

**PUBLIC AND PRIVATE SAFETY ENFORCEMENT IN THE AIR
TRANSPORTATION INDUSTRY**

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Abstract

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This dissertation contains three chapters. Chapter One, “Patterns of FAA Enforcement,” highlights problems with the Federal Aviation Administration’s (FAA) implementation of its safety oversight system for passenger-service airlines. The chapter contains information on the safety oversight system for context. A number of problems have been identified by the Government Accountability Office (GAO). Specifically, the GAO shows that the FAA reduced the number of enforcement actions from fiscal year 1993 to 1996, and has a pattern of reducing penalties levied against airlines in the FAA’s civil penalty program. These penalties are examined in detail using a sample of civil penalties from January 1990 to July 2006. The majority of civil penalties are under \$10,000, which is likely to be too low to act as a serious deterrent. This raises the question of how to reconcile critiques of the FAA by the GAO and low civil penalty amounts with the scarcity of accidents in the industry. The GAO has not assessed whether failures by the FAA are tied to actual lapses in safety as this dissertation attempts to do.

Chapter Two, “Why Be Safe? Public and private safety enforcement in the air transportation industry,” explores the simultaneous use of public and private enforcement to determine their effectiveness in promoting safety. The chapter builds on a model established

from work on the economics of safety provision in the aviation industry, by including two main instruments of enforcement—public enforcement in the form of FAA enforcement penalties and private enforcement in the form of civil lawsuits. The chapter includes data from the Bureau of Transportation Statistics, the National Transportation Safety Board, the FAA, and the U.S. Courts. I show in the chapter that public enforcement has a negligible effect on the safety record of major U.S. airlines. On the other hand, private enforcement is associated with reductions in future injuries. For an average airline, an increase of 10 lawsuits filed in a quarter is associated with a reduction of between 0.5 and 1 injuries. In this chapter, it is also confirmed that financial distress at an airline increases negative safety outcomes. This may indicate that the influence of lawsuits and civil penalties is underestimated if they coincide with periods of financial vulnerability.

Chapter Three, “Does the Market Pay Attention to the FAA?,” uses an event study to determine whether FAA enforcement penalties are large enough to affect the market value of an airline. Using data from FAA press releases and daily stock prices, I show that there is no significant change in an airline’s stock price following the announcement of a penalty, even when penalties are over \$1 million. However, when looking at the industry as a whole, there does appear to be a small reduction in stock prices following the announcement of a penalty. On average, airlines’ stock prices are reduced by an estimated 0.06% to 0.09%, consistent across all penalty amounts. Thus, the public announcement of civil penalties does appear to have a deterrent effect for the industry as a whole, although not for the individual airline.

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Chapter One

PATTERNS OF FAA ENFORCEMENT

Patterns of FAA Enforcement

1.1. Introduction

In order to understand how aviation enforcement creates incentives for safer flights, this chapter presents an overview of enforcement by the Federal Aviation Administration (FAA). The FAA has a number of tools at its disposal, and the focus of this research is on the FAA's civil-penalty program. A more general background is also provided for context. Additionally, the paper takes a more in-depth look at FAA civil penalties using a dataset of all passenger airline penalties from 1990 to 2006.

Many studies evaluating aspects of the FAA's work¹ generally avoid drawing a statistical connection between safety programs and accident or injury rates. The Government Accountability Office (GAO) has evaluated the FAA's enforcement program three times in recent years. The reports issued in 1998, 2004, and 2005 all criticized the FAA for reducing penalties. However, these reports have not provided any evidence that this has affected safety performance. Instead, the GAO's analysis focuses on airlines being deterred from further instances of non-compliance. This assumes implicitly that the mandated level of compliance is sufficient to create the desired level of safety. In this dissertation, I do not attempt to determine the optimal level of safety. Instead, the purpose of the dissertation is to examine the incentives provided by safety enforcement that encourage safer practices.

The GAO's 1998 report questioned whether the civil-penalty program acted as a deterrent for future violations (GAO, 1998). In particular, the GAO noted that the reduction in fines

¹ See Hansen, *et al.*, July 2006 for a comprehensive look at research reports on the FAA and its safety programs.

discouraged inspectors from initiating enforcement cases. Given the level of paperwork required, inspectors were reluctant to initiate enforcement cases that would result in small penalties or dropped cases.

Despite the publication of the 1998 report, the FAA continued to reduce penalties. In 2004, the GAO once again noted that penalties were consistently reduced, and noted an increasing reliance on the FAA's administrative actions, such as warning notices and letters of correction. (GAO, 2004.) The main focus of the report was on whether enforcement acted as a deterrent. The GAO found the FAA had no program or method to track the performance of the enforcement regime. Moreover, the agency lacked the data infrastructure to institute goals or performance metrics in a timely manner. In 2005, the GAO repeated its earlier criticisms of the FAA's pattern of reducing penalties (GAO, 2005). In this report, the GAO expressed particular concern that penalties were reduced for reasons other than the merits of the case. The GAO was concerned that such practices could further erode the deterrence effect of penalties.

The GAO's concerns about the deterrence effect notwithstanding, passenger air service results in very few accidents or injuries. Figure 1.1 shows National Transportation Safety Board (NTSB) data on injuries (including fatalities) and accidents from 1990 to 2006 for all passenger service airlines, normalized by passengers and departures. The 98 passenger-service airlines in the sample had an average of four accidents per million departures and 0.4 injuries per million passengers. The trend is fairly steady, with injuries showing more volatility than accidents. This is because one accident can be associated with any number of injuries (except zero). Injuries show a decline since the end of 2001. Given the safety record of airlines and the criticisms by the

GAO, I examine FAA safety regulation in general and, in particular, enforcement through civil penalties by the FAA.

In this dissertation, I use a statistical sample of civil penalties issued by the FAA from 1990 to 2006. The purpose of this introductory chapter is to provide context for the statistical analysis that follows. The next section provides a brief history of safety regulation, and descriptions of the FAA's inspection programs. Section 1.3 describes enforcement at the FAA and includes statistical analysis of every civil penalty instituted against a passenger airline from 1990 to 2006. The chapter concludes in Section 1.4.

1.2. Aviation Safety Regulation

Regulation of air travel in the United States began in 1926 with the enactment of the Air Commerce Act.² Regulatory authority resided with the head of the new Aeronautics Branch of the Department of Commerce, which was charged with encouraging air commerce, regulating air traffic, licensing pilots, issuing certificates for aircraft, and operating support functions. In 1938, the Civil Aeronautics Act created the Civil Aeronautics Authority, removing power over civil aviation from the Department of Commerce and giving it to the new agency within the Department. The agency was divided in two in 1940, giving the Civil Aeronautics Administration (CAA) responsibility for air traffic control, airman and aircraft certification, safety enforcement, and airway development. The Civil Aeronautics Board (CAB) had responsibility over safety regulations, accident investigation, and economic regulation of airlines

² A comprehensive history of commercial aviation and the development of aviation safety can be found in Heppenheimer (1995).

(regulating fares and routes). The CAB also operated as an independent agency, while the CAA still reported to the Secretary of Commerce.

The advent of jet-engine aircraft significantly changed the aviation regulatory landscape. In the 1950s, pilots were still relying on visual notification to avoid other aircraft mid-flight. However, a jet-propelled aircraft moves so quickly that a pilot may not be able to react with sufficient speed upon seeing another aircraft, even if the pilot can manage to see one. In 1956, two aircraft collided over the Grand Canyon, killing 128 people. This accident demonstrated the limitations of visual flight and led to significant reforms. Congress passed the Federal Aviation Act of 1958 to create the Federal Aviation Agency, removing aviation authority from the Department of Commerce entirely and allowing the agency's administrator to report directly to the president. The new agency assumed all the responsibilities of the CAA and the responsibility for safety regulations from the CAB. Additionally, the Federal Aviation Agency was allowed to control the entire system of navigation and air traffic control, now including military aviation.

The Federal Aviation Agency was moved into the Department of Transportation upon the Department's creation in 1965. At this time, the agency's name was changed to the Federal Aviation Administration. Additionally, the CAB was stripped of the power to investigate accidents, which was given to the newly created National Transportation Safety Board. The CAB was finally dismantled in 1984, and the FAA became the sole agency in charge of aviation oversight, with the NTSB still responsible for accident investigation.

Two additional major changes occurred after the founding of the FAA. In 1978, economic regulation of the airline industry ended. Airlines were allowed to compete directly for fares and routes, setting in motion the dismantlement of the CAB. The other major change

followed the terrorist attacks of September 11, 2001. The Transportation Security Administration (TSA) was created and took responsibility for aviation security from the FAA. However, accidents within the United States as a result of sabotage are rare. According to NTSB statistics, there were only five passenger airline accidents as a result of lapses in security in the United States, during the period of 1990 to 2006. Four of them occurred on September 11, 2001. There are not enough data to determine whether the TSA has been more or less effective at preventing security lapses than the FAA.

