulatory rents or maintenance of product market power and union strength. Analysis for 1973-1997, however, indicates that prior to recent gains, the relative earnings of air transport workers decreased markedly during the latter half of the 1980s and early 1990s. Some of the earnings advantage of airline workers represents returns to occupational skills and worker-specific quality. Labor rents are attributable largely to union bargaining power, which in turn is constrained by the financial health of carriers.

I.   Introduction

During the 20 years in which airline deregulation has been in effect, few industries have witnessed

the turmoil that has been evident in the airline product and labor markets. Bankruptcies, poor financial

performance by carriers, and corporate restructuring during the deregulation era have focused management

attention on labor costs. It is not surprising that attempts to change the level and structure of remuneration

have encountered considerable resistance in an industry with substantial union strength and a labor relations

environment characterized neither by cooperation nor trust. The very public push by carriers to lower

compensation has been predicated on the assumption that their employees are realizing rents.[1] The creation

and dissipation of rents in the airline industry is central to economists' understanding of how regulation and

deregulation works. Moreover, the level of labor rents will affect the industry's future. If substantial rents

exist, then airlines may have the opportunity to increase profitability and lower prices through reductions in

compensation. But if rents are modest and a union strike threat is present, a continuing push for lower

wages may entail unacceptably high costs.

Until recently, there was a consensus that relative earnings in the airline industry had changed little

following deregulation in 1978, with real changes through the mid- to late-1980s largely reflecting

economywide changes (see Card 1986, 1989; Johnson 1991, 1995; Hendricks 1994; and a survey on

deregulation by Winston 1993).[2] The apparent absence of falling wages in airlines is something of a puzzle,

especially given the experience of the motor carrier industry, where a large decrease in union density and

relative wages among union (and to a lesser extent, nonunion) truck drivers occurred shortly following

deregulation (Rose 1987; Hirsch 1988; Hirsch and Macpherson 1998*a*). Card (1989) concludes that either

airline industry employees were never earning substantial rents or union strength and worker rents have

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[1] Rents here are defined as payments to labor beyond long-run opportunity costs. Employees may realize short-run
premiums or quasi-rents owing to costs associated with job mobility, firm- and industry-specific skills, and implicit
contracts that allow earnings to deviate from spot marginal products. Note also that in settings where monitoring is
costly (e.g., flight attendants), "efficiency wages" may be consistent with both profit maximization and worker rents
(see Weiss 1990).
[2] Quoting Johnson (1995): "Reports of wage cuts and wage freezes and of other forms of wage concessions in the
airline industry have been heard frequently since deregulation. ... This chapter will provide a body of evidence that,
when taken together, indicates that airline workers, on average, have not experienced a significantly larger erosion
in their real wages than workers in other industries" (p. 101).

been maintained following deregulation. He emphasizes the former explanation. Hendricks (1994) concludes that union strength and a concentrated product market have allowed labor to retain high wages in the airline (and other previously regulated) industries, with trucking being more the exception than the rule.[3]

Results from recent studies suggest that such conclusions about airline deregulation were premature (Hirsch and Macpherson 1995; Crémieux 1996*b*; Card 1998). Using 1980 and 1990 Census of Population data, Card finds an approximate 10 percentage point decline in relative airline earnings between 1979 and 1989. A more limited analysis using the March Current Population Survey (CPS) and a small sample of air transport workers for 1993-94 suggests little change since 1989. Contract data indicate increased wage dispersion across carriers. Card characterizes these results as indicating relatively small rents in the airline industry from regulation, although he notes that the airline labor market may not have yet fully adjusted to deregulation. Crémieux (1996*b*), examining annual reports to the Department of Transportation from carriers for 1959-1992 finds substantial declines in pay awarded by carriers to pilots and flight attendants, with relatively little change among mechanics, relative to selected control groups.

This paper examines the transition of the labor market in the air transport industry as it evolved from the 1970s period, which was characterized by price and entry regulation, to a more competitive environment following deregulation in 1978. Using various methods, we evaluate the magnitude of relative earnings and rents in the airline industry during the 1973-97 period. We first estimate "standard" earnings differentials bassed on comparisons of airline employees with alternative comparison groups, after controlling for typically measured worker characteristics. We then present "expanded" differentials that take into account skill requirements and working conditions in airline and nonairline occupations. A separate analysis attempts to gauge how much of the airline premium is a result of labor union effects on union and nonunion earnings. We briefly discuss longitudinal analysis of airline entrants and leavers, as well as changes over time in earnings dispersion in the industry.

II. The Airline Labor Market and Deregulation's Effects on Wages and Employment

The evolution of labor relations in the airline industry has been well documented (see, among others, Northrup 1983; Cappelli 1987, 1992; Crémieux 1996*b*; and Card 1998). Following the efforts of the

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[3] The uniqueness of the airline labor market is emphasized in a newspaper quotation from Peter Cappelli: "This is an industry where unions are surging in power. I can't think of any other one" (McCartney 1995 at A-1).

Air Line Pilots Association (ALPA), created in 1931, the Railway Labor Act (passed in 1926) was extended in 1936 to cover the airline industry. The Civil Aeronautics Act of 1938 established the Civil Aeronautics Board (CAB) as the industry's chief regulatory body and, in so doing, the CAB assumed responsibility for ruling on and enforcing labor law provisions. The bargaining structure that evolved was highly decentralized, with there being separate unions by craft and carrier-by-carrier bargaining. Although there were notable exceptions, the regulatory period was most often characterized by "pattern bargaining," whereby contract settlements at one airline served as a starting point for negotiations at the next airline. Because airline rates were determined (or approved) by the CAB, largely on the basis of costs, and entry and price (but not nonprice) competition were restricted, carrier resistance to union wage demands was muted. Of course, individual carriers benefited by lower labor costs owing to regulatory lag, costs being determined on an industry rather than a carrier-specific basis (Ehrenberg 1979), and lower prices to consumers producing a larger volume of traffic. Carriers' bargaining power also may have been enhanced by the Mutual Aid Pact, a strike insurance plan created in 1958, through which a struck carrier was compensated by nonstruck carriers based on increases in traffic the latter realized during a strike.[4] While union bargaining power during the regulatory period was clearly constrained, carriers' survival and growth were not ultimately threatened by the existence of rents for airline employees.

The Airline Deregulation Act of 1978 facilitated competition in the industry, abolishing most restrictions on entry and price competition. Deregulation forced carriers to make the transition to an environment in which financial performance was driven by cost, price, and service. In such an environment, one might expect labor unions to maintain long-run rents for their members only if there were substantial barriers to entry (e.g., owing to command over airport gates and scale economies from hubs) or if they were able to organize industrywide and raise costs at most carriers. Unions retained substantial bargaining power following deregulation, benefiting from the price-driven expansion of the industry, from increased employment that accompanied the elimination of regulatory inefficiencies, and, possibly, from abolishment of the Mutual Aid Pact. The Railway Labor Act, which encourages firmwide rather than site-specific contracts, has made it difficult for airlines to create "double-breasted" nonunion operations that operate

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[4] Crémieux (1996a) provides evidence, however, suggesting that the Mutual Aid Pact was ineffective.

alongside firms' union operations, as common in the trucking and construction industries. While unions retained the ability to impose losses on carriers, increased competition, fuel price increases, and the 1979, 1981-82, and 1990-92 recessions put strong financial pressures on carriers and their workers. Wage concessions, particularly at carriers threatened by bankruptcy, became common (Nay 1991). Pattern bargaining became less a union goal and more a lever for carriers eager to match concessions received by other carriers. The risk of job loss became the key element restraining union demands.

The deregulation period has been characterized by considerable variation across carriers in wage and work rule changes. A detailed picture of the airline labor market (see, e.g., Cappelli 1992) would emphasize the financial problems of specific carriers, the effects of mergers and bankruptcies on labor, the adoption of two-tier wage agreements ("B" scales) that lowered wages for new hires relative to incumbent workers, corporate strategies intended to lower labor costs, the effects of major confrontations (e.g., the 1989 Eastern strike) on relative bargaining power and labor relations strategies, and the extent of cooperation and coordination among unions across crafts and across carriers. A common thread running through these events has been the attempt by carriers to lower compensation and decrease labor costs relative to productivity. This force is not unique to the airline industry. But the strength of this effort, the magnitude of the changes, and the turbulence with which these changes have occurred reflect the industry's history of regulation and subsequent deregulation and the inevitable movement from a high-wage industry to one where labor compensation more closely reflects opportunity costs.

