Retracting a Gift: How Does Employee Effort Respond to Wage Reductions?

Darin Lee, *LECG, LLC*

Nicholas G. Rupp, *East Carolina University*

Since the days of Henry Ford, employers have argued that higher pay induces employees to provide additional effort. While the converse is also thought to be true, there is little empirical evidence testing this hypothesis. Not only are significant company-wide pay cuts rarely observed in practice but measures of employee effort are typically difficult to quantify. This article examines the effort responses of U.S. commercial airline pilots following a recent series of large, permanent pay cuts. Using airline on-time performance as proxy for unobservable pilot effort, we find only limited support for the hypothesis that pay cuts lower employee effort.

> There are lots of penalties to cutting pay. You lose the enthusiasm and loyalty of your work force. People measure success with pay. A cut in pay means you haven't been doing well. (Business agent of a retail workers' union local with 16,000 members [Bewley 1999, 175])

We thank an anonymous referee, Barry Hirsch, Lawrence Katz, John List, María José Luengo-Prado, Daniel Rees, Bent Sørensen, and Sam Tibbs for their detailed suggestions and comments. We also thank seminar participants at East Carolina University, University of California, Irvine, and Social Science Research Center Berlin (WZB). The views expressed in this article reflect those of the authors and are not those of LECG, LLC. Contact the corresponding author, Nicholas G. Rupp, at ruppn@ecu.edu.

[*Journal of Labor Economics,* 2007, vol. 25, no. 4]

0734-306X/2007/2504-0006$10.00

I. Introduction

Economists have offered many different reasons to explain an apparent labor market inefficiency: why wages are not cut when unemployment is high. Some of the most prominent theories used to explain wage rigidity include contract theory (Fischer 1977), fair wage theory (Akerlof and Yellen 1990), and efficiency wage theory (Solow 1979), which, in turn, includes (among others) the shirking model (Shapiro and Stiglitz 1984), the partial gift exchange model (Akerlof 1982), and the labor turnover model (Stiglitz 1974).[1] Surveys of wage-setting company executives confirm that employers are reluctant to cut pay even when unemployment is high (e.g., Blinder and Choi 1990; Bewley 1995, 1999; Campbell and Kamlani 1997). In fact, most executives cited in these surveys favor layoffs instead of pay cuts because of the negative effects of a pay cut on employee morale, productivity, and turnover, especially among the companies' most valuable employees (Bewley 1995, 1999). Laboratory experiments (Fehr, Kirchsteiger, and Riedl 1993; Fehr, Gächter, and Kirchsteiger 1997) show that reciprocal motivations are important for sustaining a cooperative employee attitude since employees respond to generous compensation by providing extra effort. A double auction experiment by Fehr and Falk (1999) reveals a positive relationship between workers' effort and the wage level. Laboratory evidence has also linked pay cuts to an increase in quitting (Valenzi and Andrews 1971) and reduced productivity (Pritchard, Dunnette, and Jorgenson 1972).

While there are numerous theories, firm surveys, and laboratory experiments on the causes of wage rigidities and on potential repercussions to productivity and effort following a wage reduction, there has been little empirical work examining employee performance following an actual and permanent wage reduction. The lack of such research is most likely the result of data availability (or the lack thereof), since any study of employee effort following pay reductions requires instances of permanent, company-wide pay reductions and firm-specific data that can reliably measure
q1 employee effort, both of which are extremely difficult to come by.

This article examines changes in on-time flight performance (our proxy for unobservable pilot effort) of major U.S. airlines following announcements of significant and permanent reductions in pilot wage rates. Over the past few years, pilots (and other employee groups) at every large U.S. "legacy" carrier have experienced substantial, permanent wage rate reductions as a result of bankruptcy, negotiations under the threat of bankruptcy, or a contractually mandated arbitration decision between a carrier

[1] See Campbell and Kamlani (1997) for a summary of the theories of wage rigidity.

and its pilots' union.[2] While most pay cuts between carriers and their pilots unions have been negotiated consensually (even for carriers in bankruptcy), others have been unilaterally imposed by an independent arbitrator. In some instances, there have been significant (and widely reported) increases in flight delay and cancellation rates immediately after an announced pay cut. For example, in April 2005, the percentage of Alaska Airlines's flights that arrived on time by U.S. Department of Transportation standards (i.e., within 15 minutes of its scheduled arrival time; U.S. q2 Department of Transportation 2005) was 77%. Following the decision by an independent arbitrator to reduce Alaska's pilot pay rates by 26% on April 30, 2005, Alaska's on-time performance plummeted to 59% in May and 49.8% in June.[3] While weather, seasonality, and airport-specific differences are important causes of airline flight delays (Mayer and Sinai 2003; Mazzeo 2003; Rupp 2007) and cancellations (Rupp and Holmes 2006), our estimations control for these and other relevant factors.

Although changes in effort by other airline employee groups that have experienced a pay reduction (often concurrently with pilots) may also be a contributing factor in effort-induced changes in delay rates, we focus exclusively on pilots for a number of reasons. First, at some airlines (i.e., Northwest and Alaska) pilots were the only employee group that experienced a pay reduction during our sample period. Likewise, at airlines where all employee groups saw their pay reduced, wage cuts for pilots were typically the largest (in percentage and dollar terms) and often significantly more than those for other employee groups. In addition, we believe that the link between effort and delays is the most clear-cut for pilots. Not only do pilots have the final say as to if and when a flight is prepared to depart (and thus are in the " best" position to induce a delay), unlike many other airline employee groups, pilots have few opportunities for other types of "poor" behavior. In contrast, baggage handlers could choose to misdirect checked luggage to wrong destinations, mechanics could work more slowly on planes undergoing routine maintenance, and flight attendants and ticket agents could be less courteous to passengers. Moreover, pilots are somewhat unique in that they are essentially unsupervised, whereas other ground-based employee groups work under the scrutiny of management supervisors. Finally, unlike most other airline

[2] The trend of pay and benefit concessions in mature industries characterized by large firms saddled with high legacy costs is a problem both in the United States and abroad. In Germany, e.g., workers at Siemens AG agreed in June 2004 to wage freezes and longer work hours after the firm threatened to move 2,000 jobs to Hungary. Likewise, in 2004 German auto workers at both DaimlerChrysler and Volkswagen agreed to pay freezes and longer work hours in response to impending layoffs.

[3] These delays were widely reported in the media. See, e.g., "Alaska Airlines Seeing More Delays and Cancellations," *USA Today*, June 10, 2005.

employees, pilots have highly specialized skills that are not easily transferable outside of the airline industry. Therefore, pilots have fewer non–airline industry job options, and consequently we suspect that they are less likely to quit and take a job in another sector of the economy to show dissatisfaction over a pay cut.[4]

The contributions of this article are threefold. First, this article provides empirical evidence of the link between wage reductions and employee effort. Second, this article examines whether existing survey evidence is correct in the widely held belief that permanent pay reductions adversely affect employee effort and productivity. Third, this natural experiment of wage compression in the airline industry provides an opportunity to test the veracity of laboratory experiments that simulate the effort response of workers to temporary wage reductions. We note that the stakes are considerably smaller in the laboratory as compared to the airline industry, where the typical senior pilot (prior to the broad series of wage cuts) earned in excess of $200,000 per year.[5] Moreover, in this study, airline pilots experience a permanent pay reduction, whereas pay cuts for subjects participating in economic experiments likely view reductions in laboratory
q3 earnings as changes in temporary income. This distinction is potentially important since the permanent income hypothesis (Friedman 1957) suggests that consumption behavior depends primarily on permanent income rather than temporary or transitory income.

In support of the widely held belief that pay cuts adversely affect effort, we find both more frequent and longer flight delays the week following a pay cut announcement. We also find, however, that the effect on pilot effort is short-lived. Indeed, after the first week, we find no difference in airline flight performance.[6] Our somewhat surprising result (i.e., that a large, permanent pay cut does not induce a longer-lived reduction in pilot effort) provides counterevidence to a widespread belief among company executives that pay cuts adversely effect morale, productivity, and effort. We should note, however, that there are several institutional factors in the airline industry that play important roles in influencing pilot behavior and hence these pilot results may not be indicative of other labor groups

[4] For example, in the 6 months following a set of company-wide permanent pay cuts at Delta Air Lines in late 2004, "quit rates" among pilots reached 0.2%, while quit rates for nonpilot groups ranged from 3.9% (flight attendants) to 13.5% (reservation agents). See "Declaration of Michael L. Wachter in Support of Motion to Reject ALPA Collective Bargaining Agreement," *In re: Delta Air Lines, Inc. et al. v. Debtors*, Chapter 11 case no. 05-17923 (PCB), U.S. Bankruptcy Court, Southern District of New York.

[5] In contrast, subjects in laboratory experiments conducted by Fehr and Falk (1999) typically earned between $18 and $49 for a session lasting 2.5 hours.

[6] These findings are in contrast to the findings of Mas (2006), which documents persistent adverse effects on police performance across several New Jersey communities following "final offer" arbitration decisions in favor of the municipality .

outside of the airline industry. In particular, we note that airline pilots at large U.S. carriers remain among the highest-paid group of professionals in the economy, even after their recent pay cuts. Likewise, the seniority system among pilots (whereby a pilot who switches carriers loses his or her seniority) tends to severely limit pilot mobility, and this could play q4 an important role in explaining our results.

We also document a notable difference in the pilot effort based on the financial situation of the carrier. Specifically, we find significant declines in airline performance following pilot pay cuts at nonbankrupt carriers, whereas there is no discernible change in performance after pay cuts at bankrupt carriers. This suggests that pilots at bankrupt carriers may have feared that bankruptcy court judges might impose even larger pay cuts, or even worse, the possible liquidation of the carrier, if they did not reach a consensual agreement. In contrast, pilots at nonbankrupt carriers may believe that their wage reductions are unjustified. We argue that bankruptcy is a clear signal of a firm's financial distress and hence that it makes management's requests for pay cuts more credible. These findings support the hypothesis that fairness plays an important role in determining whether or not pilots change their level of effort.[7]

Finally, one question that naturally arises is what implications—if any—our findings have for the theory of efficiency wages. While we view our study as a "real world" test of the gift exchange hypothesis, we believe that our results have only limited applicability to efficiency wage theory more generally, as it is well established that the "gift" wage being paid to commercial airline pilots at large U.S. carriers is largely a result of union bargaining power, often under the threat of a strike (Hirsch and Macpherson 2000; Hirsch 2007).[8] Likewise, most efficiency wage theories depend on the presence of certain competitive labor market conditions that are severely impeded (or that fail to exist almost entirely) in the market for commercial airline pilots. For example, in the shirking model, firms pay efficiency wages to increase the cost to the employee of being terminated in the event that he or she is found shirking. Pilot labor unions,

[7] Interviews of randomly selected individuals by Kahneman, Knetsch, and Thaler (1986) reveal that wage reductions are more likely to be considered fair if they enable the firm to avert a loss rather than result in a gain for the company. This idea of fairness is similar to the theory of inequity proposed by Adams (1965), who suggests that inequitably paid workers experience dissatisfaction and therefore will be motivated to address this inequality. Surveys of company executives confirm these perceptions of "fairness"; this underscores the importance of justifying the wage cut to the employees, since pay reductions that are perceived as assisting a firm's survival are deemed justified, while those that are perceived as mainly improving a company's profit prospects are not (Blinder and Choi 1990; Bewley 1999).