1.2.1. Inspections

Compliance with FAA rules and regulations is primarily evaluated through inspections.³ The data period of 1990 to 2006 includes two separate FAA inspection systems. From 1990 to 1998, the FAA used a system of regularly scheduled inspections that were carried out equally across passenger airlines. From 1998 to 2006, the FAA phased in a program to target inspections based on risk.

1.2.1.1. National Program Guidelines

National Program Guidelines (NPG) were developed in 1985 to specify a minimum number of inspections necessary for the FAA to complete its mission of ensuring aviation safety. The NPG are determined nationally and assigned by region. NPG inspections represent

³ The FAA has many avenues for discovering areas of non-compliance, including a number of voluntary reporting programs, as well as information discovered through accident and incident investigations. The GAO estimated that the majority of violations were discovered through inspections (GAO, 1998).

approximately 20% of all inspections, with regional and field offices planning the remaining 80% (Hansen *et al.*, 2006).

The NPG considers several factors when planning inspections. These include program objectives, available resources, information for accident and incident investigations, information from prior inspections and enforcement actions, and information from public and voluntary reporting programs (Hansen *et al.*, 2006). Local Principal Inspectors plan inspections based on NPG guidance from Headquarters and the information at their disposal in databases, from stakeholders, and from their own experience (Hansen *et al.*, 2006). Additionally, in 2002, the Surveillance and Evaluation Program was added to the NPG to allow inspectors to adjust surveillance planning to reflect safety data and risk information.

1.2.1.2. Air Transportation Oversight System

In the last quarter of 1998, the FAA implemented the Air Transportation Oversight System (ATOS).⁴ The development of ATOS was a result of the FAA's change in methodology to system-based safety (GAO, 1999). System-based safety, or a safety management system (SMS), aims to make safety management an integral part of a firm's business operations. Using an SMS approach, ATOS evaluates "an air carrier's management, corporate safety culture, and its experience as well as its systems" (ATOS Fact Sheet, 2008).

ATOS changed the procedures by which inspections were scheduled, as well as the content of inspections. ATOS schedules inspections using two tools: the Air Carrier Assessment Tool (ACAT) and the Comprehensive Assessment Plan (CAP). Principal Inspectors complete the

⁴ Complete information on ATOS can be found in FAA Order 8900.1.

ACAT using their knowledge of the carrier and data collected in various databases that describe systems used by the carrier. The ACAT includes 28 risk indicators, such as the average age of the fleet or a change in high-level management, to identify hazards and help Principal Inspectors prioritize inspection elements. The ACAT is updated annually and reviewed quarterly.

Once priorities are established by the ACAT, these priorities are used to plan and schedule inspections using the CAP. The CAP uses baseline values to plan inspections, which are then automatically adjusted by the risk indicators in the ACAT. ATOS inspections have three functional components: (1) design assessment, which looks at the carriers' operating systems, (2) performance assessment, which evaluates the success of the operating systems in place, and (3) risk management, which identifies and mitigates risks among carriers. Inspections generate data that can be used to evaluate these three functional components.

The GAO reports that the number of airline-related inspections varies widely from fiscal year to fiscal year (GAO, 1998). For example, the number of inspections declined from 378,220 in fiscal year 1993 to 287,909 in fiscal year 1996. The FAA reported that criticism by the Inspector General fueled an increase in the number of inspections until fiscal year 1993, while decreases in the number of required inspections and new hires were responsible for the decline from fiscal year 1993 to fiscal year 1996 (GAO, 1998). The number of required inspections declined as a result of a policy move to allow inspectors more time to schedule inspections where they felt they were needed most. Also during this time, the FAA experienced some natural turnover in inspector staff. The GAO report stated that it takes two to four years for new inspectors to become sufficiently competent to conduct inspections on their own. In the meantime, inspections decline as experienced inspectors are required to train new hires.

1.3. Enforcement

FAA enforcement generally comes as a result of inspections. From fiscal year 1990 to fiscal year 1996, 4.2% of inspections resulted in a problem being recorded (GAO, 1998). Of these 88,912 inspections with problems, 25,392 enforcement actions were initiated⁵ (GAO, 1998). These enforcement actions can take the form of an administrative action, such as a warning notice or letter of correction. If administrative action is not taken, the FAA can pursue legal sanctions. Legal sanctions include regulatory penalties or the suspension of operating certificates. From fiscal year 1993 to fiscal year 2003, 53% of enforcement cases resulted in administrative actions, 23% resulted in legal sanctions, and 18% were closed without enforcement action (GAO, 2003). The predominance of administrative actions is due in part to the use of voluntary reporting programs. To encourage voluntary reporting, the FAA takes into consideration that a violation was self-reported when assessing the level of action to take.

While the GAO did not focus on any particular type of service, the research presented in this dissertation is restricted to scheduled, passenger service (known as Federal Air Regulation Part 121). The enforcement sample contains all regulatory penalties issued by the FAA from 1990 until July 2006 for Part 121 carriers. The original sample contains 159 listed carriers, many of which are small, regional carriers.

Figure 1.2 shows enforcement actions and penalties, normalized relative to departures over time. The introduction of ATOS shows a slight uptick in enforcements and penalty amounts. However, this trend is reversed following the year 2000. The fact that the introduction

⁵ Not all problems lead to enforcement actions. In some cases the airline successfully resolves the problem to the inspector's satisfaction. In other cases, there may not be sufficient evidence to support an enforcement action.

of ATOS closely precedes the change in U.S. presidents in 2001 makes it difficult to parse the reasons for the decline. According to some FAA inspectors, at least part of the decline is due to the Bush Administration's policy of encouraging inspectors to resolve issues without issuing penalties.⁶

The FAA issues approximately 45 enforcement actions per year on average. The average fine per action is \$25,000. This is a relatively small dollar amount for airlines that have millions of dollars of revenue per quarter. The sample includes 48 fines of less than \$1,000, and nearly 57% of the fines were for less than \$10,000. On the top end of the scale, there were 54 fines of \$100,000 or more.

The FAA describes the type of "final action" for the penalty, based on how the company responded to the original charge of a violation. FAA penalties fall into four basic categories of final action: Order Assessing, Civil Penalty without Finding, Civil Penalty with Finding, and Consent Order. Table 1.1 shows the frequency of each category.

Order Assessing is the most common category of final action. An order assessing civil penalty means that the FAA charged the airline with a civil penalty following a violation, and the airline agreed to pay it. If the airline decides to proceed with the dispute process, the FAA and the airline can continue to negotiate before the final judgment is made. If the final judgment is made and the airline is found to have violated an FAA regulation, a civil penalty is issued.

During the dispute process, the FAA and the airline can agree to a consent order. The airline must admit fault to all violations and pay a penalty. Otherwise, the two parties can agree

⁶ I spoke with Mark Fletcher and Guillermo Heredia, Jr., about enforcement during the Bush Administration; both were managing or acting as Aviation Safety Inspectors during this period.

to a compromise order or a civil penalty with no finding of a violation, agreeing that there was no finding of a violation (and the FAA cannot use the compromise order as evidence of any prior wrongdoing) in return for payment of the penalty. A consent or compromise order can only be made before a final decision has been issued.

Table 1.2 shows the average penalty and the range of penalties for each final action. If the airline begins by disputing the fine, but then admits fault at a later stage of the process, the penalties are an order of magnitude higher, on average. Unless the airline can show it is not at fault, disputing the process comes with a minimum penalty of \$3,750, compared to a minimum of \$250 for immediate payment.

The FAA has several categories for the type of violation that occurred, which are shown as eight categories of interest in Table 1.3, with the remaining categories subsumed into the “Other” category. The maintenance category covers any failure in the maintenance program, such as having unauthorized maintenance personnel or not performing required maintenance. This is the most common type of violation. On average, maintenance violations are also the most costly. Even excluding the \$9.5 million penalty, maintenance penalties were the highest, on average. The average maintenance penalty is more than double the average penalty of the next highest category, flight operations.

Flight operations covers everything that takes place on the flight, such as making sure passengers are given the safety announcement and flying with the appropriate fuel level. Flight-operations violations were the next most common type of violation and carried the second-highest average penalties. Records and reporting violations occur when airlines fail to document properly records required by the FAA or fail to report to the proper authorities when safety issues

arise. Aircraft violations occur when an airline fails to comply with FAA-required standards for a particular type of aircraft. Airport violations include such things as using the wrong gate at the airport or failing to make a reservation for a gate. Hazardous-materials violations occur when airlines fail to transport, process, or handle hazardous materials properly. A hazardous-materials violation can occur when an airline stores hazardous materials improperly, or mislabels them. Most other violations are related to personnel. These violations cover a very wide range, including such things as allowing an employee's medical certification to lapse and failing to lock the flight-deck door.