Theory provides a rough guide to the expected effects of product market regulation and deregulation on labor earnings. In a competitive labor market, compensation would be determined in the long-run by opportunity-cost wages and not be firm- and industry-specific financial performance, average labor productivity, or market structure. But if worker rents exist owing to regulation, market structure, or union bargaining power, the macroeconomy and changes in industry structure and performance will influence both the level of and changes in worker earnings. Regulation made possible widespread unionization, the capture of rents for union members, and nonunion rent sharing, given the absence of a large nonunion or

unregulated segment of the market.[5] Deregulation is likely to have put downward pressure on earnings in those market sectors most affected by entry. Entry in the airline industry has often proven difficult, however, owing to economies of scale and scope, licensing barriers for workers and airlines, the scarcity of airport gates, and, concomitantly, the ability of unions to maintain a strike threat and considerable bargaining power. We would expect, therefore, that deregulation would lower average industry earnings through the entry and expansion of low-cost nonunion (and some union) carriers and financial pressures on some incumbent carriers. At the same time, union workers at relatively healthy carriers might maintain for some time relatively high earnings. Industrywide earnings variance should increase. In the long run, entry and price competition might be expected to lower the industrywide earnings level as carriers with high labor costs obtain concessions from their workers or expand more slowly than do lower cost carriers.

An explicit linkage between industry performance and changes in relative airline earnings is beyond the scope of this paper. Card (1998, table 1) provides a succinct overview of industry performance, however, which we summarize below (also see Cappelli 1992). Although airline traffic is cyclically sensitive, secular changes in price and traffic were roughly similar before and after deregulation. Revenue passenger miles (RPM) grew at an average 7.1% per year from 1968 to 1978 and an average 5.3% during 1978-94; freight ton miles grew at average rates per year of 5.7% and 5.5% during the regulatory and deregulatory periods, respectively. Much of the increase in traffic has been fueled by technological change and concomitant price declines. Constant dollar price per mile decreased by 2.3% annually during 1968-78 and 2.4% annually during 1978-94. Employment growth has been substantially faster since deregulation, 2.0% annually since 1978 versus only 0.5% annually in the decade prior to deregulation. Average labor productivity growth (measured by RPM's per worker), thus, has slowed, from 6.5% annually during 1968-78 to 3.3% annually from 1968-94 (figures for the latter period exclude Federal Express employees), reflecting in part the movement to large passenger jets that occurred prior to deregulation.

The linkage between industry performance and wage outcomes is not straightforward. In a competitive labor market, wage changes should not be related to industry-specific average productivity

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[5] This contrasts with the trucking industry, where there was a large nonregulated sector (i.e., own-company transport rather than the use of common carriers) and little rent sharing among nonunion drivers and drivers outside the trucking industry (Rose 1987; Hirsch 1988). Following deregulation, entry occurred rapidly in the common carrier truckload sector market, with union density and wages falling substantially.

growth (driven in part by technological change) but, rather, to economywide changes in productivity. Employment should then adjust such that marginal revenue products roughly equal opportunity-cost compensation. Likewise, changes in price need not be closely correlated with wage changes since higher prices could be the result of higher wages or increased product demand, leading to a positive correlation, or result from increases in fuel or other costs that would result in lower traffic and a negative correlation between product price and wages (for evidence on input and product price changes, see Krueger 1997). Worker rents and union wage demands should be most heavily influenced by (unobservable) potential profits (i.e., profits that would exist absent worker rents). Card (1998, table 1) presents an accounting measure of the return on investment (ROI) for 1968 and even years beginning in 1978. The ROI was 4.9% in 1968 and 13.3% in 1978 (an average 9.1% across the 2 years), versus an average 2.9% for even years during 1980-94 (the high was 10.8% in 1988, and the low was -9.3% in 1992). Lower average returns and greater variance following deregulation could be expected to put a squeeze on extant worker rents. Also relevant for union bargaining power are product market structure and shareholder rents. Market shares of entrants and small incumbents increased modestly following deregulation, but the shares of the largest carriers rose beginning in the mid- to late-1980s (Card 1998, fig. 1), owing in part to the prevalence of hub-spoke arrangements and limited access to airport gates by entrants and smaller carriers.

III. Method, Data, and Descriptive Evidence

A. Method

The principal method used in our study is a change-in-differential approach. We examine changes over time in the earnings of air transport industry workers relative to the earnings of appropriate comparison groups of workers, first controlling for worker and job characteristics. Changes in relative earnings are attributed to deregulation and other industry-specific factors. The choice of comparison group has little effect on changes in relative earnings. The level of relative earnings is affected by the choice, although rather modestly once controlling for worker characteristics, job skill requirements, and working conditions. For some airline occupations (e.g., mechanics), there are workers in similar occupations outside of the industry that serve as a natural comparison group. But in the case of other airline groups (e.g., pilots and attendants), relatively broad comparison groups are employed since few directly comparable occupations

exist. We initially provide standard controls for measurable worker and labor market characteristics. For the years beginning in 1983, our measures of comparability are enhanced by the inclusion of occupational skill requirements and working conditions.

We first calculate changes over time in the real earnings of airline employee groups, absent use of comparison groups. An "adjusted earnings index" is constructed for the airline industry and each airline craft by estimating for each group a log earnings regression, pooled over the 1973-97 period. That is,

(1) $$\ln EARN_{ijt} = \Sigma \beta_{jk} X_{ijtk} + \Sigma \Phi_{jy} YEAR_{ijty} + \varepsilon_{ijt}$$

where $\ln EARN_{ijt}$ is the log of usual weekly earnings for individual i in airline craft group j in year t, X_{ijtk} includes variables (indexed by k) measuring worker and market characteristics, and β_{jk} are the corresponding coefficients (X_0 equals unity and β_0 is the intercept), YEAR is a set of dummy variables (indexed by y) for 1973-74 through 1997 (1977-78 is the reference year), and ε is an error term assumed to have zero mean and constant variance. For each airline group j, we construct the adjusted earnings index from Φ_{jy}, the year dummy coefficients. Values of Φ_{jy} measure the logarithmic earnings differentials relative to the base period; these are converted to a percentage index by $100[\exp(\Phi)-1]+100$, with 1977-78=100. Pooling over years assumes a stable wage structure over time, an assumption that we relax below. The industry index is based on the sample of all air transport workers.

We next estimate annual measures of "relative earnings differentials" for 1973-97. These measures reflect the log earnings differential for each airline group relative to a comparison group of nonairline employees, controlling for worker and job characteristics. The annual earnings differential for each airline group is extracted from a log earnings regression including all full-time employed wage and salary workers. We include all workers to better estimate the appropriate labor market earnings structure, allowing coefficients to vary by year.[6] We do not, however, compare the earnings of each airline craft relative to the entire labor force but, rather, calculate each differential by comparing the earnings for the airline craft to a subset of nonairline workers. This is accomplished by including dummies for each of the airline craft groups, along with occupational dummies for nonairline groups of workers. Each airline craft differential is

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[6] As widely recognized, use of narrow occupational samples will bias, among other things, the estimated returns to schooling (since schooling provides mobility across as well as within occupations) and the wage differentials associated with job skills and working conditions.

calculated either as (1) the difference between the airline craft coefficient and a single nonairline dummy coefficient when the latter corresponds exactly to the comparison group, or (2) the difference between the craft coefficient and a weighted combination (using nonairline sample sizes as weights) of nonairline dummy coefficients when the comparison group spans two or more occupational categories. The earnings differential for the air transport industry is a sample-weighted average of the composite craft differentials. This method permits the wage structure, determined largely by the nonairline sample, to be determined economy-wide and to vary by year.

We estimate two measures of airline earnings differentials, a "standard" measure and an "expanded" measure. The standard measure controls for individual and labor market characteristics typically included in household surveys. The expanded measure controls for occupational skill requirements and working conditions, allowing us to compare similar workers and jobs.[7] Letting equations (2) and (3) be the standard and expanded specifications, respectively, estimated separately by year t, we have

(2) $$\ln EARN_{it} = \Sigma \beta_{kt} X_{kit} + \Sigma \theta_{jt} AIR_{jit} + \Sigma \Omega_{ct} OCC_{cit} + \varepsilon_{it} ,$$

and

(3) $$\ln EARN_{it} = \Sigma \beta'_{kt} X_{kit} + \Sigma \Gamma_{mt} Z_{mit} + \Sigma \theta'_{jt} AIR_{jit} + \Sigma \Omega'_{ct} OCC_{cit} + \varepsilon'_{it} ,$$

where i designates individual, t is year, k indexes the standard worker and labor market control variables in X with β_k and β'_k the corresponding coefficients from equations (2) and (3), and m the expanded occupational skill and working conditions variables in Z with Γ_m the corresponding coefficients. AIR is a set of six dummy variables, indexed by j, representing airline craft groups, with θ_{jt} (or θ'_{jt}) their respective coefficients. OCC is a set of non-airline occupational control group dummies, indexed by c, representing (along with an omitted reference group) all non-airline employees, with Ω_{ct} (or Ω'_{ct}) the coefficients.

The standard earnings differential, d_{jt} for each airline group j in year t, based on equation (2), is calculated as the difference between the appropriate airline dummy and the weighted average of either the single or multiple non-air occupational comparison groups. Expanded earnings differentials d'_{jt} are calculated similarly based on coefficient estimates from equation (3). That is:

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[7] Because of heterogeneous worker tastes and sorting, and correlation between job characteristics and unmeasured worker skills, coefficients on job characteristics are unlikely to precisely measure compensating differentials for either the average or marginal worker.