[8] As Hirsch (2007) notes, air transportation has the highest union density of any private sector industry in the United States. In our study, 100% of the pilots were unionized.

however, have negotiated several clauses in their contracts that make firing a pilot nearly impossible (or extremely costly) in all but the most extreme circumstances (e.g., knowingly jeopardizing passengers' safety).[9] Similarly, in the turnover model, efficiency wages are paid by the firm to reduce excessive turnover, which lowers the training and hiring costs for the firm. The nontransferable seniority system in place at all U.S. carriers, however, has all but eliminated pilot mobility across large carriers.

The remainder of this article is organized as follows. Section II provides some institutional background on the airline industry and describes the factors contributing to the reduction in pilot pay rates. Section III describes the model, data, and econometric specification. Section IV presents estimation results, and Section V provides concluding remarks and suggestions for further research.

II. Pilot Pay Changes in the U.S. Airline Industry

Between 1995 and 2000, the U.S. airline industry experienced its most profitable period in history, with U.S. passenger carriers generating over $20 billion in net profits. Such strong profitability, however, provided the heavily unionized airline pilots with a very strong bargaining position to negotiate new contracts.[10] Toward the end of this period and continuing into 2001, pilots at a number of the large network carriers received significant pay increases. For example, in October 2000, United Air Lines pilots became the highest paid in the industry when its pilots agreed to a new contract that increased their hourly pay rates by 20%–29%. In June 2001, Delta and its pilots subsequently signed a new "industry-leading" contract, resulting in similar wage rate increases for its pilots and establishing Delta's pilots as the highest paid in the industry. Indeed, Richard Dubinsky, the head of ALPA at the time, noted, "We don't want to kill the golden goose. We just want to choke it by the neck until it gives us every last egg."[11]

Just as many of the large network carriers and their pilots were agreeing to new, long-term contracts at significantly higher pay rates, there were signs that the industry's profitability was waning. For example, the collapse of the "dot-com" and telecom bubble that had sustained a significant

[9] Moreover, an airline is unable to lay off pilots it deems as "poor performers" during an economic slowdown since most pilot contracts include "no furlough" clauses that prohibit carriers from laying off any pilots unless there is a "force majeure" event such as a war or natural disaster, and even then, it must furlough pilots according to strict reverse seniority order.

[10] Pilots at virtually all large commercial airlines in the United States are represented by the Airline Line Pilots Association (ALPA), the primary exception being American Airlines's pilots, who are represented by the Allied Pilots Association (APA).

[11] "The Death of the Golden Egg," *Financial Times*, December 27, 2004.

amount of high-fare business travel in the preceding years had collapsed. Likewise, the growth of Internet distribution channels, such as Expedia, Travelocity, and Orbitz, starting in 1998, greatly reduced search costs and began to create an unprecedented level of pricing transparency. Finally, and perhaps most important, competition from the so-called low-cost carriers (LCCs) such as Southwest Airlines, JetBlue, and AirTran intensified enormously throughout the 1990s and reached what many industry analysts considered to be a tipping point by 2001.[12]

In addition to the competitive changes discussed above, the airline industry suffered what was perhaps its single largest demand "shock" in history with the terrorist attacks of September 11, 2001 (Ito and Lee 2005). Together, these factors plunged the industry into what was undoubtedly its worst financial crisis in history. Between 2001 and 2004, for example, the industry recorded net losses of over $32 billion—significantly more than the profits the industry had earned between 1995 and 2000 and three times as large as the losses from the previous cyclical downturn (1990–92). Consequently, between 2000 and 2005, more than a dozen passenger carriers, including United, US Airways (twice), Northwest, and Delta—representing more than half of all U.S. airline capacity—filed for Chapter 11 bankruptcy protection.

A. Pilot Compensation

Pilots at virtually all commercial U.S. passenger airlines are paid an hourly rate based on their role (captain or first officer), years of experience, and the type of aircraft flown (with larger aircraft typically commanding higher hourly rates). Table 1 illustrates some hourly pilot pay rates for top-of-scale captains (i.e., those with 12 or more years of experience) as of September 2005.

While a typical airline pilot spends somewhere between 45 and 65 hours per month actually piloting an aircraft (known as "hard" or "block" hours), he or she also receives credit for a number of nonflying hours based on various formulae; consequently, a pilot's paid (or "credit") hours

[12] For example, by 2001 approximately 70% of U.S. domestic origin and destination passengers flew in city-pair markets where a low-cost carrier had at least a 5% market share, up from slightly less than 25% in 1990 (U.S. DOT DB1A database). As summarized by a Continental Airlines executive, "[There is now] a low-fare network in this country that did not exist previously. . . . We've finally reached the point, perhaps, where [LCC] penetration may be fatal [to the major carriers' high cost business model]"; see "Low Cost Airlines Put Crunch on Biggest Carriers," *Wall Street Journal*, June 19, 2002.

Table 1
Hourly Top-of-Scale Pilot (Captain) Pay Rates in Dollars as of March 2007

	Carrier					
Aircraft	American	Continental	Delta	Northwest	United	US Airways
Boeing 737/ Airbus A320	161	144	151	137	131	125
Boeing 767	174	186	178		152	144
Boeing 777/ Airbus A330	199	186	188	159	182	160

Source.—Airline Pilot Central Web site, http://www.airlinepilotcentral.com.
Note.—Rates for Boeing 737 are for "Next Generation" (i.e., 700, 800, and 900 series). Northwest and US Airways data in Boeing 777/Airbus A330 row represent Airbus A330 rate. Northwest, United, and US Airways data for Boeing 737/Airbus A320 row represent Airbus A320 rate.

is usually significantly higher than his or her actual flight hours.[13] Virtually all pilot contracts also guarantee pilots a minimum number of credit hours per month, regardless of the number of hours actually flown. Since a pilot's seniority at a given airline—which, in turn, determines the aircraft and seat (captain or first officer)—is the primary factor that determines the hourly wage rate of a pilot and because pilots cannot transfer their seniority across airlines, there has traditionally been very little mobility among pilots from one airline to another in the U.S. airline industry.[14]

B. Recent Pilot Pay and Pension Cuts

Over the past several years, numerous carriers have secured large, permanent cuts in pay rates for pilots (as well as other employees), and three carriers (United, US Airways, and Delta) have terminated their defined benefit pension plans.[15] These pay rate and benefit reductions have been the result of several different mechanisms. Section 1113(c) of the U.S.

[13] For example, a pilot's "duty-rig" guarantees pilots paid credit hours based on the number of hours on duty. A typical duty-rig might be "1 for 2," meaning that for each 2 hours a pilot is on duty, he or she will receive at least 1 credit hour. Likewise, a pilot's "trip-rig" guarantees pilots credit hours based on the total amount of time that he or she is away from base on a trip. For example, a "1 for 4" trip-rig would mean that, if a pilot is away from base for 40 hours, he or she would be guaranteed at least 10 hours of paid credit.

[14] The primary exceptions are pilots who work their way up from regional (i.e., small aircraft) carriers to large jet carriers and pilots who become furloughed at one carrier and seek employment at another carrier.

[15] It is important to note that most pay reductions in the U.S. airline industry have been accompanied by profit-sharing plans, whereby employees would receive a portion of the company's future profits. All three carriers' defined benefit pension plans were taken over by the Pension Benefit Guarantee Corporation (PBGC), a U.S. government corporation, which caps annual benefits for an age 60 retiree (the current age limit for U.S. commercial airline pilots) at approximately $30,000 per year.

Bankruptcy Code, for example, permits an airline to reject a collective bargaining agreement (CBA) if certain requirements are met.[16] For example, United Air Lines used the Section 1113(c) process to secure pilot pay cuts of 29% in January 2003 and an additional 11.3% in January 2005. Likewise, US Airways has used the Section 1113(c) process to secure two separate pilot pay cuts since 2002.[17] Northwest and Delta, both of which filed for Chapter 11 bankruptcy protection on September 14, 2005, also used Section 1113(c) to secure large pilot (and other employee group) pay cuts.[18]

A second way that carriers have reduced pilot (and other employee) wage rates has been through the imminent threat of bankruptcy. Prior to its first bankruptcy filing in August 2002, US Airways negotiated a 26% pay reduction with its pilots in hope of avoiding a bankruptcy filing. In April 2003, American—on the brink of bankruptcy—reached a consensual agreement with its pilots union to reduce pilot wage rates by 23%, thus avoiding an imminent bankruptcy filing.[19] In October 2004, Delta, too, was "on the courthouse steps" when it came to an agreement with its pilots union to reduce wage rates by 32.5%; this was roughly 2 weeks after Northwest reached an agreement with its pilots union for a 15% pay reduction. Finally, Continental secured $418 million in annual labor cost savings, including a pilot pay cut of 8.9% in March 2005, under the specter of significant layoffs and a potential bankruptcy had its targeted savings not been reached.

[16] In particular, Section 1113(c) states that "the court shall approve an application for rejection of a collective bargaining agreement only if the court finds that (1) the trustee has, prior to the hearing, made a proposal that fulfills the requirements of Subsection (b)(1); (2) the authorized representative of the employees has refused to accept such proposal without good cause; and (3) the balance of the equities clearly favors rejection of such agreement" (11 U.S.C. Section 1113(c)). Section 1113(b)(1) requires that a debtor "(A) make a proposal to the authorized representative of the employees covered by such agreement, based on the most complete and reliable information available at the time of such proposal, which provides for those necessary modifications in the employees benefits and protections that are necessary to permit the reorganization of the debtor and assures that all creditors, the debtor, and all of the affected parties are treated fairly and equitably; and (B) provide . . . the representative of the employees with such relevant information as is necessary to evaluate the proposal."

[17] Both United and US Airways also secured significant nonpilot pay cuts under Section 1113(c).

[18] Northwest's and Delta's pay cuts inside of bankruptcy occurred after our sample period. Since most other employee groups at Delta Air Lines are not unionized, Delta did not need to apply for relief under Section 1113(c) of the bankruptcy code to reduce pay rates for these groups.

[19] American's pilot reductions coincided with wage rate reductions of 15%–16% for other employee groups.

A final way in which a carrier in our study achieved a significant pilot wage cut was via an "interest arbitration" decision. In particular, the CBA that was in effect between Alaska Airlines' and its pilots' union (ALPA) until May 2005 enabled an independent, third-party arbitrator to decide (inter alia) rates of pay if Alaska and its pilots were unable to reach a consensual decision on new rates by the end of 2004. Since one of the criteria the CBA instructed the arbitrator to consider was the rates of pay at Alaska's competitors—and since these rates had been falling—the arbitrator awarded Alaska (whose pilot pay rates had become among the highest in the industry) a 26% pay reduction in April 2005. Table 2 summarizes the pilot pay cuts and pension terminations considered in q5 our event-study analysis of pilot effort.