1.4. Conclusion

The FAA enforcement program continues to be a work in progress. Since the founding of civil air regulations in 1926, there have been many organizational and procedural changes in the regulation of passenger service. These changes have been made in response to changing safety conditions, as well as to criticism from interested parties. The FAA's safety oversight program has received considerable attention over the years from the GAO. The GAO has questioned whether the civil penalty program acts as a deterrent to lapses in safety, or even to lapses in compliance. When we consider the data on civil penalties issued from 1990 to 2006, a decline in the number of enforcement actions since 1996 is clearly evident. For the most part, penalty amounts are very low in relation to airline revenues.

However, given the overall high level of safety, skepticism about the civil-penalty program may be unwarranted. The ultimate purpose of the enforcement program is to prevent accidents and injuries. It is more critical that penalties encourage safer flights than that they

cause airlines to increase compliance with regulations. The weaknesses in the civil-penalty program must be reconciled with the paucity of accidents. The next chapter contains an analysis of the relationship between civil penalties and safety. The civil penalties are compared with private lawsuits to measure the incentives each provides for safer flights. In the next chapter, I provide evidence that private lawsuits, which can be more costly to an airline, are associated with a decline in injuries. Civil penalties do not appear to reduce accidents or injuries.

Since civil penalties do not seem to encourage an airline to increase safety, the third chapter examines whether civil penalties have an effect on stock prices in the industry. In Chapter 3, changes in stock prices are analyzed to measure the impact of public announcements of civil penalties on publicly-traded airlines. The evidence confirms that receiving a penalty has little impact on the market valuation of an airline. Estimates of stock-price changes following a press release show no significant change for that airline relative to the industry. However, the act of publicizing a civil penalty does appear to be a deterrent. The press release appears to send a negative signal about safety in the industry, as evidenced by decreased prices. Civil penalties may have their greatest impact when they are publicized, rather than when they are levied.

Appendix

Figures and Tables

Figure 1.1. Injuries and Accidents, By Quarter, 1990-2006. For interpretation of the references to color in this and all other figures, the reader is referred to the electronic version of this dissertation.