(4) $d_{jt} = \theta_{jt} - \Sigma w_c \Omega_{ct},$

(5) $d'_{jt} = \theta'_{jt} - \Sigma w_c \Omega'_{ct},$

where w_c represents the sample proportion of comparison group workers in OCC_c (w_c=1.0 where a single

occupational category comprises the comparison group). The all-industry differential is the weighted

average across the craft differentials d_j or d'_j, with airline sample proportions as weights. Highly similar all-

industry differentials are obtained from a specification including a single dummy variable for the air

transport industry (compare column (6) in Table 5 to the standard differential estimates in Table 2).

B. Data

Primary data are drawn from the Current Population Survey (CPS) May earnings files for 1973-78

and the monthly CPS Outgoing Rotation Group (CPS ORG) earnings files for January 1979 through October

1997.[8] For the post-1983 period we estimate an "expanded" model that supplements data from the CPS

ORG with variables measuring occupational characteristics. These variables are either calculated from

special CPS supplements on job training and computer use or obtained from England and Kilbourne (1988),

who provide a weighted mapping of 1977 Fourth Edition *Dictionary of Occupational Titles (DOT)* variables

to 1980 Census occupation codes.[9]

The analysis includes employed full-time wage and salary workers ages 16 and over. Additional

exclusions are for public sector air transport workers and individuals whose principal activity is schooling,

whose implicit real hourly earnings are less than one dollar, and whose industry or occupation of

employment has been allocated (i.e., assigned) by the U.S. Census. Earnings for both salaried and hourly

workers is measured by usual weekly earnings on the primary job, inclusive of tips, commissions, and

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[8] The 1979-97 ORG files include the quarter samples of each monthly CPS asked questions about such things as current earnings, hours worked, and (beginning in 1983) union status. Between 1973 and 1978, the earnings supplement questions were administered only in the May surveys, but to all rotation groups. October 1997 was the most recent data available when our empirical work was completed.

[9] England and Kilbourne provide means of DOT variables for approximately 500 1980 Census occupational categories, calculated as weighted averages across roughly 12,000 DOT occupations (special Census projects mapped CPS workers to DOT occupations and 1980 Census of Population respondents to both 1970 and 1980 Census occupational codes). We match the England-Kilbourne data to 497 time-consistent 1980/1990 Census occupational codes and reassign occupational codes for a few small occupations for which England and Kilbourne have missing data. Because some of the Census occupations mix air transport and non-airline industry workers (e.g., flight attendants are drawn from the Census occupation "public transportation attendants"), we explicitly assign the DOT values to most airline craft workers based on the primary DOT airline occupation assigned to the Census occupational categories. For a description and analysis of the DOT, see Miller, et al. (1980).

overtime. Full-time is defined as at least 35 usual hours worked per week for all control groups and airline occupational groups, with the exception of pilots and flight attendants. We include pilots and attendants who report at least 15 usual hours per week since some pilots and attendants report actual flight hours rather than a broader measure of work hours.[10] Two features of the CPS -- "earnings allocation" and "top-coding" -- turn out to be important factors with which we had to deal in order to reliably analyze airline earnings. (See appendix for definitions of these terms.) Airline workers for whom earnings have been allocated by the U.S. Census are deleted where possible, while earnings adjustments are made in years in which there is incomplete designation of earnings allocations. Workers with top-coded earnings are assigned the estimated mean earnings above the earnings cap. The appendix provides further description.

In our analysis, we identify the five largest employee groups in the "air transportation" industry, based on Census occupation and industry codes. These "craft" groups account for 64% of the air transport sample, with the remaining 36% being included in the "other" category. The estimation sample includes the airline sample and all full-time wage and salary workers outside the airline industry. Air transport industry earnings differentials are calculated as weighted averages of the the craft (and "other") airline group differentials, each of which is computed by comparing that group's earnings to earnings among those in a non-air comparison groups. The comparison groups are intended to be sufficiently broad to reflect economy-wide trends, while at the same time being representative of the types of occupations that the air transport industry workers might have entered had they not been airline employees. Explicit controls for worker and occupational characteristics further enhance comparability. The selected comparison groups are as follows:

Pilots. — Comparison group includes full-time professional and specialty occupations outside of air transportation.

Flight attendants. — Comparison group includes full-time workers in sales, administrative support, and service occupations other than protective and private household services, all outside of air transportation.

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[10] Reported hours worked per week by pilots and attendants are not highly correlated with weekly earnings. Hence, our analysis is for weekly earnings rather than implied hourly earnings. Contract schedules indicate that there are few part-time pilots and attendants among the certificated air carriers.

Mechanics. — Comparison group includes full-time mechanics and repairers outside of air transportation.

Fleet service (ramp) workers. — Comparison group includes full-time workers in material moving occupations, handlers, equipment cleaners, helpers, and laborers, all outside of air transportation.

Ticket and reservation agents and traffic, shipping and receiving clerks. — Comparison group includes full-time information clerks, records processing occupations, communications equipment operators, and traffic, shipping, and receiving clerks, all outside of air transportation.

Other airline employees. — Comparison group includes full-time workers outside air transportation in the same broad occupational category as the airline workers.

C. Descriptive Evidence

We first provide (see table 1) descriptive evidence on employment, earnings, and union density in the air transportation industry, averaged over selected years, based on calculations from the CPS ORG files. Employment figures indicate substantial growth in the air transport industry, from an average 407 thousand employees during the 1973-78 regulatory period to an average 805 thousand employees in 1995-97. Growth occurred in most individual years, the exceptions being the recessionary periods 1981-83 and 1990-92 (figures for individual years are not shown). CPS sample shares by craft, calculated from the CPS ORG files for 1983-97, are also shown in table 1. Pilots and flight attendants each account for 11% of the industry sample; mechanics, 15%; fleet service workers (a category not defined precisely in the CPS), 9%; and agents and clerks, 18%. Among the 36% of airline industry workers spread across other occupations, the largest categories are "managers and administrators" and "secretaries." We detected no significant changes in the craft composition of airline industry workers over the 1973-97 period.

Table 1 also presents mean real weekly earnings, expressed in October 1997 dollars using the consumer price index for all urban consumers-experimental (CPI-U-X1), for all airline industry employees; it also presents union density by craft. Real earnings increased following deregulation, from an average $808 per week during 1973-78 to $856 during 1979-83. Since the mid-1980s (1984-87), real earnings fell

gradually from \$828 per week to \$767 per week during 1995-97. One sees broadly similar patterns among the airline craft groups.[11] Union density and air transport earnings are examined in Section V.

IV. Real and Relative Earnings in the Airline Industry

The "adjusted earnings index" for the airline industry during 1973-97 is shown by the squares in figure 1 (see table 2 for full details). Index values are derived from a log earnings regression (eq. [1]) pooled over the 1973-97 period, with controls included for years of schooling completed, potential experience and its square, gender and gender-experience interaction terms, race (two dummy variables), marital status (two), region (eight), large metropolitan area, and year (1977-78 is the omitted base year). The index is constructed from the year dummy coefficients Φ_y. Since annual sample sizes prior to 1979 are small, we use 2-year periods during 1973-78.

Standard and expanded "relative earnings differentials" by airline group and year (d_j and d'_j) are shown in figure 1 by diamonds and triangles, respectively (also see table 2). The "standard" specification is estimated for the years 1973-97, while the "expanded" specification including occupational variables (based on 1980/90 Census codes) is estimated for years since 1983. Included in the standard specification are variables measured at the individual level: years of schooling completed and potential experience and its square (separately and interacted with gender); and dummies for gender, marital status, public sector, region, large metropolitan area, and occupation (some of which represent the comparison groups for the airline crafts). Differential estimates based on the weighted average from separate female and male earnings functions are approximately .01 log points higher using the standard or expanded specification.

The expanded specification adds variables measuring the mean level of job characteristics at the occupational level. Variables included are: OCC-*Training*, the proportion of workers reporting formal or informal training on the current job; OCC-*Computer*, the proportion of workers using a computer on the job; DOT-*GED*, a 1-6 index of general educational development measuring necessary reasoning, writing, and mathematical skills; DOT-*SVP*, representing specific vocational preparation and measured by years of training required for proficiency in an occupation; DOT-*Physical*, the number of physical demands from 0

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[11]The weekly earnings measure does not include compensation for health insurance, pensions, government-mandated payroll taxes, or other fringes. Data from the March CPS for 1980 forward indicate significantly higher pension and health coverage among air transport workers than among workers outside the industry (see Hirsch and Macpherson 1995). A fringe benefit unique to the airline industry is free or subsidized travel.

to 4; DOT-*In & Out*, measuring the proportion of workers in jobs that require significant time both indoors and outdoors; DOT-*Outdoors*, measuring the proportion of workers in jobs that are primarily outdoors; and DOT-*Strength*, a 1-5 index of required strength. Variables designated OCC- are calculated by the authors from special CPS supplements and matched to individuals in the CPS ORG files based on designated occupation.[12] All occupational characteristics are treated as time-invariant over the 1983-97 period. Table 3 lists the sources and provides means of the occupational variables for airline and non-airline workers.