III. Model, Data, and Empirical Specification

Bewley's (1999) survey of company executives suggests that the morale model (e.g., partial gift exchange model proposed by Akerlof [1982]) has received the most empirical support to explain wage rigidity. Resistance to pay cutting is due to employers anticipating a negative reaction from their employees. Experiments by Fehr and Gächter (2002) provide additional support for Bewley's findings. Following efficiency wage theory, we assume that an airline is not able to perfectly monitor the effort of its pilots. Airlines provide pilots with a generous wage level (see table 1 for actual pilot hourly wage rates) and, in return, pilots reciprocate by providing effort that exceeds the minimum necessary. For example, pilots might report to work earlier than assigned, be willing to fly overtime, or do everything in their control to ensure that flights depart on time.

Pilots likely consider the airlines' current financial situation when determining the "fairness" of a wage offer. Hence, the fair wage theory would predict that pilots are more likely to be understanding of pay cuts made by financially distressed (i.e., bankrupt) carriers than those made by carriers not in bankruptcy. Following the partial gift exchange model of Akerlof (1982) and incorporating views on fair wages (Kahneman et al. 1986), we view effort e, as a function of the wage offer w and the employee's view of a fair wage f:

$$e = e(w, f(S)), \tag{1}$$

where

$$\frac{\partial e}{\partial w} > 0, \qquad \frac{\partial e}{\partial f} > 0.$$

That is, effort is increasing in both the wage offer and the employee's view of a fair wage. We posit that an employee's view of what constitutes a fair wage is, in turn, a function of the employee's subjective probability

Table 2
Summary of Pilot Compensation Cuts In Sample

Carrier	Reduction (%)	Notify Date	Effective Date	Notes
Alaska	−26	April 29, 2005	May 1, 2005	Interest arbitration decision
American	−23	April 1, 2003	May 1, 2003	Outside of bankruptcy
Continental	−8.90	February 28, 2005	April 1, 2005	Outside of bankruptcy
Delta	−32.50	October 28, 2004	December 1, 2004	Outside of bankruptcy
Northwest	−15	October 14, 2004	December 1, 2004	Outside of bankruptcy
United	−29	December 27, 2002	January 1, 2003	Chapter 11
United	−11.80	January 18, 2005	January 1, 2005	Chapter 11
United	Pension termination	May 10, 2005	May 10, 2005	Chapter 11, pension taken over by U.S. PBGC
US Airways	−26	July 6, 2002	July 1, 2002	Outside of bankruptcy
US Airways	−8	December 11, 2002	January 1, 2003	First Chapter 11 filing
US Airways	Pension termination	March 1, 2003	March 31, 2003	Second Chapter 11. Pension taken over by U.S. PBGC
US Airways	−18	October 1, 2004	October 15, 2004	Second Chapter 11 filing

Sources.—Various media reports.
Note.—All pay rate cuts listed in table 2 were consensual agreements between the carrier and their pilots' union with the exception of Alaska Airlines. Northwest and Delta secured additional pilot pay cuts as part of their 2005–2007 bankruptcies, and Delta also terminated its pilots' defined benefit pension plan.

S that the firm will survive, $f(S)$, $f'(S) < 0$, $0 \le S \le 1$. Among the factors that are likely to be important factors in determining S are the airline's financial position (liquidity, cost structure, etc.) and whether or not the airline is currently in bankruptcy. We argue that a carrier's bankruptcy status is particularly important in shaping S in light of the fact that the overwhelming majority (i.e., almost 90%) of U.S. airlines that have declared bankruptcy between 1978 and 2004 are no longer operating today.[20]

A. Event-Study Analysis

Since airline pilot effort is unobservable, we proxy pilot effort by using a variety of flight performance measures. Thus, our underlying assumption is that consistently reliable flight performance requires (inter alia) greater pilot effort. This assumption is justified given the fact that an airline captain is the ultimate authority in determining if and when a flight is ready to depart. Indeed, an ALPA attorney argued, during the opening day of Delta Air Lines's Section 1113(c) bankruptcy hearing, that "[a pilot] is the commander of that flight in much the same sense as the commander of a British frigate in the nineteenth century was. What he says is the final word."[21]

Our primary performance measure is an airline's on-time arrival rate (specifically, the proportion of daily flights arriving within 15 minutes of the scheduled arrival time). The 15 minute measure is the Department of Transportation's standard on-time definition and is also widely reported by the media. Since the 15 minute cut-off is arbitrarily determined, we also use a continuous measure of flight delays, specifically, the average arrival delay (in minutes).[22]

The explanatory variable of interest is the carrier's flight performance immediately following the announcement of a pilot pay cut.[23] We use the

[20] See *Bankruptcy and Pension Problems Are Symptoms of Underlying Structural Issues*, U.S. General Accounting Office, GAO-05-975, Washington, DC, September 2005.

[21] See the opening statement of ALPA, "Transcript of Evidentiary Hearing on Motion to Reject ALPA CBA before the Honorable Prudence C. Beatty," *In Re: Delta Air Lines., et al, v. Debtors*, November 16, 2005.

[22] As robustness checks, we also defined delays using a 30 minute (rather than 15 minute) cut-off and also considered flight cancellations.

[23] It is important to emphasize that, while pay reductions become effective on a specific date, the information regarding the potential for a pay reduction evolves over time. Typically, there are meetings between the leaders of the pilots' union and company management. Proposals and counterproposals are traded back and forth between the union and the company, often requiring several iterations before reaching an agreement. Once a tentative agreement is reached between the representatives of the pilots' union and the company, the agreement is voted on by the rank-and-file pilots. All labor contracts must be approved by a majority of pilots before going into effect. Finally, once the contract is

tentative agreement date as the event date for the pay reduction, since this is the initial date when pilots learn the details of their new, proposed labor contract. All pay cuts listed in table 2 have gone into effect, and each of the pay cuts (with the exception of the 26% pay cut at Alaska Airlines, which was imposed by an independent arbitrator) were approved by the pilots. The average pilot pay cut between October 2001 and June 2005 was 20%. Two carriers, US Airways and United Airlines, also terminated their defined benefit pension plans during our sample period (turning them over to the Pension Benefit Guarantee Corporation [PBGC]), resulting in significant reductions in postretirement benefits. In these situations, we used the date the bankruptcy judge approved the pension termination as the event date.

We are interested in comparing a carrier's on-time performance following a pay cut announcement relative to the period immediately preceding the announcement. Focusing on relatively short event windows allows us to more clearly identify the effect of pay cuts on pilot effort without introducing preexisting carrier-specific trends in on-time performance. The length of the preannouncement comparison period is the same for all carriers. Since US Airways has two pay cut events that are 80 days apart (December 11, 2002 and March 1, 2003), we opt to use 40 day preannouncement and 40 day postannouncement comparison periods for all carriers.

In those cases in which the timing of the pay cut announcement is not random (i.e., airline bankruptcies or near bankruptcies and, in turn, pay cuts have frequently occurred at the onset of the slower traffic period following Labor Day), we include month × year dummies to control for the calendar date/seasonal changes in demand for air travel. In addition, carrier dummies control for on-time performance differences that exist among carriers. To control for the variation in passenger loads (fuller flights take longer to load and are more prone to depart late), we include day-of-the-week effects since midweek flights tend to have lighter passenger loads.

B. The Data

Data on flight delays and cancellations come from the U.S. Bureau of Transportation Statistics (BTS) TranStats database (http://www.transtats.bts.gov). There were 12 permanent pilot pay reductions (ranging from 8% to 32.5%) by major U.S. carriers between October 2001 and June 2005 (see table 2). Since we want the pre- and postannouncement comparison periods to be the same for all events, we track flight performance 40 days prior to and 40 days following the pay cut announcements. We aggregate the in-

approved, there is an effective day when the new wage and benefit changes take effect.

Table 3
Flight Performance after Pilot Pay Cut Announcements, May 2002 and June 2005

Service Quality	Average for Entire Sample	First 7 Days after Pay Cut	First 14 Days after Pay Cut
Proportion 15+ minutes delayed	19.0	21.3	19.0
Proportion 30+ minutes delayed	10.9	12.6	10.7
Proportion canceled	1.3	1.7	1.2
Minutes of arrival delay	4.39	5.96	4.22
Observations	1,377,036	28,888	57,670

dividual flight data at the daily route-level measure, since we are interested in the overall flight performance of a carrier (rather than estimating delays for individual flights).[24] After collapsing the individual flight-level observations into carrier-route-level daily observations and only including the 80 day period surrounding a pay cut announcement, our 45 month sample period has 1,390,462 observations.

Most airports serve as active weather reporting stations; hence, daily weather data at origination and destination airports come from the U.S. National Oceanic and Atmospheric Administration (NOAA).[25] We are able to match daily weather data with 99% of our flight data, resulting in 1,377,036 usable observations. We include weather measures for daily snowfall and rain at both origination and destination airports.

Since the first pay cut in our sample occurred on July 6, 2002, table 3 reports summary statistics for flight performance between May 2002 and June 2005. These summary statistics support our previous findings (from figs. 1 and 2) that there is a reduction in flight performance during the 7
q7 days immediately following a pay cut announcement. Each of the four flight performance measures reveals a slightly deteriorating service quality. For example, comparing the entire sample period with the 7 days following a pay cut, we find that the proportion of flights delayed 15+ minutes increases from 19.0% to 21.3%. The flight cancellation rate registers a modest increase from 1.3% to 1.7% during the week following a pay cut. Finally, the average arrival delay increases by about 1.5 minutes from 4.39 minutes to 5.96 minutes during the week following a pay cut announcement. Expanding the window to include the first 14 days after the pay cut announcement, however, we find limited impact on flight performance as the four performance measures return to their sample averages.

[24] For example, if American Airlines offers 12 daily flights between Dallas and Atlanta, we calculate each performance measure at the route level by computing the proportion of American's Dallas–Atlanta flights on date *t* that were delayed.

[25] In cases of missing weather data, we substituted the nearest weather reporting station within a radius of 25 miles.

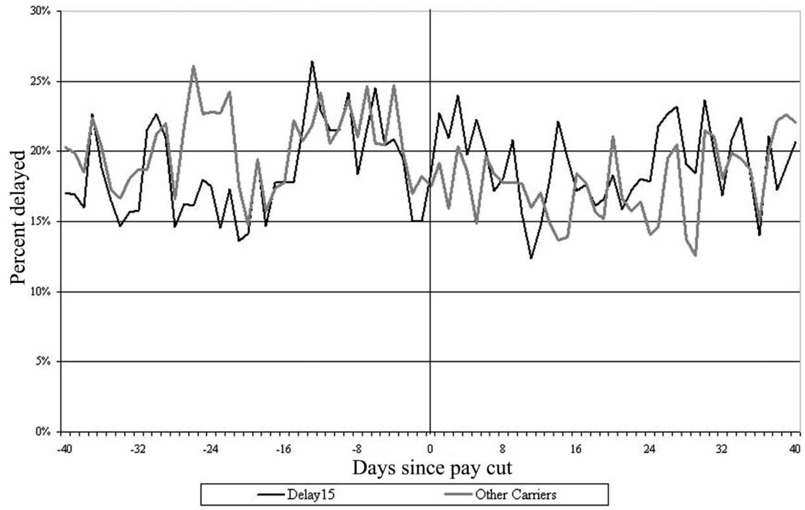

FIG. 1.—Daily average flight delays (15+ minutes) before and after pilot pay cut agreement.