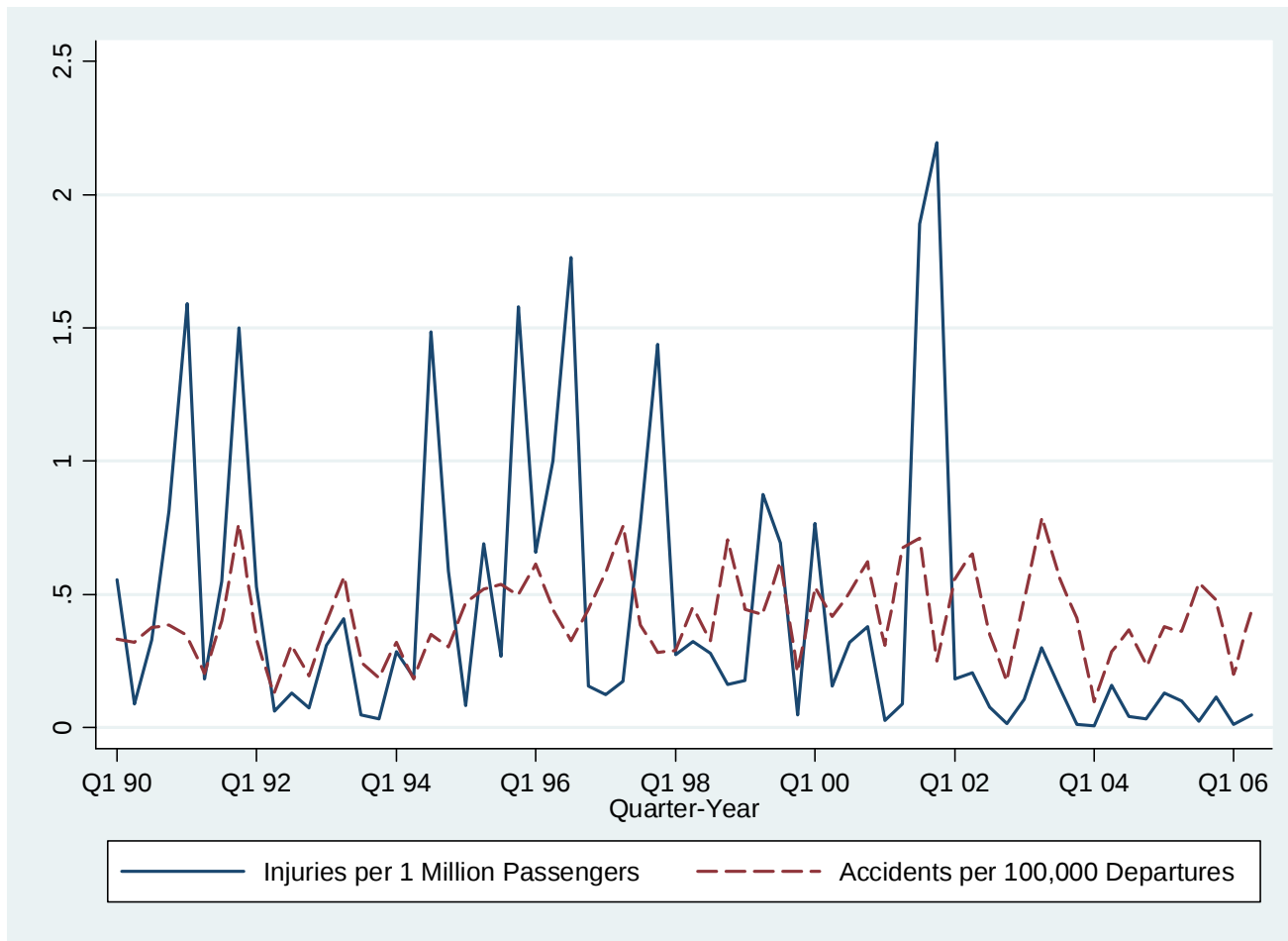


Figure 1.2. Enforcements and Penalty Amounts, 1990-2006

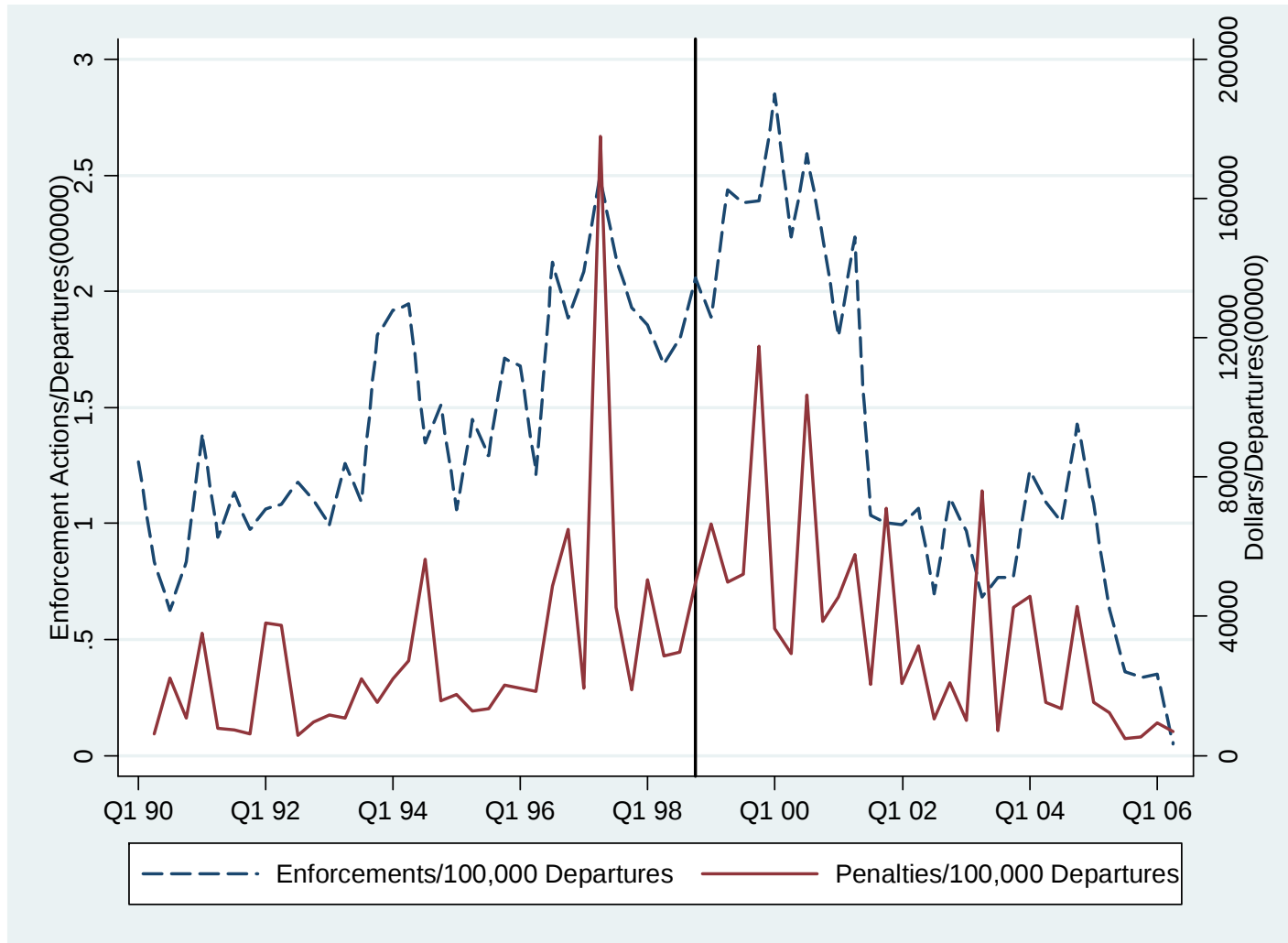


Table 1.1. Types of Final Action, 1990-2006

Final Action	Frequency	Percent	Cumulative Percent
Order Assessing	1,944	84.01	84.01
Civil Penalty, No Finding	238	10.29	94.30
Civil Penalty	106	4.58	98.88
Consent Order	11	0.48	99.35
Other	15	0.65	100.00
Total	2,314	100.00	

Table 1.2. Final Action Penalties, 1990-2006

Final Action	Mean	Minimum	Maximum
Order Assessing	\$13,071	\$250	\$2,500,000
Civil Penalty, No Violation	\$15,452	\$150	\$595,025
Civil Penalty	\$213,256	\$5,000	\$9,500,000
Consent Order	\$405,455	\$3,750	\$2,000,000
Other	\$125,333	\$750	\$600,000
Total	\$25,079	\$150	\$9,500,000

Table 1.3. Summary Statistics for Final Action Categories, 1990-2006

Category	Frequency	Percent of all Actions	Mean	Minimum	Maximum
Maintenance	1,015	43.86	\$34,575	\$500	\$9,500,000
Flight Operations	437	18.89	\$15,230	\$250	\$2,500,000
Records	145	6.27	\$13,297	\$300	\$575,000
Aircraft	9	0.39	\$24,528	\$1,000	\$100,000
Airport	5	0.22	\$6,400	\$2,000	\$15,000
Hazardous Materials	233	10.07	\$24,024	\$500	\$600,000
Security	235	10.16	\$21,687	\$490	\$595,025
Training	45	1.94	\$16,206	\$800	\$350,000
Other	190	8.21	\$14,104	\$150	\$450,000
Total	2,314	100.00	\$25,079	\$150	\$9,500,000

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Chapter Two

WHY BE SAFE? PUBLIC AND PRIVATE ENFORCEMENT IN THE AIR TRANSPORTATION INDUSTRY

Why Be Safe?

Public and Private Enforcement in the Air Transportation Industry

2.1. Introduction

Aviation safety can be affected by *ex-ante* public enforcement and *ex-post* private enforcement. Public enforcement is carried out by the Federal Aviation Administration (FAA) mainly using inspections and penalties. The inspections attempt to correct problems *before* an accident occurs. Private enforcement is carried out in the courts, when injured parties bring lawsuits *after* an accident occurs. In this chapter, I evaluate both public and private enforcement to compare their efficacy in encouraging safer outcomes.

Previous work on the economics of aviation safety has focused on the ways in which financial distress affects safety and the ways in which accidents affect airline finances. Golbe (1986), Rose (1990), Dionne *et al.* (1997), and Noronha and Singal (2004) study whether financial distress causes an airline to under-invest in safety provision, leading to more accidents. All four found that accidents increase in periods of financial distress. This work informs my model for the relationship between enforcement and safety outcomes.

Using event studies, Borenstein and Zimmerman (1988), Mitchell and Maloney (1989), and Bosch, Eckard, and Singal (1998) measure the financial losses suffered by airlines following a fatal accident by looking at the fall in stock prices. They find that the majority of the cost to an airline is from litigation costs, rather than from direct physical costs or loss in demand from passengers. This indicates a role for private enforcement in increasing safety by airlines, but these papers say nothing about the role of public enforcement.

Drawing on existing work, this chapter assesses the economic incentives (or disincentives) for safety that are generated by public and private enforcement. I use a panel

dataset of 98 airlines from 1990 to 2006 to measure the relationship between enforcement and safety. I estimate the effect of enforcement on safety events (accidents and incidents) and injuries. My results show that public enforcement, in the form of FAA penalties, does not lead to a reduction in safety events or injuries. The coefficients on public enforcement are not statistically significant and are unexpectedly signed positive. This may be because the FAA's enforcement process is successful in identifying unsafe practices at airlines, but not successful in correcting those practices before an accident occurs. In the analysis, public enforcement may also be endogenous if airlines with events and injuries are continuously targeted for enforcement by the FAA. This will give positive, biased estimates for public enforcement, but not for private enforcement which occurs after the events or injuries have taken place.

I find evidence that private enforcement in the form of lawsuits does reduce the number of future injuries for an airline. I estimate a reduction of one injury in a quarter for an airline that had an increase of 10 lawsuits in the quarter before. I also confirm previous results that find a positive relationship between events and financial distress, by looking at the performance of several airlines as they approach bankruptcy. This suggests a possible underestimation of the effect of enforcement, if enforcement is costly enough to bring about financial distress. The effect of private enforcement that leads to improved safety outcomes might be cancelled out by an increase in financial distress. In cases where financial distress is driving up injuries and accidents, expensive litigation would reinforce this effect rather than create an incentive to improve safety. However, this cannot be confirmed, as discussed in Section 2.4.2.

The next section contains a brief overview of previous research on airline safety. Section 2.3 includes an overview of the methodology and data used in the paper and is followed by results in Section 2.4. Section 2.5 is a brief conclusion.

2.2. Literature Review

2.2.1. Previous Research

The literature measuring the financial effects of fatal airline accidents provides background on the cost of litigation to an airline. While the event-study aspect of these papers is discussed more in Chapter 3, the papers are highlighted here as they provide a literature stream on the effect of litigation on airlines. These papers use event studies to measure the loss in market value for airlines following a fatal accident. They then decompose the estimated market loss, in part to quantify the cost of litigation. Borenstein and Zimmerman (1988), Mitchell and Maloney (1989), and Bosch, Eckard, and Singal (1998) use airlines' returns from a sample of large, scheduled U.S. carriers. The earlier papers include accidents from as early as 1962 to 1987. Bosch *et al.* use accidents from 1978 to 1996. Borenstein and Zimmerman, and Bosch, *et al.*, use event studies to estimate abnormal returns for airlines that experience a fatal crash, compared to airlines that do not. In the first stage, the results for the authors are of similar magnitude: a loss of 0.94% in equity value by Borenstein and Zimmerman and 1.2% by Bosch, *et al.*

Alternatively, Mitchell and Maloney divide fatal accidents into those in which the airline is at fault and those in which the accident is caused by other factors. They estimate abnormal returns for at-fault airlines and no-fault airlines. They find that no-fault airlines do not suffer a market loss; Mitchell and Maloney's estimate for the market loss to at-fault airlines is 1.6%, which is larger than the estimates of Borenstein and Zimmerman and Bosch *et al.* If Mitchell and Maloney are correct in estimating no loss for no-fault airlines, the larger loss is logical given that the others' estimates would be diluted by the presence of no-fault airlines.

After estimating abnormal returns, the authors analyze the abnormal returns to determine how much of the loss in equity is due to decreases in demand and/or litigation. Borenstein and Zimmerman measure the effect of litigation by assuming its costs are a function of the number of passengers killed or seriously injured. They use the total number of injuries in each accident to proxy for litigation costs. Mitchell and Maloney use the cost of liability insurance, given that airlines are fully insured against litigation. Bosch, *et al.* only look at changes in demand by analyzing returns of airlines that have significant route overlap with the airline involved in the fatal accident. Even with different measurements, all three papers find that litigation costs are a significant portion of the loss in market value. Mitchell and Maloney provide the only direct measure—42% of the loss is due to increased insurance costs.

In this chapter, I do not use event-study methodology. Instead, I follow the methodology used in the literature on financial distress and safety outcomes. Rose (1990), Dionne, Gagné, Gagnon, and Vanasse (1997), and Noronha and Singal (2004) analyze whether financial distress is a harbinger of reduced prioritization of safety. These three papers use the same model for safety provision. They model accidents as a function of departures and their chosen measures of financial distress (and include control variables for geographical or industry conditions). This model is then estimated using panel datasets of large, scheduled carriers. (Rose and Noronha and Singal use data from U.S. carriers, while Dionne, *et al.* use data for Canadian carriers). Given the count nature of the data, the three papers model accidents as being drawn from a Poisson distribution and estimate using maximum likelihood. Rose and Dionne, *et al.* include airline fixed effects. However, Noronha and Singal do not employ fixed effects, because of lack of variation in their measure of financial distress. I follow Rose and Dionne, *et al.* in including

airline fixed effects, and I follow Noronha and Singal in using a combined measure of accidents and incidents. Further, I use injuries as an additional safety outcome.