A. All Airline Employees

The adjusted earnings index for the airline industry (1977-78=100) indicates little change in real earnings between 1973 and approximately 1983-84, followed by a decline during the remainder of the 1980s and the 1990s. Relative to the regulatory base period, 1977-78, adjusted weekly earnings fell by about 20% by 1996-97, with much of the decline occurring in the 1990s, that is, many years after deregulation.

Although a 20% decrease in real earnings is substantial, the effects of deregulation are best assessed by comparing airline earnings to those among comparable workers and jobs outside the airline industry. Figure 1 presents two measures of "relative" earnings differentials. Using the standard specification, we find what appear to be sizable earnings premiums for airline employees. Differentials were about .22 log points or 25% prior to deregulation, and increased following deregulation to over 30% (the peak was .30 log points or 35% in 1982). The 1979-83 rise in relative earnings following deregulation primarily reflected a decrease in real earnings outside the industry associated with two recessions and high rates of inflation, and not an increase in real airline salaries. Since the mid-1980s, the differential has fallen, to about 15% (.13 and .15 log points in 1996 and 1997, respectively). In short, we find that relative earnings in the industry have fallen since the mid-1980s, but that airline workers remain well paid compared to workers with similar measured characteristics.[13]

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[12] There is substantial collinearity among several included and excluded occupational variables. We do not include the DOT variable measuring the presence of hazards, since its coefficient is incorrectly signed. The DOT rates pilots and attendants as hazardous occupations. Not accounted for is the fact that flight personnel spend much of their working time away from home, but also receive long blocks of leisure time. Standard errors on occupation or group variables matched to individual data are biased downward (Moulton 1990).

[13] Subsequent analysis (not shown) using the CPS for full-year 1997 and the first half of 1998 indicates a moderate increase in relative airline earnings, particularly among union workers. This evidence supports the thesis that airline unions retain substantial bargaining power, with wage demands varying with the financial health of the industry. Card (1998), who examines Census data for 1979 and 1989, finds an approximate 10% decline in relative earnings. He finds

An alternative measure of relative earnings, based on the expanded specification accounting for occupational differences in skill requirements and working conditions, is also shown in figure 1 for the period beginning in 1983. About .10 log points of the airline wage advantage is accounted for by relatively high skill and training requirements in airline occupations. Following control for occupational characteristics, earnings premiums remain, but these are on the order of about 10% during the late 1980s and early 1990s, and roughly 5% during 1996-97. The smaller differential reflects the fact that for most, although not all, airline occupations, job training and skill requirements exceed those for the average worker.[14]

Longitudinal analysis provides an alternative approach to measuring earnings differentials between airline and nonairline employment. In an earlier version of our paper (Hirsch and Macpherson 1995), we constructed multiple CPS panels to measure the earnings gains and losses of workers moving into and out of the air transport industry. The analysis provides a control for fixed worker-specific differences in unmeasured skills and preferences whose effects are transferable across jobs, as well as provides a natural measure of alternative labor market opportunities for airline workers. The panel analysis is limited by what are relatively small sample sizes of air industry joiners and leavers, sensitivity to measurement error, and the possibility of bias resulting from endogenous job switching.

Panel evidence indicates small earnings premiums among joiners and leavers. Estimates from the standard model indicate average gains of about 4% for workers joining the airline industry and losses of about 8% among those leaving. Gains and losses are 2% and 6%, respectively, using the expanded specification, which accounts for changes in job skills and working conditions. The lower premium estimates for entrants than for leavers is consistent with steep experience and tenure profiles in the industry and with the nontransferability of industry and occupation specific skills (Neal 1995). Card (1998) uses the

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little change between 1989 data and estimates based on a small March 1994-95 CPS sample. The 1979-89 comparison masks the increase and subsequent decrease in relative earnings during the 1980s.

[14] The two variables that most affect the expanded estimates are OCC-Training and OCC-Computer. Absent those two variables, there is little difference between the standard and expanded estimates. The strong relationship between earnings and these measures suggests that in general they provide good proxies for occupational and worker skills. Average computer use by occupation across the June 1984 and 1989 CPS Computer Use Supplements is used as an index of relative occupational skills for the entire 1983-97 period. Its coefficient is relatively stable over time, whereas inclusion of a computer index that is allowed to increase over time produces coefficients that steadily decline. For a recent analysis of individual computer use and the earnings distribution, see Autor, Katz, and Krueger (1998).

CPS Displaced Worker Surveys (DWS) to measure earnings losses among workers displaced from air transport jobs, thus providing a measure approximating exogenous job change (Gibbons and Katz 1992). He finds that a high percentage (39%) of reemployed workers remain in the air transport industry but that earnings losses are small, surprisingly, for reemployed displaced air transport workers whether they stay in the industry or leave it; moreover, losses are similar to losses among workers displaced from jobs in other industries.

The longitudinal evidence from the DWS and our CPS panels supports the thesis that a sizable portion of the earnings advantage observed among airline industry employees is due to high unmeasured skills and that much of that portion is transferable across jobs. Surprisingly, neither we nor Card find a downward time trend in longitudinal air transport differentials. The absence of such a finding might simply result from what are small sample sizes. Alternatively, it could reflect what were higher unmeasured skills during the regulatory years than during recent years. If this is so, then the decline in relative earnings shown in figure 1 may overstate the decline in quality-adjusted differentials. Even if the decline in relative airline compensation has been accompanied by the hiring of workers with lower (unmeasured) quality, it is not clear whether this has translated into a significant productivity decline.

The conclusion reached in earlier CPS studies of the airline industry was that declines in earnings had been small and largely paralleled economy-wide movements. The evidence provided here, in addition to recent work by Card (1998) and Crémieux (1996*b*), causes us to modify that conclusion. It is unlikely that the decline in relative earnings since the 1980s could have occurred had airline employees not been realizing substantial rents prior to and shortly following deregulation. Part of the measured earnings advantage of airline industry employees, however, is the result of compensating differentials for high skills and other job characteristics. By the mid-1990s, the earnings premium for the average airline industry employee was rather modest. Of course, part of this decline may reflect the intense competition and low profits in the industry during much of the period. The increase in relative earnings during 1997 suggests that airline earnings are not determined independently of firms' financial performance.[15]

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[15] See, also, footnote 13. Firm and establishment size, which are not controlled for directly in our analysis, are associated economy-wide with high wages. As shown by Brown and Medoff (1989), among others, much of the size-wage advantage appears to reflect worker rents whose origins cannot be readily identified. Airline carriers are large

B. Airline Crafts

We examine briefly wage differentials among the major airline crafts. Table 4 presents the earnings

index and earnings differentials from the standard specification by craft for three selected time periods,

1973-78, 1981-83, and 1994-97, to be referred to as the "regulatory," "peak premium," and "current"

periods, respectively. Evidence for pilots is the most problematic, owing to the high proportion of pilots

with top-coded and allocated earnings and the uniqueness of the occupation. The earnings of pilots relative

to a comparison group of full-time workers in professional specialty occupations are large, suggesting

premiums of .40 and .54 log points prior to and shortly following deregulation, using standard control

variables.

Although the premium has declined since the early 1980s, it remains high (.36 log points).

Inclusion of occupational variables in our expanded model reduces by roughly .08 log points estimates of

the pilot premium. It is, of course, difficult to assess whether some of the measured premium reflects a

compensating differential for skills or working conditions that remain unmeasured.[16]

Relative earnings for flight attendants is based on a comparison with similar full-time workers in

sales, administrative support, and service occupations outside of air transportation. Flight attendants

realized substantial premiums, before and following deregulation, standard estimates indicating differentials

of .40 and .45 during the 1973-78 and 1981-83 periods, respectively. Their earnings fell sharply after 1993,

however, with our estimate of the 1994-97 differential being just .14. Estimates from the expanded

specification are about .10 log points lower.[17]

The earnings of airline mechanics relative to full-time mechanics outside the airline industry have

been relatively stable over the deregulation period. Estimates from the standard model indicate differentials

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companies, but their workers need not work in large establishments. Although some of the airline wage differential
may reflect the effects of employer size, much of this is likely to constitute a rent. The training and computer variables
in our expanded specification are likely to be positively correlated with employer size and capture size effects
reflecting higher skills.

[16] In the Wealth of Nations, Adam Smith argues: "The wages of labour vary according to the small or great trust which
must be reposed in the workmen." (Smith 1937, original 1776, p. 105). Although we can be sure that Smith was not
referring to pilots (his examples are jewelers, physicians, and lawyers), great trust is obviously placed in pilots. What
is not clear is the degree of scarcity (and price) associated with labor in whom great trust can be given, and how much
of the pilot premium is associated with such trust.