C. Econometric Specification

One approach for determining the magnitude of the change in on-time performance is to conduct an event-study analysis (Jacobson, LaLonde, and Sullivan 1993). Hence, we begin by estimating the following baseline model:

$$\begin{aligned} Y_{itr} = \beta X_{itr} &+ \text{carrier fixed effects} + \text{calendar fixed effects} \\ &+ \chi_{i,-40} + \chi_{i,-39} + \ldots + \chi_{i,-1} + \chi_{i,0,} \\ &+ \chi_{i,1} + \ldots + \chi_{i,40} + \varepsilon_{itr}, \end{aligned} \tag{2}$$

where i is a carrier, t is a calendar date, and r is a route. Symbol β represents estimated regression coefficients of X_{itr}, a vector of independent variables that are likely to affect flight delays, including weather, airport congestion, and whether or not the route involves a hub airport for a specific carrier. The dependent variable Y_{itr} is a daily measure of average flight delays for a given route (where a route is defined as a directional airport pair [i.e., flights from Boston (BOS) to Los Angeles International (LAX) and flights from LAX to BOS are treated as distinct routes]). The variable $\chi_{i,-40}$ is an indicator function that takes the value of one 40 days prior to a pay cut announcement by carrier i (etc.). All carriers are included in the sample, even if the pilots are not experiencing a pay cut during the sample period (this enables us to identify the carrier effects).

Figure 1 illustrates a simple average of 15+ minute flight delays for

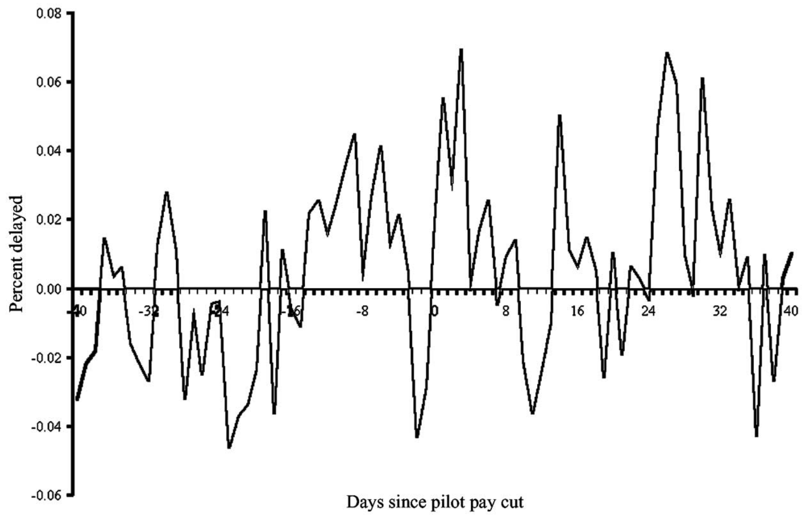

FIG. 2.—Regression-adjusted event-study estimates of the effect of pilot pay cuts on flight delays (15 minute); -40 to +40 days event window.

both the pay-cutting carrier and all other non-pay-cutting carriers for each day from 40 days prior to and 40 days after the pay cut announcement (not controlling for any other factors). Prior to the pay cut, there is little systematic difference between the average delay rates for the pay-cutting carrier and all other carriers. Immediately after the pay cut, announcement at day 0, there appears to be a slightly higher rate of 15 minute delays for the pay-cutting carrier; however, after about day 7, this gap disappears. Figure 2 plots each of the estimated coefficients $\chi_{i,-40}$ to $\chi_{i,40}$ from equation (2) (i.e., controlling for other important flight delay factors such as weather, airport congestion, and carrier specific effects) with the event time on the horizontal axis. Agai, we see a slight increase in the occurrence of 15+ minute delays for the first week after the pay cut announcement but no obvious pattern thereafter.

Since the event-study estimated coefficients from our baseline model (eq. [2]) indicate an increase in flight delays during the first week, we track flight performance for 7, 14, and 28 days following the announcement date. We use relatively short event windows in order to avoid contamination by other events. Given that the financial condition of the airline may influence whether the wage cut is perceived as “fair,” we measure the flight performance of wage reductions at nonbankrupt airlines (7 days and no bankruptcy) and bankrupt carriers (7 days and bankruptcy). This latter variable is an indicator of pay cut agreements negotiated when the carrier was in Chapter 11 bankruptcy (analogous dummy variables are defined for 14 and 28 days).

A Breusch-Pagan (1979) test for heteroskedasticity overwhelmingly ($p < .0001$) rejects the null hypothesis of homoskedasticity; hence, we use the following weighted least squares (WLS) estimation:

$$Y_{itr}\sqrt{n_{itr}} = \alpha\sqrt{n_{itr}} + \zeta_{FE}\sqrt{n_{itr}} + \beta X_{itr}\sqrt{n_{itr}} + \gamma D_{itr}\sqrt{n_{itr}} + \varepsilon_{itr}, \qquad (3)$$

where α is a constant; ζ_{FE} denotes various fixed effects, including calendar date (month × year), carrier effects, and day-of-week effects; and n_{itr} is the number of daily scheduled flights by carrier i at date t on route r. The dependent variable $Y_{itr}\sqrt{n_{itr}}$ represents a daily weighted average of flight performance for each carrier on a route. Variable D_{it} is the pay cut dummy variable, which equals one if carrier i has announced a significant pay cut reduction within the past 7 (14 or 28) days and zero otherwise, and ε_{ijt} is the error term. After doing the WLS estimation, the Breusch-Pagan test no longer rejects the null hypothesis of homoskedasticity. Because we suspect that delays for a particular carrier likely occur in bunches due to unobserved events such as a weather event that we cannot control for (i.e., high winds at hub airport) or unobserved labor unrest, we cluster standard errors into the following groups: carrier × month × year (e.g., Delta, June, 2003).

The variable airline hub origination (airline hub destination) is an indicator variable assuming the value of one for flights originating from (destined for) a carrier's hub airports. Following Lee and Luengo-Prado (2005), we define an airport as a carrier's hub if 50% or more of its passengers at the respective airport are making a connection. Since airport congestion is an important flight delay determinant (e.g., Mayer and Sinai 2003), we include airport flights origin (destination), which is the total number of daily departing and arriving flights at the origination (destination) airport. We include flight distance between airports in the regressions, since longer flights provide a larger window for the carrier to "make-up" time while airborne and hence arrive on time. The regressions also include weather measures (daily rain and snowfall) at both the origination and destination airports.

Finally, since some airports experience unique capacity (e.g., New York's LaGuardia) or location-specific weather constraints, such as dense morning fog (e.g., San Francisco or Seattle), we include airport fixed effects in some estimations. Likewise, we include carrier fixed effects in every estimation to control for firm specific differences in scheduling practices.

q8 To check the robustness of our results, we also estimate a difference-in-difference specification. The difference-in-difference approach compares a given carriers' system-wide performance relative to other carriers serving the same airport. The advantage of the difference-in-difference estimation is that it enables us to control for inherent airport specific differences in performance between hub and nonhub carriers, given that hub carriers typically have higher delay rates compared to their nonhub counterparts operating at the same airport due to the peaking of flights by hub carriers (Brueckner 2002; Mayer and Sinai 2003). In constructing our difference-in-difference regressions, we compare a carrier's performance at its primary airports with those of all other carriers operating at these same airports. A detailed description of how we formulated our difference-in-difference regressions can be found in the appendix.

IV. Estimation Results

Estimation results from the equation (3) WLS regressions for our primary measure of effort (15+ minute delays) are summarized in table 4. For presentation purposes, we have suppressed estimated coefficients for the day-of-week, month, year, and carrier effects. We are most interested in the effect on 15+ minute delays since this represents the DOT's criterion, which is widely reported by the media and used by airlines themselves for marketing purposes. Consequently, if pilots wished to show their displeasure to management by inducing a delay, we suspect that it would show up most prominently in the 15+ minute measure. In fact, we find marginally higher rates of 15+ minute arrival delays during the 7 days after a pay cut (model 1). The regression estimate of 0.0298 suggests that, for every 100 scheduled flights, there are an additional 2.98 flights arriving 15+ minutes late the week after a pilot pay cut announcement.

It is important to emphasize that many pilot pay cuts do not occur in a vacuum. Since pay cuts usually occur when a carrier is in financial distress, management may also be simultaneously seeking wage concessions from other nonpilot employee groups. In fact, there are only two instances (US Airways [March 1, 2003] and Northwest) in our sample of 12 events in which pilots were the sole labor group experiencing a wage reduction at the airline (i.e., no other employee group experienced a pay cut during the 80 day window straddling the pilot wage reduction).[26] To control for other labor groups that experienced a pay cut, we created an indicator variable "nonpilot pay cut," which takes the value one after another major labor group at the airline experiences a wage reduction and zero otherwise. After controlling for wage cuts by nonpilots, we find no significant change in flight delays during the week after a pilot pay cut announcement (see model 2). Both the 7 days and the nonpilot pay cut

[26] There are four instances in which other labor groups (e.g., flight attendants, baggage handlers, mechanics, or customer service agents) accepted pay reductions prior (between 1 and 30 days) to the pilot agreement. Likewise, there are two instances in which pilots and at least one other major labor group experienced pay cuts on the same day, and there are three instances in which other labor groups experienced a wage reduction after the pilots had received theirs (by 9–15 days).