All three papers discussed above conclude that financial distress affects safety outcomes. However, they use different measures of financial distress: Rose uses operating profits, Dionne, *et al.* use debt-equity ratios, and Noronha and Singal use bond ratings. Rose finds that both accidents and incidents increase as operating margins decrease. Dionne, *et al.* use debt-equity ratios to separate financially healthy airlines that are increasing debt to increase investment and financially unhealthy airlines that are increasing debt to make up for financial losses. The sign on the debt-equity ratio indicates whether the airline is in financial distress. Airlines with positive debt-equity ratios are healthy; airlines with negative debt equity ratios are in financial distress. A negative debt-equity ratio occurs when net equity is negative—when the asset value is below the value of the debt used to purchase it. For example, when a house is valued less than its outstanding mortgage, the equity in the house is negative. An increase in magnitude of the debt-equity ratio in both cases means the airline is taking on more debt. Their results confirm financial distress is associated with an increased number of airline accidents. Noronha and Singal use bond ratings, believing that they are more predictive of bankruptcy than operating profits or debt-equity ratios (because they include expectations about the future financial health of the airlines). They find that airlines with lower bond ratings also have more accidents and incidents.

The sample of airlines analyzed in this chapter includes airlines that go bankrupt. According to the research discussed, safety events are on the rise in the period of time before bankruptcy for an airline. During this period, any increase in enforcement could exacerbate financial distress, and therefore cause an increase in events or injuries. Additionally, if

enforcement is costly enough to create financial distress at an airline, then events and injuries may increase. This issue is explored more fully after the main results are presented.

2.2.2. FAA Enforcement

The focus of this chapter is on FAA civil penalties. Civil penalties are one tool the FAA has at its disposal, part of the legal sanctions program. Alternatively, the FAA can enforce rules and regulations by using administrative actions (warning notices or letters of correction). Administrative actions are taken when the FAA decides that it does not need legal means to address an instance of noncompliance. For the most part, administrative actions are taken against violations that do not represent direct risks to safety.⁷ Legal sanctions (assessing regulatory penalties or suspending operating certificates) are more serious than administrative actions, and are used to bring an airline into compliance when it has violated the law. For these violations, the FAA can institute a civil penalty, always requiring both a corrective action from the airline and a punitive fine. In the most severe cases, the FAA can suspend or revoke an airline's operating certificate. Effectively, this grounds an airline, since non-certificated airlines are not allowed to engage in service. Six airlines in the sample had their certificates revoked. In Section 4.2, I discuss airlines that exit the sample for various reasons, including those six airlines.

⁷ Generally, the criteria for using an administrative action (rather than a legal sanction) are: (1) there is no violation of the law, (2) the violation does not call into question the airline's operations, (3) the violation does not substantially disregard safety or security, (4) the violator has a constructive attitude toward compliance, and (5) the violation is not part of a trend of non-compliance. FAA regulations represent guidance on how to carry out the laws that describe the FAA's functions. Administrative actions are assessed for violations of regulations that are not severe enough to conflict with the legal code. A full description of the FAA's enforcement program is in FAA Order 2150.3B (October 2007).

Within the FAA, enforcement of airline safety is the responsibility of the Air Transportation Oversight System (ATOS),⁸ created in 1998. ATOS's primary duty is to carry out airline inspections. Like a number of federal inspection programs, ATOS carries out targeted inspections, over-sampling based on perceptions of risk. The creation of ATOS represents a change from the previous system, under which the FAA scheduled a specific number of inspections for each airline, regardless of risk.

2.2.3. Overview of Lawsuits in the Industry

A safety event may result in a civil lawsuit when injured parties or their families file suit against an airline, either in federal court or in state court.⁹ The choice of federal or state court is initially made by the plaintiffs when they file suit. However, litigants (plaintiffs and defendants) can file to have the case removed from one venue to the other. According to attorneys¹⁰ who specialize in these cases, airlines usually prefer federal court because they believe themselves to be at greater risk for large punitive damages in state courts. Plaintiffs prefer the opposite for the same reason. There are no statutory prohibitions to filing (or removing) a case at the state level, but cases can only be tried in federal court if they meet certain criteria. The first is "diversity" in the jurisdiction, which is found when litigants are from different states. According to documents

⁸ A description of ATOS and the National Program Guidelines, the program preceding ATOS, can be found in Chapter 1. For full programmatic details, see FAA Order 8900.11 (2008).

⁹ International flights are governed by the Warsaw Convention. The data in this paper are only for flight segments within the United States.

¹⁰ I consulted three attorneys about aviation litigation; one (Jim Casey) represented the industry, one (Justin Green) represented litigants, and one (Kyle Levine) represented an airline. Further details are in the References section.

from the U.S. Courts, any case brought under the diversity jurisdiction must be associated with at least \$75,000 in potential damages, or it will be handled in state court.

All class action and multi-district litigation cases are handled in federal court. In multi-district litigation, the judge assigns one set of lawyers to represent the plaintiffs in the case and another set of lawyers to represent the defendants. Multi-district litigation acts similarly to class action litigation, allowing for many plaintiffs to coordinate their cases in one trial. Multi-district litigation is used to coordinate cases that revolve around the same set of facts, while class action lawsuits are used to allow many plaintiffs to participate in a lawsuit without having to file separate lawsuits. According to the attorneys I consulted, generally each individual victim (or victim's family) files a lawsuit following the accident in his or her own federal district court or in state court. Then the individual cases are consolidated into one case pretrial, through the multi-district litigation process.

The data for this chapter come from the federal court system. State courts do not track lawsuits consistently, so complete data are not available. Even within the federal court system, data are consistently available only on the dates for court filings and not for the details of cases. Thus, there is no way to know the extent to which this sample represents the entire population of lawsuits filed following an injury from air transportation. The absence of state lawsuits may introduce a bias in the results. However, the direction of the bias is unclear. On the one hand, it is possible that these cases are not economically significant because of the jurisdiction rules (cases moved to federal court if they meet the \$75,000 minimum) so they may have very little effect on safety outcomes. On the other hand, if the quantity of these cases were large enough, they might still have an impact on safety outcomes.

2.3. Methodology and Data

2.3.1. Methodology

Safety outcomes are the dependent variables in the analysis. I use safety events and injuries as outcomes, and like Rose (1990) and Noronha and Singal (2004), I include the number of incidents in the measure of safety events, since incidents represent a failure in some aspect of safety. I refer to the combined total of accidents and incidents as events. Unlike previous studies, I also use total injuries.

The key explanatory variables are the number of lawsuits filed (the measure of private enforcement), and a dummy variable for the presence of a civil penalty (the measure of public enforcement). Specifications using the number of penalties or the amount of penalties did not have the explanatory power of the specification presented here using a dummy variable for the presence of a civil penalty.

I include four one-quarter lags for each enforcement variable. These lags are necessary because of the timing of safety improvements or lawsuits. An airline may be able to make safety-improving changes within one or two quarters. According to the industry representatives with whom I spoke, airlines begin working immediately on safety issues once they are known. In some cases, relatively minor changes need to be made to bring an airline back into compliance. These include changes in record-keeping oversight or changes in maintenance schedules. These changes might lead to improvement in an airline's safety outcomes in one or two quarters. Additional lags are included to account for changes that are not made within one or two quarters after enforcement. In some cases, improvements to safety outcomes may not be realized until a few quarters have passed. Another reason for including lagged enforcement variables is that litigation can be subject to delays. There are many possible reasons for such delays. These

include the transfer of cases from state court to federal court, the search for an attorney, and the need to deal with the personal tragedy before seeking redress.