[17] A high proportion of attendants receive some training on-the-job, but the length of required training, measured by
DOT-SVP, is short -- 2 months for attendants compared to about 3 years for pilots and mechanics. Absent inclusion of
OCC-Training, the standard and expanded premium estimates for attendants are similar.

of about .17 log points during the regulatory period, followed by a moderate increase to about .20 following deregulation and a subsequent decline to about .17 currently. A portion of the earnings advantage among airline mechanics reflects a compensating differential for greater training requirements and, to a lesser extent, relatively high physical demands, with estimates from our expanded model indicating a current premium of roughly .13.[18]

Fleet service (ramp) workers service airplanes and facilitate passenger and cargo service (e.g., baggage and material handling and directing plane movement on the ground). They are scattered across several airline crafts and a large number of CPS occupational categories; this makes estimates more difficult to interpret. Standard estimates indicate differentials of .04, .14, and .05 in the regulatory, peak, and current periods, while estimates from the expanded model indicate a differential that is slightly negative during 1994-97. The latter result is driven by the fact that a high proportion of ramp employees perform work outdoors and their occupations require relatively high levels of strength. Working in the opposite direction are relatively low levels of required training.

Earnings differentials among ticket and reservation agents and traffic, shipping, and receiving clerks are based on a comparison group of full-time nonair industry information clerks, record processing clerks, and communication equipment operators. Estimates from the standard specification indicate substantial premiums of .27 and .37 during the regulatory and peak periods, with a sharp decline to .11 during the mid-1990s. Controlling for occupational skills and working conditions reduces the differential estimates markedly, a result driven entirely by the high level of computer use among agents and clerks and the high proportion of employees receiving formal job training. Values of the DOT skill variables, however, are not high for agents and clerks, while working conditions are relatively less demanding for agents and clerks than among the labor force as a whole.

Finally, we examine the earnings of the 36% of air transport industry workers not included in our five craft categories. Because of this group's diversity, adjustment for worker characteristics and broad occupational category is important. The relative earnings advantage for the noncraft (and largely nonunion)

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[18] Crémieux (1996) also concludes that relative earnings declined less for mechanics than for pilots or flight attendants. When we use an alternative comparison group consisting of full-time blue-collar workers in manufacturing, differentials are moderately higher.

airline employees are lower than for the industry as a whole, .14 and .20 during regulation and shortly after deregulation, and .06 during 1994-97. The expanded specification suggests an earnings differential for noncraft employees of close to zero. Noncraft airline employees shared in industry rents made possible by regulation and market power, but such rents appear to now be gone. If relative labor costs among airlines are to decline further, it must come from concessions among pilots, attendants, and mechanics. But these are the crafts where union bargaining power remains an important factor, a topic to which we turn below.

V. Union Differentials and Earnings Dispersion in the Air Transport Industry

Unions provide an institutional mechanism that facilitates the transfer of rents from shareholders to workers. Twenty years following deregulation, the air transport industry remains highly unionized (see table 1). Based on calculations from the CPS, 49% of all air transport employees were union members in 1973-78, with the figure falling to 39% in 1997.[19] As long as unions are organized throughout much of the industry and maintain similar labor costs across carriers, individual firms are not at a competitive disadvantage. And a strike against a hub-based airline, at least by flight personnel, prevents a company from maintaining full operations. Deregulation, however, allowed expansion of existing carriers, facilitated entry of new carriers (some being nonunion), and increased route and price competition. Competition of this kind not only exerts downward pressure on wage rates but also increases the dispersion in wages between low- and high-wage carriers (Card 1998) and between union and nonunion workers (see below). Although unions have maintained the ability to impose large costs on carriers, their bargaining power has been constrained by intense product market competition, new corporate strategies, and the weak financial conditions of carriers during much of the deregulatory period.

We examine the effect of unions on earnings in the airline industry by estimating both the within-industry union-nonunion differential and the effects of industry union density on the industry earnings level. Our analysis relies on the economywide sample of full-time workers. Previously (eqq. [2] and [3]), the airline industry premium was calculated as the weighted average of the individual air industry craft groups. Here we use a simpler specification that includes a single dummy variable for employment in the air

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[19] Prior to deregulation, unionization among craft workers at the major carriers was almost universal. In a prescient paper appearing shortly after deregulation, Hendricks, Feuille, and Szerszen (1980) provide arguments as to why changes in union power might occur slowly. Northrup (1983) also provides an early analysis of expected changes in the labor relations environment following deregulation.

transport industry. The following models are estimated by year (we omit time subscripts), with results

presented in table 5.

(6) $$\ln EARN_i = \Sigma\beta_k X_{ik} + \theta AIR_i + \varepsilon_i$$

(7) $$\ln EARN_i = \Sigma\beta'_k X_{ik} + \theta' AIR_i + \Phi' AIR \cdot Union_i + \varepsilon'_i$$

(8) $$\ln EARN_i = \Sigma\beta''_k X_{ik} + \theta'' AIR_i + \Phi'' AIR \cdot Union_i + r'' Ind\text{-}\%Union_i + \varepsilon''_i$$

Following previous notation, X represents control variables defined at the individual level, AIR is a dummy

variable equal to one if employed in the air transport industry, *Union* is a dummy variable designating

individual union membership, and *Ind-%Union* is the proportion of workers' three-digit industry that is

unionized in each year (based on our calculations from the CPS).

Table 5 provides estimates from the "standard" specification for the entire 1973-97 period. Data

prior to 1983 are based on the availability of union status information from the May CPS.[20] The first

column presents coefficient estimates of θ from equation (6), which measure annual industry wage

differentials between similar airline and nonairline workers. Results are virtually identical to those

presented previously and do not warrant discussion.[21] Equation (7), shown next in table 5, adds the

interaction of AIR and *Union*, the latter designating individual union membership. The coefficient θ' now

represents the industry earnings differential for nonunion airline workers relative to nonair union and

nonunion workers, Φ' is the within-industry union-nonunion differential, and $\theta' + \Phi'$ is the industry earnings

differential for union workers.[22] Equation (8), shown on the right-side of table 5, adds industry union

density, *Ind-%Union*, intended to reflect the effects of organizing strength on the level of nonunion and

union wages. The reduction in the coefficient on the air industry dummy between equations (6) and (8), θ -

θ'', provides an estimate of how much of the industry earnings advantage is accounted for by both the

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[20] The sample size for 1979-81 is about half that of the earlier two-year periods. Roughly half of the 1979-81 sample is for 1979, since one-half of the CPS rotation groups were asked the earnings question in 1979 and one-quarter in 1980 and 1981. There was no union question in the 1982 surveys.

[21] Although airline craft dummies are not included, airline industry workers are coded as members of the occupational control groups with whom they are compared. Where the comparison group corresponds to a single control dummy the appropriate airline workers are coded as a one. Where the comparison group is spread across several control dummies, the airline workers are coded as α_w for each, where α_w is the proportion of the non-airline sample in each of the categories ($\Sigma\alpha_w = 1$).

[22] We do not include *Union* separately. To do so would have the effect of comparing union (nonunion) air industry workers to union (nonunion) non-air workers. This is appropriate only if one regards union status as a transferable skill-related attribute such as schooling (for a discussion of this issue in the context of federal pay comparisons, see Linneman and Wachter 1990). Our industry differentials represent a comparison of air transport workers to an implicitly sample-weighted combination of non-air union and nonunion workers.

within-industry union earnings premium and the extent of industry union density, assuming that the economywide effect of the latter applies to the air transport industry. The coefficient θ'' represents an estimate of any remaining airline earnings differential resulting from factors other than unionization and measured characteristics.

Results indicate that much of the earnings advantage of airline employees, particularly for recent years, is associated with unionization. Looking at results for 1983, for example, we find that the substantial .29 air industry log earnings advantage is reduced to .185 for nonunion airline workers, following an accounting for within-industry union-nonunion differentials, and to .12 after accounting for industry union density. In 1997, the total industry earnings premium from the standard model is .15. Adding the union dummy reduces θ to .05, while addition of the density variables reduces it further to .01. In short, the results suggest not only that the airline industry wage advantage has fallen over time but also that all of any remaining premium is union related. Union bargaining power is reflected in both an earnings advantage for union compared to nonunion workers and in a higher earnings level for nonunion workers owing to the high industry union density.[23]

Much of our attention has focused on industry wage levels. Yet the identification of within-industry earnings differentials helps us understand labor market behavior in the airline industry. As seen in table 5, during and immediately following the regulatory period, the within-industry union differential was only about .10, while the industry earnings premium was large, reflecting substantial nonunion rent sharing and limited wage competition within the industry. Following deregulation, the union-nonunion differential rose to as high as .25 in 1985, while entry and price competition in product markets spurred relative earnings decreases among nonunion workers. Over time, competitive forces placed downward pressure on union as well as nonunion earnings and brought about a narrowing of the union-nonunion differential to a level around .15 during the early 1990s, a period of financial distress in the industry. During the 1996-97 rebound in airline profitability, however, the union premium returned to mid-1980s levels. This pattern is consistent