Table 4
Event-Study Estimates of the Effect of Wage Reductions on the Occurance of 15+ Minute Flight Delays

	(1)	(2)	(3)	(4)	(5)	(6)
Days after pilot pay cut:						
7 days:	.0298+	.0241				
	(.0177)	(.0172)				
No bankruptcy			.0426+	.0437+		
			(.0246)	(.0241)		
Bankruptcy			.0053	.0047		
			(.0209)	(.0205)		
14 Days:						
No bankruptcy					.0055	.0063
					(.0214)	(.0209)
Bankruptcy					−.0101	−..0111
					(.0203)	(.0200)
Nonpilot pay cut		.0116	.0110	.0129	.0142+	.0161*
		(.0082)	(.0081)	(.0080)	(.0081)	(.0079)
Hub variables:						
Airline hub origination	.0255**	.0255**	.0255**	.0297**	.0255**	.0297**
	(.0037)	(.0037)	(.0037)	(.0029)	(.0037)	(.0029)
Airline hub destination	−.0189**	−.0189**	−.0189**	−.0006	−.0189**	−.0005
	(.0034)	(.0034)	(.0034)	(.0027)	(.0034)	(.0027)
Logistical variables:						
Airport flights origin (in 1,000s)	.0239**	.0238**	.0238**	.0035	.0238**	.0035
	(.0022)	(.0022)	(.0022)	(.0103)	(.0022)	(.0104)
Airport flights destination (in 1,000s)	.0361**	.0360**	.0359**	.0046	.0359**	.0047
	(.0024)	(.0024)	(.0024)	(.0100)	(.0024)	(.0100)
Distance (in 1,000s of miles)	.0178**	.0178**	.0178**	.0123**	.0178**	.0123**
	(.0015)	(.0015)	(.0015)	(.0016)	(.0015)	(.0016)

Weather variables:						
Snow origination	.0064**	.0064**	.0064**	.0062**	.0064**	.0062**
	(.0003)	(.0003)	(.0003)	(.0003)	(.0003)	(.0003)
Snow destination	.0045**	.0045**	.0045**	.0044**	.0045**	.0044**
	(.0002)	(.0002)	(.0002)	(.0002)	(.0002)	(.0002)
Rain origination	.0013**	.0013**	.0013**	.0013**	.0013**	.0013**
	(.0000)	(.0000)	(.0000)	(.0000)	(.0000)	(.0000)
Rain destination	.0015**	.0015**	.0015**	.0015**	.0015**	.0015**
	(.0000)	(.0000)	(.0000)	(.0001)	(.0000)	(.0001)
Constant	.1746**	.1753**	.1876**	.4450**	.1751**	.4435**
	(.0157)	(.0156)	(.0164)	(.0359)	(.0156)	(.0359)
Airport fixed effects?[a]	No	No	No	Yes	No	Yes
Mean of dependent	.190	.190	.190	.190	.190	.190
Variable	[.29]	[.29]	[.29]	[.29]	[.29]	[.29]
R^2	.162	.162	.162	.183	.162	.180

NOTE.—N = 1,377,036. Event time window (−40 days to +40 days) is for wage cuts occuring May 2002–June 2005. Standard errors (in parentheses) are clustered by month, year, and carrier (i.e., Delta, June, 2003). Standard deviations are in brackets. Regressions include month × year, carrier, and day of week indicator variables.

[a] Include indicator variables for each origination and destination airports.

+ Significant at the 10% level.

* Significant at the 5% level.

** Significant at the 1% level.

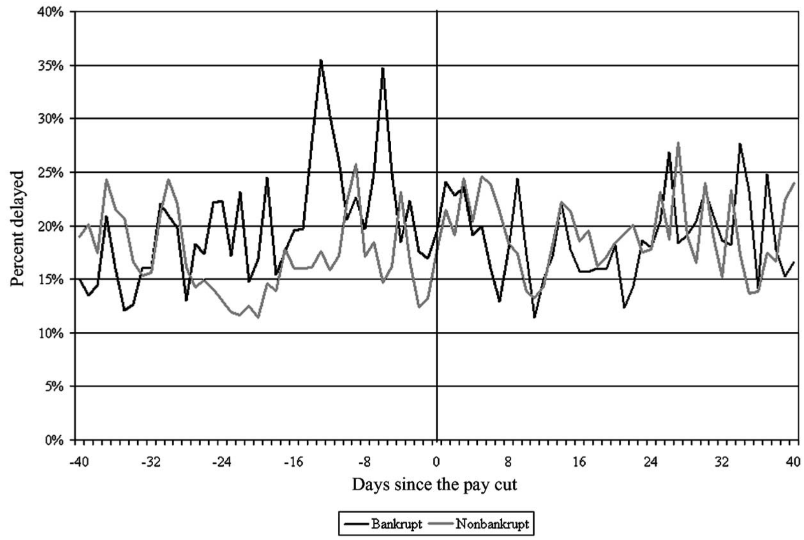

FIG. 3.—Caption: Daily average flight delay (15+ minutes) before and after pilot pay cut agreement]

variables in model 2 have positive coefficients (0.024 and 0.012, respectively); however, we cannot reject the hypothesis that they have no effect on flight delays. Moreover, these results suggest that we should control for pay cuts by other labor groups; hence, all remaining specifications include the nonpilot pay cut variable.

Model 3 decomposes the effect of wage reductions for bankrupt and nonbankrupt carriers. The results are quite striking: pay cuts for nonbankrupt carriers lead to a substantial deterioration in flight performance, while pay cuts at bankrupt carriers have no noticeable impact on flight performance. The results suggest a more than 4 percentage point increase in the occurrence of flight delays for nonbankrupt carriers during the week after the pay cut announcement. Figure 3 shows the average flight delays for both bankrupt and nonbankrupt carriers before and after the pay cut announcement (like fig. 1, these averages do not control for other important delay factors such as weather or airport congestion). Before the pay cut, the bankrupt carrier frequently has more flight delays, while after the pay cut the nonbankrupt carrier commonly has more 15+ minute flight delays. We find that our results are robust to the airport fixed effects specification (model 4), as nonbankrupt carriers again have significantly higher occurrences of 15+ minute delays while nonbankrupt carriers experience no notable changes in performance following pilot pay cuts.

Expanding the event window to include the first 14 days following a pilot pay cut, we find no discernible change in 15+ minute flight delays during the 2 weeks after a pay cut (see model 5) for either bankrupt or nonbankrupt carriers. Similar results are found when we include airport fixed effects (model 6). Moreover, we also examined the 28 days after a pay cut and found no effect on any of our flight performance measures; therefore, for brevity, we have not reported those results in table 4.[27] Given the lack of significance for any period longer than 1 week, we believe that pilot pay cuts have negligible long-term effects on flight performance.

Given that the 15+ minute cut-off is somewhat arbitrary, for robustness, we reestimated the same set of models from table 4 using the average duration (in minutes) of flight delays. Estimation results are summarized in table 5. Model 1 indicates that the average delay increases by approximately 2 minutes during the week following a pay cut (recall that during the sample period May 2002 to June 2005, the average delay was approximately 4.5 minutes). After controlling for pay cuts by other labor groups, model 2 reveals that the average delay increases by less than 2 minutes the week after a pilot pay cut. Moreover, the 7 days coefficient loses its statistical significance. Models 3 and 4 separate the additional delay experienced by nonbankrupt carriers (2.3 minutes) versus bankrupt carriers (1.4 minutes) during the week following a pilot pay cut. The
q9 coefficients of neither of these, however, are statistically significant. Considering the 14 day period, we find no change in the length of arrival delays following pilot wage reductions (models 5 and 6). The airport fixed effects estimation (model 6) attributes a slight increase in flight delays (approximately 1 minute) due to pay cuts by nonpilot labor groups.

In sum, this analysis of flight performance following pilot pay cuts reveals the following: (1) The week following a pilot pay cut we find a small and short-lived increase in the occurrence of 15+ minute flight delays and the average length of delay. (2) After controlling for pay cuts by other employee groups, we find limited impact on flight performance during the week after a pilot pay cut. (3) Moreover, 2 weeks and 4 weeks after a pilot pay cut, there is no discernible change in flight performance, which suggests minimal long-term effects on effort following pilot pay reductions. (4) The financial position of the carrier cutting pay matters, as we find little impact on performance at bankrupt carriers following pay cuts, whereas nonbankrupt carriers that reduce pay experience a short-lived deterioration in flight performance, with more frequent 15+ minute flight delays.

[27] Likewise, when delays are defined using a 30+ rather than 15+ minute threshold, the sign and magnitude of the estimated coefficients are, in general, similar; however, in some specifications, the coefficients become less significant. Complete results for the 30+ minute specification and the 28 day even window are available from the authors upon request.

Tuesday Jul 03 2007 01:13 PM JOLE v25n4 250406 BBS

Table 5
Event-Study Estimates of the Effect of Wage Reductions on Minutes of Flight Delay

	(1)	(2)	(3)	(4)	(5)	(6)
Days after pilot pay cut:						
7 days:	2.1934^{+}	1.8083				
	(1.3117)	(1.2926)				
No bankruptcy			2.2272	2.3109		
			(1.7832)	(1.7557)		
Bankruptcy			1.3795	1.3299		
			(1.8398)	(1.7988)		
14 Days:						
No bankruptcy					−.1516	−.0919
					(1.5020)	(1.4713)
Bankruptcy					−.0102	−.0870
					(1.7580)	(1.7328)
Nonpilot pay cut		.7917	.7777	.9469	1.0281	1.1960^{+}
		(.6507)	(.6567)	(.6462)	(.6371)	(.6254)
Hub variables:						
Airline hub origination	1.9467**	1.9452**	1.9457**	2.2415**	1.9467**	2.2417**
	(.3201)	(.3205)	(.3207)	(.3422)	(.3207)	(.3421)
Airline hub destination	−1.1634**	−1.1646**	−1.1641**	.0353	−1.1630**	.0356
	(.3131)	(.3135)	(.3136)	(.3195)	(.3134)	(.3194)
Logistical variables:						
Airport flights origin (in 1,000s)	1.6473**	1.6404**	1.6397**	.2297	1.6393**	.2337
	(.1807)	(.1806)	(.1807)	(.9530)	(.1809)	(.9539)
Airport flights destination (in 1,000s)	2.1581**	2.1506**	2.1499**	−.0413	2.1494**	−.0393
	(.1948)	(.1949)	(.1948)	(.7353)	(.1945)	(.7350)
Distance (in 1,000s of miles)	−.0746	−.0753	−.0752	−.5273**	−.0754	−.5273
	(.1278)	(.1279)	(.1279)	(.1284)	(.1279)	(.1282)

Weather variables:						
Snow origination	.6479**	.6482**	.6482**	.6521**	.6488**	.6527
	(.0319)	(.0319)	(.0319)	(.0323)	(.0319)	(.0323)
Snow destination	.3934**	.3936**	.3936**	.3863**	.3942**	.3868
	(.0394)	(.0394)	(.0394)	(.0394)	(.0395)	(.0394)
Rain origination	.1165**	.1166**	.1166**	.1160**	.1166**	.1160
	(.0054)	(.0054)	(.0054)	(.0054)	(.0054)	(.0054)
Rain destination	.1339**	.1340**	.1340**	.1335**	.1340**	.1335
	(.0060)	(.0060)	(.0060)	(.0061)	(.0060)	(.0061)
Constant	3.6467**	3.6985**	5.6051**	. . .	3.6968**	. . .
	(1.3815)	(1.3773)	(1.3603)		(1.3823)	
Airport fixed effects?[a]	No	No	No	Yes	No	Yes
Mean of dependent	4.39	4.39	4.39	4.39	4.39	4.39
Variable	[27.24]	[27.24]	[27.24]	[27.24]	[27.24]	[27.24]
R^2	.128	.128	.128	.138	.128	.138

Note.—N = 1,371,533. Event time window (−40 days to +40 days) is for wage cuts occuring May 2002–June 2005. Standard errors (in parentheses) are clustered by month, year, and carrier (i.e., Delta, June, 2003). Standard deviations are in brackets. Regressions include month × year, carrier, and day of week indicator variables. Observations are daily route averages for each carrier.