Unlike previous work, I do not use departures to control for differences in airline size or the probability that an event or injury will occur. Instead, I include airline fixed effects to control for differences among airlines, including size. I include airline-specific trends to control for changes within airlines over time, which includes trends in the number of departures that may increase or decrease the probability of events or injuries. These controls substantially account for changes in departures over time, and including departures did not materially change results. I also include year-quarter dummies to control for outside factors that may affect safety during the given time periods. I estimate the following equations:

$$\begin{aligned} events_{a,t} = & \alpha + airline_a + \beta_1 lawsuits\ filed_{a,t-1} + \beta_2 lawsuits\ filed_{a,t-2} \\ & + \beta_3 lawsuits\ filed_{a,t-3} + \beta_4 lawsuits\ filed_{a,t-4} + \beta_5 penalties_{a,t-1} + \beta_6 penalties_{a,t-2} \\ & + \beta_7 penalties_{a,t-3} + \beta_8 penalties_{a,t-4} + \sum_t^T \delta_t year\ quarter_t + \varepsilon_{a,t} \end{aligned} \quad (2.1)$$

$$\begin{aligned} injuries_{a,t} = & \alpha + airline_a + \beta_1 lawsuits\ filed_{a,t-1} + \beta_2 lawsuits\ filed_{a,t-2} \\ & + \beta_3 lawsuits\ filed_{a,t-3} + \beta_4 lawsuits\ filed_{a,t-4} + \beta_5 penalties_{a,t-1} + \beta_6 penalties_{a,t-2} \\ & + \beta_7 penalties_{a,t-3} + \beta_8 penalties_{a,t-4} + \sum_t^T \delta_t year\ quarter_t + \varepsilon_{a,t} \end{aligned} \quad (2.2)$$

using ordinary least squares (OLS) and maximum likelihood estimation of a Poisson distribution¹¹.

¹¹ See Section 17.3, “The Poisson Regression Model” in *Introductory Econometrics: A Modern Approach* by Jeffrey M. Wooldridge, South-Western College Publishing, 2000.

2.3.2. Data

The data for this paper are taken from four sources. The dependent variables for safety events and event outcomes come from the National Transportation Safety Board (NTSB). The control variables for financial and traffic data come from the Bureau of Transportation Statistics (BTS). The variables for public enforcement come from the FAA, and the lawsuit variables come from the U.S. Court System. A detailed explanation of the data is provided in the Appendix for this chapter.

The data are organized by airline-quarter, with 2,612 observations from 1990 to the second quarter of 2006. There are 98 separate carriers in the final sample, although many of these are not present in every year and quarter. This leads to concerns about sample selection, which I will discuss later in this chapter.

Table 2.1 provides the summary statistics for the data set. The table shows three market variables for airlines—revenue, departures, and passengers. There are 248 fewer observations for the revenue variable than for the other variables. This is because the data from the BTS are self-reported, so for these quarters, airlines chose not to submit revenue data to the BTS.¹² Note, however, that this variable is only provided for context. Since the missing revenue data are not present in the final specification, they are not problematic in the analysis.¹³ The sample of 98 airlines includes small charter services, as well as large commercial airlines such as United Air Lines. The wide distribution of operations is illustrated by Figure 2.1, a histogram of departures

¹² Analysis did not show a consistent pattern in the missing data when comparing means across quarters when revenue was reported and when it was not. Airlines did not appear to fail to report in or around quarters with more enforcement, events, injuries, or when revenue was lower.

¹³ Excluding revenue does not create omitted variable bias because, like departures, revenue is accounted for by airline fixed effects and time trends.

in 2005 by airline. The distribution contains many more small airlines, but the sample covers airlines of every size. The airlines in the sample show a wide range of values for the number of departures, with a minimum of one per quarter and a maximum of 271,000 per quarter.

Safety outcomes are measured by events and by injuries. As mentioned before, I use the term “events” to refer to what the NTSB categorizes as either “accidents” or “incidents.”¹⁴ According to federal regulations, an “accident” is defined as an event that involves either death or serious injury to any person, or substantial damage to the aircraft, while an “incident” is an occurrence that in some way affects the safety of operations, but does not lead to the consequences necessary to categorize it as an accident. For example, incidents include minor collisions at the airport (e.g., the airplane runs into the jet bridge at the gate) or collisions with birds while flying. An incident is also recorded when an indicator light comes on, or when passengers notice a strange odor and the pilot is forced to land the plane. The NTSB has discretion to determine whether the occurrence represents a lapse in safety that should be recorded as an incident. On the other hand, any event like the ones mentioned that does lead to substantial damage or injury would be recorded as an accident.

Accidents are recorded for minor events, such as when strong turbulence causes a passenger to fall and injure himself or when an airplane hits a baggage vehicle, damaging the aircraft, but causing no injuries. Major events that involve fatalities or destroyed aircraft are also defined as accidents. This is one reason to use injuries as a dependent variable. Injuries provide some measure of the severity of an accident. In the sample, airlines average approximately 0.35 events per quarter and nearly 1.5 injuries per quarter. In the sample, events occur in 25% of the total quarters. Fatalities have a mean of 0.60, which means that there is slightly more than one

¹⁴ Full definitions can be found at 49 CFR Part 830.

fatality per airline every six months. In the entire time period, there is an average of 1.21 injuries per accident.

I use the number of lawsuits filed in federal court as my measure of private enforcement. Lawsuits occur more frequently than public enforcement; on average, airlines experience over two lawsuits filed per quarter, but only 0.63 penalties per quarter. On average, the airlines in the sample have at least one penalty in 20.1% of their quarters. Penalty dollar amounts are relatively low—in the sample, over 99% of fines are under \$1,000,000 and 90% are under \$100,000. The average penalty is approximately \$60,000, but the median penalty is only \$15,750. However, the relevant factor seems to be whether an airline experienced a penalty at all. Analysis not included here shows that the estimates change very little when using a dummy indicator for penalties rather than penalty amounts, but that using dummy variables is more statistically efficient.

Figures 2.2 and 2.3 show the trends in the main variables over time. The number of flights was increasing throughout the 1990s, and the increase in the number of departures contributed to an increase in the number of safety events. As a result, the number of enforcement actions rose until the market dropped in 2001. However, after the brief negative shock in 2001, the number of flights slowly returned to its previous level, while injuries, events, and enforcement were declining. This safety improvement could have several underlying causes. One possibility is that the implementation of ATOS improved safety outcomes. Another possible explanation is that there were improvements in safety technologies. Additionally, the economic downturn may have eliminated some of the less-safe airlines, while leaving safer airlines in business.

2.4. Results

The results from regressions using ***total events*** as the dependent variable are found in Table 2.2. The first set of regressions estimates equation (1) using OLS. The first column uses year-quarter fixed effects. The second column uses year-quarter and airline fixed effects, and column three uses those dummies and allows for an airline-specific time trend. Standard errors are included in parentheses. These are robust standard errors, adjusted for clustering by airline.

For the most part, the coefficient estimates on enforcement are positive, which means that these estimates suggest an increase in enforcement that is associated with an *increase* in the number of events. This is to be expected in the first column, because larger airlines with more flights and aircraft have more opportunities for enforcement. However, after controlling for airline fixed effects, the coefficients should become negative if increased enforcement is associated with a reduction in the number of events. Instead, the coefficients remain positive in most cases.

The coefficients on penalties may be positive because the FAA is identifying unsafe airlines but failing to provide sufficient incentives to improve. There may also be concerns about endogeneity as penalties increase attention on an airline. This is particularly true after the implementation of ATOS, which targets airlines for inspection based on risk factors. However, analysis not presented here shows positive coefficients exist both before *and* after the implementation of ATOS. Controlling for the implementation of ATOS had no effect on estimates. Additionally, this effect should be mitigated by including four quarters of previous enforcement. These concerns do not exist for private enforcement, which occurs after an event.

The coefficients on penalties are small; having at least one penalty in a quarter is associated with an increase of 0.06 or 0.04 events in the next quarter. In addition, these estimates

are not statistically significant. Similarly, lawsuits show a negligible effect, increasing events by roughly 0.06 with an additional 10 lawsuits, or one standard deviation in the sample.

The second set of estimates in columns four and five in Table 2.2 use maximum likelihood estimation on a Poisson distribution for the dependent variable. No estimates are included for the third specification with airline trends because the equation was not concave. Additionally, airlines that experienced no events were dropped, reducing the sample from 78 airlines to 52 and eliminating the possibility that enforcement could reduce events or injuries to zero. The Poisson results generally mirror the OLS results. The coefficients are all positive when airline fixed effects are not included and are not statistically significant. They remain mostly positive with the addition of airline fixed effects, and the estimates remain statistically insignificant. Unlike in the OLS results, the coefficient estimates for the number of lawsuits are economically significant: in the specification with the one-quarter lag, an increase of 10 lawsuits is estimated to increase the number of events by 5%, which is statistically significant at the one-percent level. Having a penalty in one quarter is associated with a 13% increase in events in the next. The results do not indicate that enforcement is reducing the number of events.

Table 2.3 shows the same sets of regressions using ***total injuries*** as the dependent variable. When using injuries instead of events, the results provide stronger support for the notion that lawsuits may be a factor in improving safety. In the set of OLS regressions, once airline fixed effects are included, the lagged lawsuits are all signed negative, and the first quarter lag is statistically significant at the one-percent confidence level. An increase of 10 lawsuits is associated with a decrease of approximately one injury in the next quarter, and nearly another one-half of an injury in the quarter after.