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[23] Our analysis does not address the possibility of union-related skill upgrading by which union wage premiums lead firms to hire and retain higher quality workers. Wessels (1994) shows that skill upgrading need not follow from standard theory. Card (1996) and Hirsch and Schumacher (1998) conclude that unions are associated with positive selection among workers with low measured skills, and vice-versa, but have little effect on average skill levels.

with there being continued union bargaining strength, but a willingness to moderate demands when employment or bankruptcy is threatened.[24]

It is instructive to note differences between the airline and trucking industries following deregulation in each. As documented by Rose (1987), Hirsch (1988), and Hirsch and Macpherson (1998*a*), union membership and wages among truck drivers fell quickly toward competitive levels following deregulation, while nonunion wages, already close to competitive levels, changed little. By contrast, deregulation in the airline industry initially had a large effect on nonunion earnings, while union earnings eroded slowly. This is consistent with evidence in table 5 indicating that during the regulatory period, union and nonunion workers were earning rents, and that union bargaining power has been able to slow the long-run transition to competitive wage levels for its members. In contrast to trucking, airline unions maintained bargaining strength owing to higher levels of coverage, a more specialized workforce requiring training and in some cases certification (e.g., pilots), sizable market shares among major carriers, and a hub system vulnerable to strikes (Cappelli 1992). Over time, union power may have eroded in the face of price competition spurred by low-cost carriers, gradually declining membership density, and falling relative wage levels and cost differentials within the industry. That being said, unions continue to have a major presence in airline labor markets, and their bargaining power has been recently enhanced by robust product market conditions and an easing of competition from low cost carriers.

The increase in within-industry earnings dispersion following deregulation can be seen not only in union-nonunion differences, but also by differences in wage payments across carriers and in industry earnings dispersion. Other studies have demonstrated an increased dispersion in contractual wages across carriers following deregulation (Johnson 1991, pp. 158-59; Card 1998, Tables 7a-7c). We examine changes in earnings dispersion in the airline industry relative to economy-wide dispersion using individual data from the CPS. We provide two alternative measures, the variance in the log of weekly earnings and the variance of the residuals from log earnings regressions, which we have estimated separately for the airline industry

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[24] Nay (1991) concludes that financial conditions or "ability to pay" is the primary determinant of whether airline unions grant concessions, while Thomas, et al. (1995) provide evidence that the capital market has responded positively to airline wage concessions. Flanagan (1984) provides economy-wide evidence suggesting that unions provide concessions when employment for the "median" member is threatened. Freeman and Kleiner (1994) conclude that unions in U.S. manufacturing will push firms to the brink of bankruptcy to acquire wage gains, but rarely push them to the point of failure.

and economy-wide (excluding air transport).[25] The regression residuals account for changes over time in measurable labor force composition and earnings structure. Comparison of airline dispersion to that elsewhere in the economy is important since earnings inequality (particularly for males) increased economy-wide during this period.

Rather than present results for each year, table 6 provides the averages across years for three periods: 1973-78, 1986-88, and 1995-97 (the same pattern is evident using annual figures for the entire period). Earnings dispersion increased throughout much of the period. Economywide variances in earnings equation residuals increased from .09 in 1973-78 to .12 in 1986-88 to .13 in 1995-97, while air transport residual variances grew significantly more, from .06 to .10 to .12 over the same period. Much of the airline industry increase occurred during the 1970s and early 1980s, that is, during the period leading up to and immediately following deregulation. For example, residual variances in air transport increased from .052 to .087 between 1975-76 and 1979.[26] The evidence is consistent with the thesis that regulation, coupled with substantial union bargaining power, compressed earnings differentials within the industry. Deregulation lessened wage uniformity within the industry as labor costs became an important dimension over which airlines struggled to gain a competitive advantage.

VI. Conclusion

The magnitude of labor market rents and their relationship to product market structure, the regulatory environment, and labor unions are topics at the core of labor economics. Twenty years after deregulation, the airline industry may not yet have settled into what can be considered a steady state. The conclusion that deregulation had little effect on relative airline earnings (e.g., Winston 1993), however, can no longer be maintained. In contrast to steady or rising relative earnings in the years immediately prior to and following deregulation, relative earnings have fallen significantly during the latter half of the 1980s and the 1990s. Workers in the airline industry remain highly compensated. Much of the high pay, however, is

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[25] Omitted from the analysis are the bottom and top 5% of earners in the combined air industry and economy-wide samples. Analysis of dispersion using the 5th through 95th percentiles of the earnings distribution eliminates top-coded earners and prevents attaching undue weight to outliers resulting from measurement error.
[26] The latter results are not shown in Table 6. Card (1998) uses decennial Census data to compare dispersion within the air transport industry and economy-wide between 1979 and 1989, and concludes that relative changes were roughly similar. This comparison misses the increase in dispersion prior to 1979.

the result of worker attributes and job characteristics. Wage premiums remain, but they appear modest for most airline employees, with the notable exception of pilots.

Labor unions provide the key institutional force through which rents have been maintained. Following deregulation, earnings dispersion increased as the pay gap between unionized carriers and employees and an increasing number of nonunion carriers and employees expanded. Worker rents remained sizable and initially rose in the face of expanding traffic, a less than perfectly elastic supply of workers, and sustained union power. This experience contrasts with that in the motor carrier industry, where union strength and rents quickly eroded following deregulation (Rose 1987; Hirsch and Macpherson 1998*a*). Beginning in the mid-1980s, worker rents in air transport fell substantially, however, first for nonunion workers and eventually for union employees. Unions' ability to impose costs on carriers remains substantial, but bargaining power has been constrained by the poor financial performance of carriers during much of the period. Such constraints eased after 1995, with a subsequent increase in the union premium. The industry's history of contentious labor relations and the shallow reservoir of trust held by all parties suggest that current earnings outcomes need not represent a steady state. Absent greater cooperation, attempts by management or labor to significantly alter compensation levels may produce long-run outcomes at individual carriers attractive neither to firms' shareholders nor employees.

Appendix: Earnings Allocation and Top-Coding in the CPS

This appendix describes two features of the CPS which we addressed -- "earnings allocation" and "top-coding." Among workers for whom an earnings measure is not reported, the Census assigns earnings by an allocation procedure, which assigns each nonreporting individual the reported earnings of a "donor" selected on the basis of individual and job characteristics. If an employee group within an industry or occupation realizes a premium, inclusion of workers with allocated earnings will cause the premium to be understated because most workers are assigned donors without a detailed industry or occupation match. We find that all groups of air transport workers with allocated earnings (and, in particular, pilots) have mean earnings lower than airline workers without allocated earnings. Where possible, we exclude air transport workers with allocated earnings. During the years 1973-78, workers who do not provide earnings information have no earnings value included in the May CPS public use files. For the CPS-ORG files for 1979-88, an accurate earnings allocation flag is included. During 1989-93, an allocation flag is included, but it designates only a minority of workers whose earnings are allocated. There is no earnings allocation flag in the 1994 through August 1995 *CPS-ORG*. Beginning in September 1995, a comprehensive earnings allocation flag is included. We exclude from the analysis all air industry workers with allocated earnings in 1973-88 and from September 1995 forward, some with allocated earnings in 1989-93, and none during 1994 through August 1995. For those years in which not all allocated earners can be identified, we utilize information from years with complete information to predict the proportion of allocated air industry earners and the craft-specific log earnings gap between those with and without allocation. For 1989 through August 1995, we then select the predicted proportion of airline workers in each year to whom earnings is allocated (accounting for the fact that some allocated workers in 1989-93 are already omitted), choosing those workers with the highest likelihood of allocation based on out-of-sample probit equation parameters. Selected individuals then have their CPS log earnings inflated by the craft-specific average gap between allocated and non-allocated workers. Among workers outside of the air industry, average earnings for those with and without allocated earnings are roughly equivalent. While our method involves individual measurement error, it allows us to correctly measure changes over time in absolute and relative air industry earnings.

Weekly earnings in the CPS are top-coded at $999 for 1973-88 and $1,923 beginning in 1989 (the latter corresponds to $100,000 in annual earnings). An unedited earnings field, top-coded at $1,999, is provided in 1986-88. We use this value where available for workers whose edited earnings are capped at $999 during 1986-88. Apart from pilots, few airline craft workers are at the earnings cap. Top-coding is a serious problem, however, for pilots. Although few pilots were at the $999 cap in the early 1970s (e.g., 4% in 1973-74 and 6% in 1975-76), more than 40% of pilots were top-coded in the years 1981-85. Pilots for whom we had to assign earnings dropped sharply (to about 20%) beginning in 1986 when the unedited earnings field included weekly earnings up to $1,999, and it has crept upward over time.