[a] Include indicator variables for each origination and destination airports.

[+] Significant at the 10% level.

** Significant at the 1% level.

A. Difference-in-Difference Results

Results from our difference-in-difference estimations are summarized in table 6 for each of the seven carriers that cut pilot pay during the sample period. The advantage of the difference-in-difference specification is that it enables a performance comparison across airlines at the same airports over time. In particular, changes in flight performance following a wage reduction can be examined to determine whether the relative flight performance of carriers changes following pay cuts. In addition, the difference-in-difference estimations serve as a robustness check of the pay cut regression results discussed previously.

q10

Table 6 reveals significantly higher rates of flight delays (15+ minutes) for four of the seven carriers during the week after a pilot pay cut. Using the 15+ minute delay measure, the magnitudes for these four carriers range from an increase of 1.6 percentage points (United) to 22.8 percentage points (Alaska). Recall that, for the entire sample, 19% of flights arrive 15+ minutes late. Hence, the increase in the rate of delays at United translates into an 8% increase in delays, while Alaska experienced a 120% increase in flight delays 1 week after a pilot pay reduction.[28] The two remaining carriers with notable increases in flight delays following a pay cut are Continental and Northwest, which experienced a 6.5 and 7.4 percentage point increase, respectively. The three carriers with no significant change in flight delays 1 week after a pay cut are American, Delta, and US Airways.

The bottom half of table 6 shows difference-in-difference results for the 2 week period following a pilot pay cut. On the whole, we find similar results for the 2 week period compared to the 1 week period, since the same four carriers (Alaska, Continental, Northwest, and United) experienced significantly more 15+ minute flight delays. We note, however, that the magnitude of the estimated coefficient is smaller for three of the four carriers, indicating fewer 15+ minute delays for the 2 week period compared to the 1 week period. During the 2 week period following a pay cut, Alaska had the largest change in performance with a 17.1 percentage point increase in delays, followed by Northwest and Continental at 7.8 and 5.5 percentage points, respectively. United's increase in flight delays is a slight 1.3 percentage points. American, Delta, and US Airways have no discernible changes in 15+ minute flight delays in either the 1

[28] The extraordinarily large increase in Alaska's delay rate following its pilot pay cut may indicate that Alaska's pilots felt that the large (−26%) pay cut imposed by the independent arbitrator was unjustified since Alaska—unlike most of the carriers in our sample—had not yet experienced the same degree of financial distress as many other large network carriers. As a robustness check, we excluded Alaska from the sample and reestimated tables 4 and 5. We find similar results; however, the magnitude of the pay cut coefficients is reduced by approximately 10%.

Table 6
Difference-in-Difference Estimates: Wage Reductions and Percentage of Flights Arriving 15+ Minutes Late

	Alaska	American	Continental	Delta	Northwest	US Airways	United
7 days after pay cut:							
Effect	.2283**	.0488	.0651**	−.0121	.0741*	−.0089	.0163+
	(.0339)	(.0325)	(.0194)	(.0420)	(.0297)	(.0130)	(.0084)
Weather variables:							
Snow origination	. . .	.0010	.0012+	−.0021	.0008	.0014	−.0010
		(.0012)	(.0006)	(.0040)	(.0011)	(.0009)	(.0010)
Rain origination	.0002	.0011**	.0006**	.0007**	−.0001	.0005**	.0005**
	(.0002)	(.0002)	(.0001)	(.0001)	(.0003)	(.0002)	(.0002)
Constant	.1125**	.0016	.0080**	−.0008	.0318**	.0332**	−.0089**
	(.0057)	(.0025)	(.0030)	(.0037)	(.0038)	(.0048)	(.0022)
R^2	.042	.032	.068	.063	.013	.023	.023
14 days after pay cut:							
Effect	.1706**	.0263	.0550**	−.0020	.0776	−.0072	.0127+
	(.0349)	(.0179)	(.0193)	(.0233)	(.0169)	(.0110)	(.0076)
Weather variables:							
Snow origination	. . .	.0011	.0011+	−.0020	.0008	.0014	−.0010
		(.0012)	(.0006)	(.0040)	(.0011)	(.0009)	(.0010)
Rain origination	.0002	.0011**	.0006**	.0007**	−.0001	.0005**	.0005**
	(.0002)	(.0002)	(.0001)	(.0001)	(.0003)	(0.0002)	(.0002)
Constant	.1112**	.0014	.0075	−.0009	.0306**	.0335**	−.0092**
	(.0056)	(.0025)	(.0030)	(.0037)	(.0038)	(.0049)	(.0022)
R^2	.046	.122	.072	.062	.025	.023	.024

NOTE.—$N = 574$. Event time window (−40 days to +40 days) is for wage cuts occuring between May 2002 and June 2005. Difference-in-difference estimations are defined as the difference in the average daily flight delay rates at carrier X's hub airports versus the average daily flight delay rates for all other carriers at carrier X's hub airports. Robust standard errors are in parentheses.
+ Significant at the 10% level.
* Significant at the 5% level.
** Significant at the 1% level.

week or the 2 week period after a pay cut announcement. These results are consistent with our pooled regressions, which showed no systematic impact on flight performance for either the 2 week or 4 week period following a pilot pay cut.

Finally, table 7 summarizes difference-in-difference results for the length of flight delays. Alaska (16 minutes) and United (2 minutes) are the only two carriers that experienced significantly longer flight delays 1 week after a pilot pay cut. Two weeks after a wage reduction, we find four carriers experienced significantly longer flight delays: Alaska (11.8 minutes), Continental (3.5 minutes), Northwest (3.1 minutes), and United (1.7 minutes).

B. Discussion of Results

Two results from our analysis of the effect of pay cuts on pilot effort stand out. First, why are effort reductions among pilots experiencing large pay cuts apparently so short-lived? Second, why are the performance differences following pay cuts for bankrupt and nonbankrupt carriers so different? We address each of these questions in turn.

1. *Why Are Pilot Effort Effects So Short-Lived?*

Contrary to both Mas (2006)—which finds persistent (i.e., several month) negative effort responses by New Jersey police officers following “final offer” arbitration losses—and considerable laboratory evidence (e.g., Fehr and Falk 1999; Fehr and Gächter 2000), we find only short-lived impacts on pilot effort following pilot wage reductions. Three primary explanations come to mind.[29]

The first two potential explanations are tied directly to results from surveys of company executives that suggest that employees’ views on the fairness of pay cuts are likely to have a strong impact on employee effort and morale (Blinder and Choi 1990; Bewley 1999). In particular, it is important to emphasize that, even after the pay cuts documented in our analysis, U.S. commercial airline pilots—as a group—are still among the

[29] In addition to the three potential explanations described below, it is important to emphasize that there are substantial differences between the laboratory environment and the “real world” pilot labor market. For example, Fehr and Falk (1999) construct a double auction experiment in which, in the first stage, both firms and workers are free to submit bids and to accept labor bids and offers at any time in the initial trading period, while, in the second period, the worker’s effort is revealed. In the pilot labor market, negotiations with different carriers by pilots does not occur because the seniority system ties most pilots to a single airline. The other notable differences between the lab and the pilot labor market involve both the scale (lab pay cuts reduce a subject’s pay by a few dollars, while pilot pay cuts reduce pay by thousands of dollars) and the duration, since laboratory pay cuts is very short (ending upon completion of the experiment) whereas real world pay cuts are permanent.

Table 7
Difference-in-Difference Estimates: Wage Reductions and Minutes of Flight Delay

	Alaska	American	Continental	Delta	Northwest	US Airways	United
7 days after pay cut:							
Effect	15.9123**	−.6648	4.4105	−1.5595	2.9664	−.8406	2.3191*
	(3.8766)	(3.1221)	(2.7640)	(2.9791)	(2.0144)	(1.0000)	(1.0107)
Weather variables:							
Snow origination	. . .	−.0628	.1202	−.0791	−.3525*	.2260*	−.1199
		(.1812)	(.1528)	(.5179)	(.1652)	(.0986)	(.0990)
Rain origination	.0372*	.1014**	.0481**	.0725**	−.0469	.0348+	.0711**
	(.0151)	(.0321)	(.0116)	(.0205)	(.0372)	(.0206)	(.0212)
Constant	6.6735**	−.6772*	1.5273**	.7387+	2.6366**	1.6573**	.2560
	(.4945)	(.2912)	(.3095)	(.4105)	(.3873)	(.4311)	(.2155)
R^2	.032	.083	.045	.070	.052	.024	.044
14 days after pay cut:							
Effect:	11.7999**	−.0335	3.4764+	.5058	3.1131*	−.5761	1.6744*
	(2.9832)	(1.6036)	(1.9407)	(1.9983)	(1.2328)	(.8603)	(.6791)
Weather variables:							
Snow origination	. . .	−.0654	.1185	−.0719	−.3503*	.2255*	−.1180
		(.1794)	(.1521)	(.5173)	(.1655)	(.0986)	(.0987)
Rain origination	.0368*	.1013**	.0483**	.0723**	−.0464	.0347+	.0713**
	(.0153)	(.0322)	(.0116)	(.0205)	(.0372)	(.0206)	(.0211)
Constant	6.5848**	−.6823*	1.4960**	.7084+	2.5897**	1.6749**	.2153
	(.4958)	(.2961)	(.3101)	(.4139)	(.3906)	(.4480)	(.2187)
R^2	.035	.083	.046	.070	.054	.024	.044

Note.—$N = 574$. Event time window (−40 days to +40 days) is for wage cuts occuring between May 2002 and June 2005. Difference-in-difference estimations are defined as the difference in the average minutes of daily flight delay at carrier X's hub airports vs. the average minutes of daily flight delay for all other carriers at carrier X's hub airports. Robust standard errors are in parentheses.

+ Significant at the 10% level.
* Significant at the 5% level.
** Significant at the 1% level.

most highly paid professionals in the U.S. economy (Hirsch 2007). For example, following the 32.5% wage rate reduction agreed to in late 2004 by Delta Air Lines pilots, average monthly pilot earnings at Delta were $12,653, as compared to average earnings of $10,888 for physicians, $10,010 for judges, and $8,950 for lawyers.[30] Thus, notwithstanding the broad series of recent wage reductions, pilots are still well compensated, especially considering the average number of hours worked per month.

Second, the seniority system in place at virtually every airline—combined with the fact that thousands of pilots have been furloughed since September 11th, 2001—implies that the reservation wage for most major airline pilots is still substantially below their post–pay cut wage. For example, as noted earlier in table 1, a top-of-scale US Airways Boeing 737 Captain still earns $125 per hour, even after three rounds of pay cuts. If this pilot were to leave US Airways and pursue a position at another carrier that is currently hiring (e.g., a low cost or regional carrier), he or she would be forced to abandon her accumulated seniority and start at the bottom of the seniority scale at the new carrier, resulting in a substantially lower wage.[31] This, too, suggests that, after an initial period of reduced effort, pilots are likely to come to the conclusion that their new wage rates are still "fair," especially when compared to their next best alternative.