While there is evidence of a deterrent effect for *private* enforcement, *public* enforcement does not appear to reduce the number of injuries. Instead, the presence of a penalty is associated with an *increase* of 0.8 injuries in the next quarter when airline trends are included. The same endogeneity concerns apply to these positive estimates as when using events as the dependent variable

The Poisson results in columns three, four, and five in Table 2.3 show the same general pattern as the OLS results. However, many airlines could not be included in this analysis, because they did not have an injury. If enforcement has the effect of reducing injuries to zero, this effect would not be calculated when these airlines are dropped. This means this smaller sample of airlines may underestimate the effect of enforcement. With the smaller sample of airlines, the coefficients on penalties remain large, positive almost without exception, and statistically insignificant. The coefficients on lawsuits are negative through the first three quarters. The first quarter lag estimates that an increase of 10 lawsuits in one quarter is associated with a reduction in the number of injuries by 24% or 34%, depending on whether airline time trends are included.

Reviewing the results in Tables 2.2 and 2.3, no deterrent effect by public enforcement on either events or injuries is evident. The deterrent effect of private enforcement emerges when injuries are the dependent variable. Taken together, the results suggest that litigation may be a better avenue for decreasing the number of injuries suffered by the flying public.

2.4.2. Sample Selection

An important source of possible selection bias is the early exit of airlines from the panel. This occurs because airlines cease to operate, either because they go bankrupt, merge with another airline, or are acquired by another airline. Of the 98 airlines present in the panel, only 49

are present at the end of the reporting period, and only 18 are present from start to finish. If enforcement is driving bankruptcies, then the estimates are biased downward when enforcement improves aviation safety by eliminating unsafe airlines. Additionally, based on the literature, we expect that financial distress will lead to a reduction in safety provision, and therefore increased enforcement. It is not likely that sample selection underlies the positive coefficients on penalties. Penalty amounts are not large enough in most cases to create financial distress; on average, penalty amounts are 0.18% of revenue and all but one are under 3% of revenue. However, if we restrict our attention to the airlines that go bankrupt, it is possible that very costly enforcement could lead to an increase in the number of events or injuries when an airline is nearing bankruptcy. In this case, we should see a positive relationship between enforcement and safety outcomes for those airlines that exit the sample due to bankruptcy.

The airlines that exited are shown in chronological order of exit in Table 2.4, with their reasons for exit. The majority of airlines that exited the panel did so because of bankruptcy, as shown in Table 2.5. Of these 34 airlines, six were victims of the FAA's strongest form of enforcement—suspension of an airline's operating certificate. Three airlines had their certificates suspended in 1996, following a focus on safety issues at start-up airlines caused by the ValuJet crash in May of that year (Association of Flight Attendants, 2010). Once their operating certificates were suspended, these six airlines were immediately put out of business. The panel also included four cargo airlines that offered passenger service for some period of time which was later terminated. Without passenger service, these airlines cease to be represented in the panel.

Table 2.6 presents the summary statistics comparing the airlines that exit early with their counterparts that remain in the panel. The differences are substantial; on average, airlines that

remain in the panel have ten times as many events per departure. They also have eight times as many injuries per passenger. Yet, even a relatively higher number of events per departure is not necessarily an indication that these airlines are less safe, since the absolute level of events is so low. However, these differences are not statistically significant. This shows the difficulty in achieving statistical significance in such a small sample. There are statistically significant differences in lawsuits and penalties as shown in Table 2.6, but these variables are not normalized by size, so we would expect the larger (no exit) airlines to have been greater targets of enforcement.

To test for selection bias, I look at whether enforcement affects the probability that an airline exits the sample. I test this with two dependent variables: a dummy variable indicating whether the airline exits in the next quarter and a dummy variable indicating whether the airline exits due to bankruptcy in the next quarter. Evidence that this may be the case can be found in Figures 2.4, 2.5, and 2.6. These graphs show how enforcement is deviating from its average as airlines get closer to bankruptcy. The trend is upward for both public and private enforcement, with higher-than-average enforcement shortly before bankruptcy.

Summary statistics for these variables are in Table 2.1. For the independent variables, I use events, injuries, or enforcement summed over a year. The variables are summed over the year in order to have enough variation in the data to estimate the model. This is equivalent to using four quarters in the regressions reported previously, and it allows for a reduction in the number of zero observations in these variables. However, given the lack of variation in the data (even with variables summed over the year), estimation of a probit model was not possible. The following equations show the linear probability model for the probability an airline exits in the next quarter:

$$exit_{a,t} = \alpha + airline_a + \sum_{j=1}^4 events_{a,t-j} + \sum_t^T \delta_t year\ quarter_t + \varepsilon_{a,t} \quad (2.3)$$

$$exit_{a,t} = \alpha + airline_a + \sum_{j=1}^4 injuries_{a,t-j} + \sum_t^T \delta_t year\ quarter_t + \varepsilon_{a,t} \quad (2.4)$$

$$exit_{a,t} = \alpha + airline_a + \sum_{j=1}^4 lawsuits_{a,t-j} + \sum_{t=1}^4 lawsuits_{a,t} + \sum_t^T \delta_t year\ quarter_t + \varepsilon_{a,t} \quad (2.5)$$

The three equations use a dummy variable that an airline will exit in the next quarter. One dependent variable is equal to one for any type of exit in the next quarter, and a second is equal to one only for a bankruptcy. I estimate a linear probability model for the two dependent variables, looking separately at the effect of events, injuries, and enforcement.

The results from regressions to test these relationships are presented in Tables 2.7 and 2.8. The first column uses year-quarter dummy variables to control for time, and the second column uses airline-specific time trends. The results show the effect of events, injuries, and enforcement separately on the probability of an exit. The baseline probability of exiting in any quarter for the sample is 0.018, if we assume that all airlines are equally likely to exit. One additional event is associated with an increase in the probability of exit by as much as 0.03, which is significant at the 10% level. This confirms the result from the literature on financial distress, which showed that financial distress increases the number of accidents. Comparing Tables 2.7 and 2.8, we see that the coefficients are nearly identical when looking at bankruptcies or looking at any type of exit.

Although the number of events seems to be increasing while an airline is approaching exit, the relationship between the approach of exit and the number of additional injuries is not

consistent across specifications. The estimates switch signs, depending on the time specification. The standard errors are large enough that the point estimates in columns one and two are not statistically different from one another. The coefficients indicate that one additional injury alters the probability of exit or bankruptcy by less than 0.001 (in either direction), which is a negligible effect.

As discussed previously, research on the financial cost of fatal accidents implies the majority of the cost stems from the resulting litigation. This would indicate that lawsuits play an important role in financial distress. However, litigation is fully insured by airlines, and this spreads the cost of the litigation over time.¹⁵ With insurance, airlines may see the cost of litigation reflected in higher premiums. The analysis shows that when airline time trends are included in the last columns of Tables 2.7 and 2.8, there is a small positive relationship between lawsuits and exit or bankruptcy. This relationship is statistically significant in the last column of each table. An increase of ten lawsuits over the year (slightly more than twice the average for these airlines) increases the probability of bankruptcy by 0.018. However, the point estimates on

¹⁵ The FAA requires owners and operators of aircraft to carry insurance. According to an article by CS&A Insurance, airline insurance is usually not underwritten by one company. The potential losses are so high that normally one insurance company is unwilling to underwrite the entire risk (Chappell, 2004). Aon Corporation provides a number of market studies on aviation insurance on its website, www.aon.com. In one such report, Aon describes the relationship between insurance premiums, safety events and litigation:

“In the end, it is impossible to remove the potential for incidents in the airline industry, which has an inherently high potential for catastrophic loss. The fact that the number of fatalities, and with it the amount of liability claims, has once again been relatively low [*sic*] be a major factor in the insurance negotiations during 2008.”

(Aon Aviation, 2008).

lawsuits are negative when using time dummies. Thus, the evidence of a positive relationship is inconsistent.

The FAA's penalty program clearly contributed to bankruptcy in at least one case. The largest fine in the sample, \$9.5 million, was levied against Eastern Airlines, which went bankrupt in the next quarter. However, fines are generally much smaller than this, and are not likely to contribute to bankruptcy. The FAA can also suspend an operating certificate if safety concerns are grave. In Tables 2.7 and 2.8, the point estimates for penalties are small, but they are consistently negatively signed. The FAA does not appear to be targeting airlines based on financial health; an additional \$50,000 in penalties is associated with a lower probability of bankruptcy by 0.003.

These regressions provide evidence for the correlation between financial distress and decreased safety. Decreased safety should be associated with increased enforcement, particularly *ex-post* private enforcement. There is weak evidence that this is the case. However, the regressions do not show that FAA penalties are higher before a bankruptcy. Given that the FAA has other tools at its disposal to shut down an airline, enforcement penalties may not be a contributing factor. While selection bias may be at work for lawsuits, FAA penalties do not appear to be high enough to contribute to many airline bankruptcies, except in the unusual case of Eastern Airlines.