Earnings to top-coded workers are assigned as follows. For the economy-wide control group and airline workers other than pilots, top-coded workers are assigned estimated mean earnings above the cap, based on the assumption that the upper tail of gender-specific annual earnings distributions follows a Pareto distribution. These values, available for 1973-97 in Hirsch and Macpherson (1998*b*, p. 6), increase slowly over time, being approximately $1,400 for women and $1,500 for men during 1973-88, when the cap is $999, and averaging roughly $2,900 and $3,100 for women and men during 1989-97, when earnings are capped at $1,923 (the means rise gradually over time). Workers whose unedited fields are capped in 1986-88 are assigned the Pareto value corresponding to the $1,923 cap in 1989. The mean of earnings for pilots at the cap is assigned based on information derived from the U.S. Department of Labor, Bureau of Labor Statistics, Industry Wage Surveys (IWS) of the airline industry for the years 1975, 1980, 1984, and 1989 (these surveys have been discontinued). For the period 1973 through 1988, we calculate a time-series index of mean earnings above the $999 weekly earnings cap based on data provided for pilots and navigators in the IWS. These values are assigned to pilots who are at the $999 cap for 1973-85 and to those pilots during 1986-88 with missing earnings in the unedited earnings field but at $999 in the edited field. Pilots whose unedited earnings are at or above $1,923 during 1986-88 or at the $1,923 cap during 1989-97 are assigned the mean real earnings above $1,923 calculated from the 1989 IWS. This latter assumption appears reasonable given the constant real wage observed in labor contracts at 11 carriers for Boeing 727 Captains between December 1987 and January 1995 (Card 1998, table 7a).

References

Autor, David H.; Katz, Lawrence F.; and Krueger, Alan B. "Computing Inequality: Have Computers Changed the Labor Market?" *Quarterly Journal of Economics* 113 (November 1998): 1169-1213.

Brown, Charles, and Medoff, James. "The Employer Size-Wage Effect."*Journal of Political Economy* 97 (October 1989): 1027-59.

Cappelli, Peter. "Airlines." In *Collective Bargaining in American Industry: Contemporary Perspectives and Future Directions*, edited by D.B. Lipsky and C.B. Donn, pp. 135-86. Lexington, MA: Lexington Books, 1987.

_____. *Labor Relations and Labor Costs in the Airline Industry: Contemporary Issues*. Washington, DC: U.S. Department of Transportation, Office of the Secretary, May 1992.

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

_____. "Deregulation and Labor Earnings in the Airline Industry." Industrial Relations Section Working Paper no. 247, Princeton, NJ: Princeton University, 1989.

_____. "The Effect of Unions on the Structure of Wages: A Longitudinal Analysis." *Econometrica* 64 (July 1996): 957-79.

_____. "Deregulation and Labor Earnings in the Airline Industry." In *Regulatory Reform and Labor Markets*. edited by James Peoples, pp.183-230. Norwell, MA: Kluwer Academic Publishing, 1998.

Crémieux, Pierre-Yves. "Does Strike Insurance Matter? Evidence from the Airline Industry's Mutual Aid Pact." *Journal of Labor Research* 17 (Spring 1996): 201-17. (*a*)

_____. "The Effect of Deregulation on Employee Earnings: Pilots, Flight Attendants, and Mechanics, 1959-1992." *Industrial and Labor Relations Review* 49 (January 1996): 223-42. (*b*)

England, Paula, and Kilbourne, Barbara. *Occupational Measures from the Dictionary of Occupational Titles for 1980 Census Detailed Occupations*. technical Report ICPSR, no.8942. Ann Arbor, MI: Interuniversity Consortium for Political and Social Research, , Fall 1988.

Ehrenberg, Ronald G. *The Regulatory Process and Labor Earnings*. New York: Academic Press, 1979.

Flanagan, Robert J. "Wage Concessions and Long-term Union Flexibility." *Brookings Papers on Economic Activity,* no. 1 (1984): 183-216.

Freeman, Richard B., and Kleiner, Morris. "Do Unions Make Enterprises Insolvent?" *Industrial and Labor Relations Review* 52 (July 1999): 510-27.

Gibbons, Robert, and Katz, Lawrence F. "Does Unmeasured Ability Explain Inter-industry Wage Differentials?" *Review of Economic Studies* 59 (July 1992): 515-35.

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

Hendricks, Wallace; Feuille, Peter; and Szerszen, Carol. "Regulation, Deregulation and Collective Bargaining in Airlines." *Industrial and Labor Relations Review* 34 (October 1980): 67-81.

Hirsch, Barry T. "Trucking Regulation, Unionization, and Labor Earnings: 1973-85." *Journal of Human Resources* 23 (Summer 1988): 296-319.

Hirsch, Barry T., and Macpherson, David A. "Earnings, Rents, and Competition in the Airline Labor Market." Working Paper no. 94-12-1. Tallahassee: Florida State University, Department of Economics, December 1995.

_____. "Earnings and Employment in Trucking: Deregulating a Naturally Competitive Industry." In *Regulatory Reform and Labor Markets*, edited by James Peoples, pp. 61-112. Norwell, MA.: Kluwer Academic Publishing, 1998. (*a*)

_____. *Union Membership and Earnings Data Book: Compilations from the Current Population Survey*, 1998 ed. Washington, DC: Bureau of National Affairs, 1998. (*b*)

Hirsch, Barry T., and Schumacher, Edward J. "Unions, Wages, and Skills," *Journal of Human Resources* 33 (Winter 1998): 201-19.

Johnson, Nancy Brown. "Airline Workers' Earnings and Union Expenditures Under Deregulation." *Industrial and Labor Relations Review* 45 (October 1991): 154-65.

_____. "Pay Levels in the Airlines since Deregulation." In *Airline Labor Relations in the Global Era: The New Frontier*, edited by Peter Cappelli, pp. 101-15. Ithaca, NY: ILR Press, 1995.

Krueger, Alan B. "Labor Market Shifts and the Price Puzzle Revisited." Working Paper no. 5924. Cambridge, MA: National Bureau of Economic Research, February 1997.

Linneman, Peter D., and Wachter, Michael L. "The Economics of Federal Compensation." *Industrial Relations* 29 (Winter 1990): 58-76.

McCartney, Scott. "Why Are Big Airlines Considering Mergers? Look in the Cockpit." *Wall Street Journal* (Eastern ed.) (November 9, 1995).

Miller, Ann R.; Treiman, Donald J.; Cain, Pamela S.; and Roos, Patricia A., eds. *Work, Jobs, and Occupations: A Critical Review of the Dictionary of Occupational Titles.* Final Report to the U.S. Department of Labor by the Committee on Occupational Classification and Analysis. Washington, DC: National Academy Press, 1980.

Moulton, Brent R. "An Illustration of a Pitfall in Estimating the Effects of Aggregate Variables on Micro Units." *Review of Economics and Statistics* 72 (May 1990): 334-38.

Nay, Leslie A. "The Determinants of Concession Bargaining in the Airline Industry." *Industrial and Labor Relations Review* 44 (January 1991): 307-23.

Neal, Derek. "Industry-Specific Human Capital: Evidence from Displaced Workers." *Journal of Labor Economics* 13 (October 1995): 653-77.

Northrup, Herbert R. "The New Employee-Relations Climate in the Airlines." *Industrial and Labor Relations Review* 36 (January 1983): 167-81.

Rose, Nancy L. "Labor Rent Sharing and Regulation: Evidence From the Trucking Industry." *Journal of Political Economy* 95 (December 1987): 1146-78.

Smith, Adam. *The Wealth of Nations*, edited by Edwin Cannan (1776; reprint, New York, Modern Library, 1937).

Thomas, Steven L.; Officer, Dennis; and Johnson, Nancy Brown. "The Capital Market Response to Wage Negotiations in the Airlines." *Industrial Relations* 34 (April 1995): 203-17.

U.S. Department of Labor, Bureau of Labor Statistics. *Industry Wage Survey: Certificated Air Carriers*. Issues for 1975 (Bulletin no. 1951), 1980 (Bulletin no. 2129), 1984 (Bulletin no. 2241), and 1989 (Bulletin no. 2356). Washington, DC: Government Printing Office.

Wessels, Walter. "Do Unionized Firms Hire Better Workers?" *Economic Inquiry* 32 (October 1994): 616-29.

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

Table 1
Air Transportation Employment and Weekly Earnings, 1973-97

	1973-78	1979-83	1984-87	1988-91	1992-94	1995-97
Employment (thousands)	407.0	505.5	554.0	698.8	744.5	804.8
Weekly earnings (1997$)	808	856	828	814	787	767

	Mean Employment Shares by Craft, 1983-97 (%)	Mean Union Density by Craft	
		1973-78 (%)	1983-97 (%)
All air transport	…	49.2	39.5
Pilots	11.0	60.2	58.7
Flight attendants	11.4	77.7	72.8
Mechanics	14.9	61.9	46.7
Fleet service workers	8.5	71.0	46.1
Agents and clerks	18.1	33.7	30.6
All other occupations	36.1	37.5	22.0

NOTE. -- Data sources are the 1973-78 May CPS and 1979-97 (through October 1997) CPS ORG files. Industry employment represents all private wage and salary workers, ages 16 and over, in thousands. Mean weekly earnings are calculated as described in the text and Appendix, and are in October 1997 dollars, indexed by the CPI-U-X. Occupation sample shares are calculated from the 1983-97 CPS ORG files.