A third potential explanation—and one that requires some additional empirical tests—is that pilots could be fully expecting the wage reductions prior to the announcement of the tentative agreement. That is, perhaps the actual wage reductions have already been "priced in" to pilots' expectations. To test this hypothesis, we turn to the financial markets. By examining the stock market reaction following the announcement of pay cuts, we can effectively determine whether or not they were considered surprises. Following Brown and Warner (1985), we calculate the daily abnormal returns (A_{it}) as

$$A_{it} = R_{it} - R_{mt}, \tag{4}$$

where R_{it} is the stock market return to the pay-cutting carrier i at day t

[30] See *Declaration of Michael L. Wachter in Support of Motion of Reject ALPA Collective Bargaining Agreement*. Moreover, even after Delta's second pilot pay cut (which occurred after our sample period) of 14% in 2006, average monthly earnings would remain among the highest in the economy.

[31] For example, the starting hourly pilot wage rates (for first officers) at Southwest, JetBlue, and AirTran are $52, $47, and $43 per hour, respectively. Likewise, as noted by Hirsch (2007), there are substantial pay differences between large jet (i.e., "mainline" carriers) and regional carriers, which operate fleets of smaller (i.e., 30–90 seat) aircraft. For example, the starting hourly first officer pay rates at regional carriers such as Republic and Mesa are, respectively, $23 and $21 (http://www.airlinepilotcentral.com).

Table 8
Cumulative Abnormal Returns (CAR) after Pilot Wage Reductions

Carrier	Notification Date	Wage Reduction (%)	CAR Window (−1, 1) (%)
Alaska	April 29, 2005	−26.0	0.7
American Airlines	April 1, 2003	−23.0	106.7
Continental	February 28, 2005	−8.9	12.1
Delta Airlines	October 28, 2004	−32.5	11.2
Northwest Airlines	October 14, 2004	−15.0	8.6
United	December 27, 2002	−29.0	33.3
United	January 18, 2005	−11.8	−3.4
United	May 10, 2005	Pension termination	7.9
US Airways	July 6, 2002	−26.0	10.1
US Airways	December 11, 2002	−8.0	3.8
US Airways	March 1, 2003	Pension termination	−3.2
US Airways	October 1, 2004	−18.0	79.7
Average		−19.8	22.3

NOTE.—In situations where the stock market is not open on announcement date (weekend or holiday), the event date is the next trading day.

and the market return R_{mt} is proxied by the AMEX airline index (XAL), an equally weighted index of the large capitalized airlines. At day $t = 0$, carrier i announces the pay cut. When possible, the 100 trading days prior to the announcement (from $t = -101$ to $t = -2$) make up the estimation period that is used to calculate the variance for traditional t-statistics. Our focus is a single null hypothesis that the magnitude of the pilot pay cut was not expected by the financial markets. This null hypothesis can be rejected if there is either a mean effect or a variance effect. To allow for the possibility of an event-induced increase in variance, following Boehmer, Musumeci, and Poulsen (1991), we also use a cross section of cumulative abnormal returns to form an estimator of the variance. Moreover, to determine the power of our test, we determine the likelihood of rejecting the null hypothesis that A_{it} is zero using bootstrap methods (which do not require normality assumptions).[32] To prevent event overlap, in two cases the estimation period was shortened to 70 trading days (United's wage reduction on January 18, 2005) and 50 trading days (US Airways' wage cut on December 11, 2002). The cumulative abnormal returns (CAR) is the sum of A_{it}.

We report in table 8 the CAR (%) calculated for the 3 days surrounding the pay cut announcement. We find positive abnormal returns to the stock of the pay-cutting carrier for 10 of the 12 events, with an average cu-

[32] Specifically, we formed the bootstrap distribution of abnormal returns by randomly drawing 1,100 times (with replacement) an A_{it} from the 100-day estimation periods (the period before the 12 pay cut events). The p-values represent the proportion of A_{it}'s in the bootstrap distribution that exceed the observed A_{it} for the event. We then conducted 1,000 iterations of this procedure, and we report the average p-values from these iterations in table 9.

Table 9
Daily Abnormal Returns (AR) after Pilot Compensation Reduction Announcements ($N = 12$)

Daily Abnormal Returns	AR (%)	*t*-Statistic	Event-Induced Variance Test Statistics*	Bootstrap Distribution *p*-Values of AR†
Event day −1	4.71	2.30	1.38	.119
Event day 0	8.74	4.09	1.95	.054
Event day 1	8.85	4.15	3.76	.051
Cumulative Abnormal Returns	**CAR (%)**	***t*-Statistic**	**Event-Induced Variance Test Statistics**	**Bootstrap Distribution *p*-Values of CAR**
Event window (−1, 0)	13.46	4.14	1.81	.051
Event window (0, 1)	17.60	5.40	1.86	.033
Event window (−1, 1)	22.31	5.70	2.76	.024

* To allow for event-induced variance, we calculate Boehmer, Musumeci, and Poulsen (1991) standardized cross-sectional test statistics.
† The *p*-values represent the probability of rejecting the null hypothesis that the AR (or CAR) equals zero. We form a bootstrap distribution by sampling (with replacement) the AR from the 100-day estimation period (the period before the pay cut). The *p*-value is the proportion of AR (or CAR) from the bootstrap distribution that exceeds the event's observed AR (or CAR). This iterative procedure is done 1,000 times.

mulative return of 22.3% during this 3 day window. Both the traditional *t*-statistic ($p < 0.01$) and the nonparametric Wilcoxon signed-rank test ($p < 0.02$) reject the hypothesis that the 3 day CAR (-1, 1) equals zero. A one-sided sign-test also marginally rejects ($p < 0.08$) the hypothesis that the CAR (−1, 1) is zero, with the alternative hypothesis being that the CAR (−1, 1) is positive.

Table 9 reports significant single-day returns for the day before (+4.71%), the day of (+8.74%), and the day after (+8.85%) the pilot pay cut. Finally, the bottom of table 9 reports various 2 day and 3 day CAR windows, all of which register positive and significant returns using
q11 traditional *t*-statistics. When allowing for the possibility of changing variances, the standardized cross-sectional test statistics indicate that five of the six abnormal returns reported in table 9 are statistically significant at the 10% level. The bootstrap distribution *p*-values for A_{it} for the day of the event ($p = 0.054$) and the day afterward, ($p = 0.051$), along with all three CAR windows (*p*-values ranging from 0.024 to 0.051), also suggest the presence of a nonzero change in abnormal returns.

In sum, evidence from the financial markets suggests that pilot pay cuts (or their magnitude) were surprising; hence, we have reason to believe that pilots were also surprised by the pay cut announcements. This suggests that the details of the agreement were not leaked in the days and weeks leading up to the announcement.[33] We do not find this result surprising since neither side (the labor union nor the management team) gains an advantage by leaking information and both are both often under strict instructions from the bankruptcy court to bargain in good faith. Leaking the details of a pending pay cut would undermine the spirit of good faith negotiations, and in fact, it could severely jeopardize one side's bargaining power if, for example, the bankruptcy judge were to learn that the leak could be attributed to a particular side.[34]

2. *Bankruptcy Differences*

We now discuss our second noteworthy finding, that is, that pay cuts elicited substantially different pilot effort responses at bankrupt versus nonbankrupt carriers. At the outset, we note that care must be taken when interpreting these results since there can be significant differences among the financial conditions of even the nonbankrupt carriers in our data set. In particular, our results suggest that the arbitration decision at nonbankrupt Alaska Airlines provoked the single largest negative effort response by pilots. When Alaska Airlines is excluded from our sample, the magnitude of the nonbankrupt carrier coefficients and t-statistics falls by about 10%.[35] Nonetheless, we believe that bankruptcy serves as a credible signal to pilots (and labor generally) regarding the severity of a carrier's financial crisis. Put differently, pilots are likely to update their "survival" probability of a carrier once it declares bankruptcy.

In contrast, nonbankrupt carriers seeking wage concessions are more likely to be met with skepticism regarding whether the pay cut being sought is genuinely needed for survival. Likewise, we believe that the issue of fairness also plays an important role. In bankruptcy, airlines typically invoke the full protection of the bankruptcy laws to force all stakeholders (i.e., aircraft leaseholders, debt holders, vendors, airports, etc.) to make significant concessions. For example, Section 1110 of the U.S. Bankruptcy Code allows carriers to reject aircraft leases, which provides the carriers with significant leverage to renegotiate lease terms. In contrast, carriers are far more limited

[33] Examining A_{it} for the 2 weeks immediately before the pay cut announcement ($t = -10$ to $t = -2$) reveals that none of these daily abnormal returns are significantly different from zero. Likewise, the CAR for the week before the pay cut ($t = -6$ to $t = -2$) is also insignificant. Hence, there is no evidence to suggest that news of the pay cut deal had been leaked.

[34] An alternative explanation, which we are unable to rule out, is that positive abnormal returns surrounding pay cut announcements reflect investors' response to reaching a settlement since an agreement eliminates the possibility of a strike or work slowdown.

[35] For example, reestimating model 4 in table 4 without Alaska reduces the coefficients and t-statistics for 7 days and nonbankrupt from 2.31 ($t = 1.81$) to 2.05 ($t = 1.58$).

as to what they can accomplish outside of bankruptcy with respect to nonlabor cost savings. Thus, an out-of-bankruptcy restructuring often leaves labor feeling "singled out," and consequently pilots (and labor generally) are likely to view pay cuts outside of bankruptcy as "unfair."

V. Conclusions

This article examines changes in employee effort following significant and permanent pay reductions by studying various airline flight performance measures of large U.S. airlines over the past several years. Our study finds only limited evidence to support the concerns expressed by company officers in interviews (Bewley 1999) regarding the adverse effects on employee morale from wage cuts as well as in theories linking gift-wages and effort (Akerlof 1982).

In particular, we find that, when U.S. airlines retracted their high wage "gift" to pilots, there is only limited evidence to suggest that pilots responded by supplying less effort, resulting in more frequent and longer flight delays. Moreover, when we do find evidence of a negative effort response, it tends to be very short-lived and is limited primarily to nonbankrupt airlines.

We believe that two factors somewhat unique to the labor market for commercial airline pilots help to explain this surprising result. First, since the U.S. airline industry was deregulated in 1978, commercial pilots have earned labor market rents (Hirsch and Macpherson 2000). Likewise, even after the recent pay cuts experienced by pilots over the past several years, commercial airline pilots at large U.S. carriers still tend to be very well compensated (Hirsch 2007). Pilot salaries rival those of physicians, lawyers, and other high-paying professions, yet pilots work substantially fewer hours than most other highly paid professionals. Second, the seniority system in place at virtually every airline—combined with the large number of pilot layoffs in the wake of September 11th—implies that the reservation wage for most major airline pilots is still substantially below their post–pay cut wage. Consequently, after an initial period of reduced effort, pilots are likely to come to the conclusion that their new wage rates are still "fair," especially when compared to their next best alternative. Surveys of company executives suggest that employees' views on the fairness of pay cuts are likely to have a strong impact on employee effort and morale (Blinder and Choi 1990; Bewley 1999).

Performance differences of bankrupt and nonbankrupt carriers are also consistent with the notions of fairness and effort documented in the literature. In particular, we find evidence that is consistent with the belief that pay cuts by bankrupt firms are viewed as being more "fair" than pay cuts by nonbankrupt firms. Indeed, it is only among pilots at the nonbankrupt carriers that we consistently find lower effort following a pay cut. Even among this set of pilots, we find that the reduction in effort is short-lived. Recent field experiments by Gneezy and List (2006) suggest that short-lived changes in effort may not be unique to airline pilots since they observe short-lived effects on effort by employees who received a "gift" of wages above the market clearing level. Whether our findings of a short-lived effort response by pilots to pay reductions are generalizable to occupations beyond the airline industry is a topic for future research.

Appendix

Difference-in-Difference Specification

The first step of the difference-in-difference estimation is to find the difference in performance of the hub carrier with the nonhub carriers at each carrier's primary airport:[36]

$$\text{Diff}_{ith} = Y_{ith} - Y_{-ith}, \tag{A1}$$

where Y_{ith} measures the daily mean flight performance of carrier i's flights on day t originating from airport h and Y_{-ith} is the daily mean flight performance for all carriers other than carrier i on day t for flights originating from airport h. Since there typically are several primary airports for a given carrier i, we divide n (the number of carrier i's flights at airport h) by the sum of n flights at every primary airport for carrier i:

$$\text{Weight}_{ith} = \frac{n_{ith}}{\sum_{h=1}^{m} n_{ith}}, \tag{A2}$$

where m is the total number of primary airports. The Weight expression enables larger hub operations to be more representative of carrier i's flight performance, which is denoted as follows:

$$\text{WeightDiff}_{ith} = \text{Weight}_{ith} \times \text{Diff}_{ith}. \tag{A3}$$

Finally, we sum the WeightDiff expression across all m primary airports for carrier i:

$$\text{SumDiff}_{it} = \sum_{h=1}^{m} \text{WeightDiff}_{ith}. \tag{A4}$$

[36] The airports we consider as primary airports for each carrier are American (DFW, ORD, MIA, and STL [after January 1, 2002]), Alaska (SEA), Continental (CLE, EWR, and IAH), Delta (ATL, CVG, SLC, and DFW [before February 1, 2005]), Northwest (DTW, MEM, and MSP), United (DEN, IAD, ORD, LAX, and SFO), and US Airways (CLT, PHL, and PIT).

q12 The above SumDiff is calculated daily for each carrier in the sample.[37]

We estimated the following difference-in-difference regression:

$$\text{SumDiff}_{it} = \alpha + \beta W_{it} + \gamma D_{it} + \varepsilon_{it}, \quad \text{(A5)}$$

where W_{it} represents the weighted weather conditions (snow and rain) at carrier i's primary airport, D_{it} is the pay cut dummy variable previously defined, and ε_{it} is the error term. We include weather conditions because Rupp and Holmes (2006) find that hub airlines have inherent advantages over nonhub airlines in operating flights during severe weather conditions (e.g., better access to de-icing equipment, maintenance/service personnel, and replacement flight crews). We choose to weight the weather conditions using the Weight_{ith} definition from equation (A2) since an inch of snow at a larger hub likely has a greater impact on a hub carrier's flight performance than an inch of snow at a smaller hub.

References

Adams, J. S. 1965. Inequality in social exchange. *Advances in experimental social psychology*, vol. 2, ed. Leonard Berkowitz, 267–99. New York: Academic Press.

Akerlof, George A. 1982. Labor contracts as partial gift exchange. *Quarterly Journal of Economics* 97, no. 4:543–69.

Akerlof, George A., and Janet Yellen. 1990. The fair wage-effort hypothesis and unemployment. *Quarterly Journal of Economics* 105, no. 2:255–83.

Bewley, Truman F. 1995. A depressed labor market as explained by participants. *American Economic Review Papers and Proceedings* 85:250–54.

———. 1999. *Why wages don't fall during a recession*. Cambridge, MA: Harvard University Press.

Blinder, Alan S., and Don H. Choi. 1990. A shred of evidence on theories of wage stickiness. *Quarterly Journal of Economics* 105, no. 4:1003–15.

Boehmer, Ekkehart, Jim Musumeci, and Annette B. Poulsen. 1991. Event-

[37] For example, consider the following SumDiff calculation (eq. 7) for 15+ minutes late US Airways' flights on May 15, 2003. Y_{ith} (the proportion of US Airways flights 15+ minutes late) at its three primary airports, Charlotte (CLT), Pittsburgh (PIT), and Philadelphia (PHL), was 0.4153, 0.3520, and 0.3077, respectively. Y_{-ith} (non–US Airways' flights 15+ minutes late) at these same three airports was 0.2333, 0.1309, and 0.2222, resulting, respectively, in a Diff_{ith} of 0.1820, 0.2211, and 0.0855. US Airways had 236 (CLT), 179 (PIT),and 143 (PHL) scheduled flight departures at its three primary airports, for a total of 558 flights on May 15, 2003. This corresponds to a Weight_{ith} of 0.423 (CLT), 0.321 (PIT), and 0.256 (PHL). Next, the WeightDiff_{ith} is 0.423 × 0.1820 (CLT), 0.321 × 0.2211 (PIT), and 0.256 × 0.0855 (PHL). Finally, SumDiff_{it} adds each of the WeightDiff_{ith} figures, resulting in a 0.1699 value for US Airways. This number is interpreted as follows: on May 15, 2003, US Airways had a flight delay rate (15+ minutes) at its primary airports (CLT, PIT, and PHL) that was 17 percentage points higher than such delays by the other airlines at the same three airports.

study methodology under conditions of event-induced variance. *Journal of Financial Economics* 30, no. 2:253–72.

Breusch, T. S., and A. R. Pagan. 1979. A simple test for heteroskedasticity and random coefficient variation. *Econometrica* 47:1287–94.

Brown, J. Stephen, and Jerold B. Warner. 1985. Using daily stock returns. *Journal of Financial Economics* 14, no. 1:3–31.

Brueckner, Jan K. 2002. Airport congestion when carriers have market power. *American Economic Review* 92, no. 5:1357–75.

Campbell, Carl M., III, and Kunal S. Kamlani. 1997. The reasons for wage rigidity: Evidence from a survey of firms. *Quarterly Journal of Economics* 112, no. 3:759–89.

Fehr, Ernst, and Armin Falk. 1999. Wage rigidity in a competitive incomplete contract market. *Journal of Political Economy* 107, no. 1: 106–34.

Fehr, Ernst, and Simon Gächter. 2000. Fairness and retaliation. *Journal of Economic Perspectives* 14, no. 3:159–81.

———. 2002. Do incentive contracts undermine voluntary cooperation? Working paper no. 34, Institute for Empirical Research in Economics, University of Zurich.

Fehr, Ernst, Simon Gächter, and Georg Kirchsteiger. 1997. Reciprocity as a contract enforcement device: Experimental evidence. *Econometrica* 65, no. 4:833–60.

Fehr, Ernst, Georg Kirchsteiger, and Arno Riedl. 1993. Does fairness prevent market clearing? An experimental investigation. *Quarterly Journal of Economics* 108 (May): 437–59.

Fischer, Stanley. 1977. Long-term contracts, rational expectations, and the optimal money supply rule. *Journal of Political Economy* 85, no. 1: 191–205.

Friedman, Milton. 1957. *A theory of the consumption function*. Princeton, NJ: Princeton University Press.

Gneezy, Uri, and John A. List. 2006. Putting behavioral economics to work: Testing for gift exchange in labor markets using field experiments. *Econometrica* 74, no. 5, 1365–84.

Hirsch, Barry T. 2007. Wage determination in the U.S. airline industry: Union power under product market constraints. In *Advances in airline economics*, vol. 2, ed. Darin Lee. Amsterdam: Elsevier (forthcoming). q13

Hirsch, Barry T., and David A. Macpherson. 2000. Earnings, rents, and competition in the airline labor market. *Journal of Labor Economics* 18, no. 1:125–55.

Ito, Harumi, and Lee, Darin. 2005. Assessing the impact of September 11th terrorist attacks on U.S. airline demand. *Journal of Economics and Business* 57, no. 1, 75–95.

Jacobson, Louis S., Robert J. LaLonde, and Daniel G. Sullivan. 1993.

Earnings losses of displaced workers. *American Economic Review* 83, no. 4:685–709.
Kahneman, Daniel, Jack L. Knetsch, and Richard Thaler. 1986. Fairness as a constraint on profit seeking: Entitlements in the market. *American Economic Review* 76, no. 4:728–41.
Lee, Dee, and Maria Luengo-Prado. 2005. The impact of passenger mix on reported hub premiums in the U.S. airline industry. *Southern Economic Journal* 72, no. 2:372–94.
Mayer, Christopher, and Todd Sinai. 2003. Network effects, congestion externalities, and air traffic delays; or why all delays are not evil. *American Economic Review* 93, no. 4:1194–215.
Mas, Alexandre. 2006. Pay, reference points, and police performance. *Quarterly Journal of Economics* 121, no. 3:783–821.
Mazzeo, Michael J. 2003. Competition and service quality in the U.S. airline industry. *Review of Industrial Organization* 22, no. 4:275–96.
Pritchard, Robert D., Marvin D. Dunnette, and Dale O. Jorgenson. 1972. Effects of perceptions of equity and inequity on worker performance and satisfaction. *Journal of Applied Psychology* 56, no. 1:75–94.
Rupp, Nicholas G. 2007. An empirical investigation into the causes of flight delays. Working paper, Department of Economics, East Carolina University.
Rupp, Nicholas G., and George M. Holmes. 2006. An investigation into the determinants of flights cancellations. *Economica* 73, no. 292:749–84.
Shapiro, Carl, and Joseph E. Stiglitz. 1984. Equilibrium unemployment as a worker discipline device. *American Economic Review* 74, no. 3:433–44.
Solow, Robert M. 1979. Another possible source of wage stickiness. *Journal of Macroeconomics* 1, no. 1:79–82.
Stiglitz, Jospeph E. 1974. Alternative theories of wage determination and unemployment in LDC's: The labor turnover model. *Quarterly Journal of Economics* 88, no. 2:194–227.
U.S. Department of Transportation. 2005. *Office of aviation enforcement and proceedings: Air travel consumer report*, Washington, DC: U.S. Government Printing Office.
Valenzi, E. R., and I. R. Andrews. 1971. Effect of hourly overpay and underpay inequity when tested with a new induction procedure. *Journal of Applied Psychology* 55, no. 1:22–27.