Table 2
Air Transport Industry Adjusted Earnings Index and Relative Earnings Differentials, 1973-97

Year	Adjusted Earnings Index	Standard Earnings Differential	Expanded Earnings Differential
1973-74	100.5	.201	…
1975-76	99.2	.227	…
1977-78	100.0	.219	…
1979	102.2	.250	…
1980	100.5	.254	…
1981	101.7	.291	…
1982	102.4	.301	…
1983	101.4	.291	.196
1984	98.0	.245	.141
1985	95.0	.219	.121
1986	96.0	.213	.115
1987	92.2	.173	.072
1988	93.7	.199	.098
1989	92.2	.199	.095
1990	90.4	.202	.093
1991	86.2	.171	.066
1992	88.8	.210	.106
1993	85.8	.174	.056
1994	84.6	.119	.026
1995	83.0	.126	.027
1996	79.6	.129	.029
1997	81.2	.150	.058

NOTE. -- Data sources are the 1973-78 May Current Population Survey (CPS), the 1979-97 Current Population Survey Outgoing Rotation Group (CPS ORG) files (through October 1997), selected CPS supplements, and the *Dictionary of Occupational Titles*. The "Adjusted Earnings Index" (see "squares" in fig. 1), with base year 1977-78=100, measures full-time real weekly earnings over time, following adjustment for years of schooling, potential experience and its square, gender, gender-experience interactions, race, marital status, region, and large metropolitan area. The "Standard Earnings Differential" (see "diamonds" in fig. 1) measures the sample-weighted average of the logarithmic earnings differences between each airline group and a control group of non-airline employees, following control for years of schooling, potential experience and its square, gender, gender-experience interactions, race, marital status, region, large metropolitan area, and (where appropriate) broad occupation. The "Expanded Earnings Differential" (see "triangles" in fig. 1) are estimated for 1983 forward. They are estimated by the same method as the standard measure above, but also include occupational skill and working condition variables. OCC-*Training*, OCC-*Computer*, DOT-*GED*, DOT-*SVP* and its square, DOT-*Physical*, DOT-*In & Out*, DOT-*Outdoors*, and DOT-*Strength* (see table 3 for definitions and sources). Shown at the bottom of the table, mean standard errors averaged over the years 1979-1997 are 2.7 for the Adjusted Earnings Index, .015 for the Standard Earnings Differential, and .015 for the Expanded Earnings Differential. For the years 1973-78, standard errors are slightly larger. The standard errors exhibit little year-to-year variation.

Table 3
Means and Average Coefficients of Occupational Skill and Working
Condition Variables, 1983-97

Variable	Air Transport	Not Air Transport	Average Regression Coefficient	Average Standard Error
OCC-*Training*	.575	.413	.386	(.0123)
OCC-*Computer*	.548	.332	.349	(.0088)
DOT-*GED*	3.796	3.792	.021	(.0048)
DOT-*SVP*	1.771	2.129	.026	(.0040)
DOT-*SVP-SQ*	5.502	7.163	-.002	(.0005)
DOT-*Physical*	2.056	1.697	.022	(.0025)
DOT-*In & Out*	.119	.186	.109	(.0068)
DOT-*Outdoors*	.021	.049	.110	(.0124)
DOT-*Strength*	2.097	2.224	.024	(.0032)

NOTE. – The OCC variables are calculated at the occupational level by authors from the Current Population Survey (CPS) supplements listed below. The DOT variables are calculated from the *Dictionary of Occupational Titles* (England and Kilbourne 1988). Variable OCC-*Training* is the proportion of workers receiving formal or informal training on the current job (calculated from the January 1983 and 1991 CPS); OCC-*Computer* is the proportion of workers using a computer on the job (calculated from the October 1984 and 1989 CPS); DOT-*GED* is a 1-6 index of general educational development measuring necessary reasoning, writing, and mathematical skills; DOT-*SVP* and its square, represent specific vocational preparation and measured by years required for proficiency in an occupation; DOT-*Physical* is the number of physical demand, measured from 0 to 4; DOT-*In & Out*, measures the proportion of jobs requiring considerable time indoors and outdoors; DOT-*Outdoors*, measures the proportion of jobs that are primarily outdoors; and DOT-*Strength*, a 1-5 index, measures required strength on job. Means are calculated for individuals over the 1983-97 period (N=2,054,562 nonair and N=12,593 air transport industry). "Average" regression coefficients and standard errors are mean values from the annual 1983-97 expanded regressions.

Table 4
Adjusted Earnings Index and Relative Earnings Differentials by Craft
Group and Period

Time Period and Craft Group	Adjusted Earnings Index 1977-78 = 100	Standard Earnings Differential
Regulatory period, 1973-78:		
Air transport industry	99.9	.216
Pilots	99.4	.403
Flight attendants	98.2	.401
Mechanics	96.4	.165
Fleet service workers	99.3	.036
Agents and clerks	101.8	.269
All other occupations	101.7	.135
Peak premium period, 1981-83:		
Air transport industry	101.8	.295
Pilots	110.5	.545
Flight attendants	96.4	.453
Mechanics	96.6	.195
Fleet service workers	99.4	.141
Agents and clerks	105.4	.367
All other occupations	104.0	.201
Current period, 1994-97:		
Air transport industry	82.1	.131
Pilots	89.3	.364
Flight attendants	74.5	.139
Mechanics	88.3	.169
Fleet service workers	76.8	.049
Agents and clerks	74.9	.107
All other occupations	86.2	.064

NOTE. -- Data sources are the 1973-78 May Current Population Survey (CPS) and the 1979-97 Current Population Survey Outgoing Rotation Group (CPS ORG) files (through October 1997). See table 2 notes and the text for details.

Table 5
Union Effects on Air Transport Industry Earnings Levels and Earnings Differentials, 1973-97

		Specifications (Partial Regression Results)				
	(1)	(2)		(3)		
Year	AIR	AIR	AIR· Union	AIR	AIR· Union	Ind· %Union
1973-74	.201	.169	.064	.086	.072	.376
1975-76	.226	.178	.098	.091	.099	.433
1977-78	.218	.167	.106	.076	.114	.418
1979-81	.250	.206	.097	.135	.107	.353
1982	…	…	…	…	…	…
1983	.291	.185	.232	.117	.237	.345
1984	.245	.147	.243	.076	.248	.360
1985	.221	.124	.247	.056	.251	.347
1986	.213	.148	.159	.075	.162	.343
1987	.173	.094	.206	.026	.207	.316
1988	.199	.113	.212	.047	.216	.297
1989	.199	.109	.225	.041	.228	.309
1990	.203	.134	.175	.076	.176	.282
1991	.171	.109	.168	.051	.171	.273
1992	.210	.163	.128	.104	.131	.264
1993	.174	.100	.188	.037	.189	.280
1994	.119	.061	.143	-.007	.146	.271
1995	.126	.070	.150	.020	.151	.214
1996	.130	.040	.244	-.002	.245	.207
1997	.149	.048	.261	.007	.263	.194
Mean SE 1973-81	.022	.030	.044	.030	.043	.010
Mean SE 1983-97	.015	.019	.031	.019	.031	.008

NOTE. -- Shown in the table are partial regression results from log earnings functions estimated annually for the pooled airline and non-airline sample (see equations 6-8 in the text). The data sources are the May 1973-81 Current Population Survey (CPS) and the 1983-97 Current Population Survey Outgoing Rotation Group (CPS ORG) files. No CPS union information is available for 1982. All results shown are from the "standard specification." Column 1 includes the airline industry dummy AIR and no controls for unionization; column 2 adds individual union membership dummies for the airline industry only (AIR·*Union*); and col. 3 further adds industry union density (Ind·%*Union*). Mean standard errors (SE) for 1973-81 and 1983-97 are shown.

Table 6
Variance of Log Earnings and Residuals of Air
Transport versus Nonair Workers

Year	Air Transport Industry		Nonair Workers	
	$\sigma^2(\ln E)$	$\sigma^2(\varepsilon)$	$\sigma^2(\ln E)$	$\sigma^2(\varepsilon)$
1973-78	.096	.056	.157	.088
1986-88	.158	.100	.196	.120
1995-97	.196	.121	.215	.134

NOTE. -- Data are from the 1973-78 May Current Population Survey (CPS) and 1986-88 and 1995-97 Current Population Survey Outgoing Rotation Group (CPS ORG) files. They include workers with weekly earnings in the fifth through ninety-fifth percentiles. Columns marked $\sigma^2(\ln E)$ provide the variance of the log of real weekly earnings, unadjusted for worker characteristics, for, respectively, air transport industry workers and all wage and salary workers outside of the air transport industry. Columns marked $\sigma^2(\varepsilon)$ provide the variance of the regression residual from separate log earnings regressions using the standard specification (see table 2) estimated separately for airline and nonairline workers.