2.5. Conclusion

Overall, the results show that there is a mixed effect of enforcement on airline safety. Neither private enforcement in the form of federal lawsuits nor public enforcement in the form of FAA penalties appears to lead to a significant decrease in the total number of accidents or incidents an airline may have in the future. However, when looking at the number of injuries

resulting from air transportation, there is some evidence that lawsuits have an effect. The point estimates indicate that an increase of 10 lawsuits filed in one quarter is associated with the reduction of one injury in the next.

These conclusions may be understated in the case of drastic impacts on an airline's ability to stay in business. I provide some evidence that safety decreases and litigation increases before a bankruptcy. However, given the relative scarcity of bankruptcies in the sample, this evidence is not conclusive. Thus, I cannot say definitively that FAA penalties are not influencing airlines' safety records or that the impact of litigation is understated.

In this chapter, I have provided a first step in looking at the issue of public and private enforcement in the air transportation industry. Further research on the industry effects of enforcement may strengthen (or weaken) the conclusions found here. This chapter treats each airline as an isolated actor, although both public and private enforcement are (to some degree) a matter of public record. To the extent that one airline reacts to the FAA penalties of another airline, future research might show an important role for FAA penalties. The impact of the publication of FAA enforcement actions on individual airlines and the industry as a whole is addressed in the next the chapter.

Appendices

Data

The financial and traffic data on airlines for this chapter come from the Bureau of Transportation Statistics (BTS). The BTS organizes information into several categories, including financial data and carrier statistics. I matched the data from different sources by airline using the BTS variable *carrier_name* as my guide. No consistent airline identifier was present among all data sources; thus, in each case, I had to hand match an airline name to a *carrier_name*. In cases where I was unsure of whether two similar names were a match, I used the internet to verify all carrier names that could be associated with an airline.

From the Air Carrier Financial Reports, I used Schedule P-12, quarterly profit and loss statements. From the Air Carrier Statistics, I used Schedule T-100 Domestic Segment to construct a dataset on air carrier traffic. This provided data on every flight taking place in the U.S. by segment (one take off and landing). All data were collected from 1990 to the most recently available quarter.

The traffic data are reported monthly, and therefore had to be collapsed by quarter. Additionally, the data included information on all flights taking place in the U.S., regardless of carrier. Thus, while the financial data were associated with a set of 125 large domestic carriers, the traffic data were associated with 396 domestic and international carriers. Cross checking the three sets of data yielded 123 airlines in common.

The data on airline accidents were collected from the National Transportation Safety Board (NTSB), under the link “downloadable datasets.” The NTSB provides a database of accident information for every event handled by the NTSB since 1982. The database is organized by event. From the database, I used the table referred to as “aircraft” and the table referred to as

“events.” The first table gave detailed information about the aircraft and its operator, as well as the number of injuries and fatalities associated with the event and the damage to the aircraft. The second table gave additional information on injuries and fatalities, as well as detailed information about conditions when the event occurred. The two tables were matched by event identification number.

The data on FAA enforcement actions came from the Aviation Data Systems Branch. These data are not publicly available, but can be requested in writing. The data originally contained 2,314 total records, organized by airline. The airline names were matched to the carrier names provided from the BTS, resulting in 2,001 total matched records for airlines present in both sources.

The lawsuit data came from the Public Access to Electronic Records (PACER) database, the federal judiciary’s tracking system for U.S. District Courts. PACER contains information on all suits filed in federal court. In order to obtain the lawsuits, I searched the PACER database by the name of the airline and restricted lawsuits to nature-of-suit code 310. Nature-of suit-code 310 applies to civil cases filed for personal injury associated with an airplane. I made a reasonable attempt to capture all airlines by searching with as few words as possible (e.g. a search for Pinnacle instead of Pinnacle Airlines) or conducting two searches with different spellings (e.g., a search for Delta Air Lines and Delta Airlines).

Output from PACER was limited to the name of the case, the case number, the court in which the case was filed, the date it was filed, and the date it closed. The outcome of the case falls generally into four categories: settled, transferred/remanded, dismissed, or judgment. The outcome of the case is not listed in PACER, but as long as the suit was settled, dismissed, or came to a judgment, the closed date that appears is the end of the suit. However, if the suit was

remanded or transferred, the closed date represents the last time the suit was heard in that particular court, not the end of the case. A remanded suit goes to state court, where it can no longer be tracked. A transferred suit will begin again in a different district court.

In order to avoid double counting transferred cases, I grouped cases that had the same name (e.g., *Funari v. Northwest Airlines*) but changed jurisdictions as transferred cases. As long as the dates of the two suits coincided (the filed date of the most recent case closely followed the closed date of the preceding case), I marked it as the same case that had been transferred. The two cases were then condensed into one case, with the earliest file date and the most recent closed date. This resulted in a list of 6,135 total lawsuits in the final data set.

Figures and Tables

Figure 2.1. Histogram of Departures in 2005

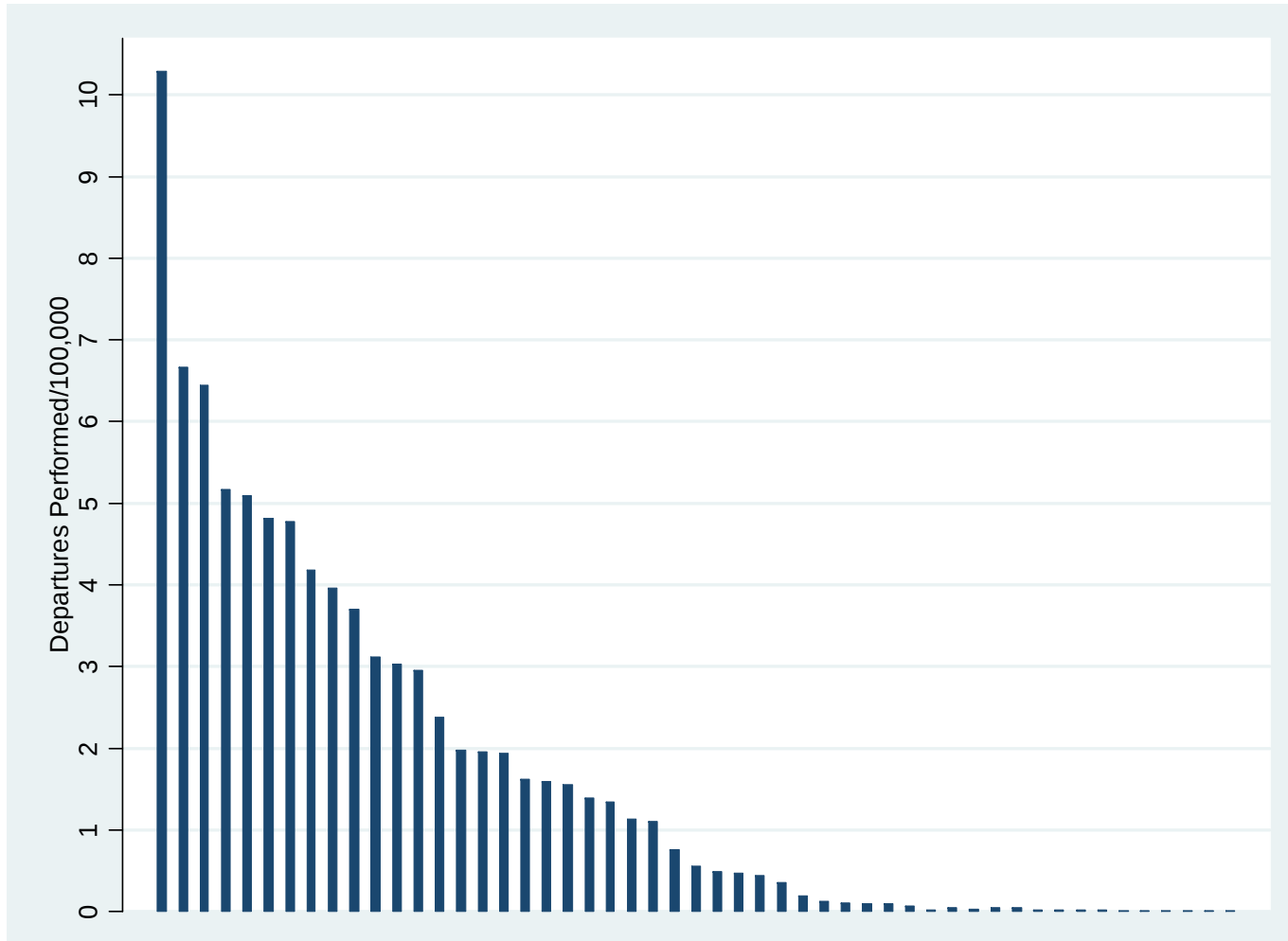


Figure 2.2. Graph of Passengers, Injuries, and Lawsuits over Time

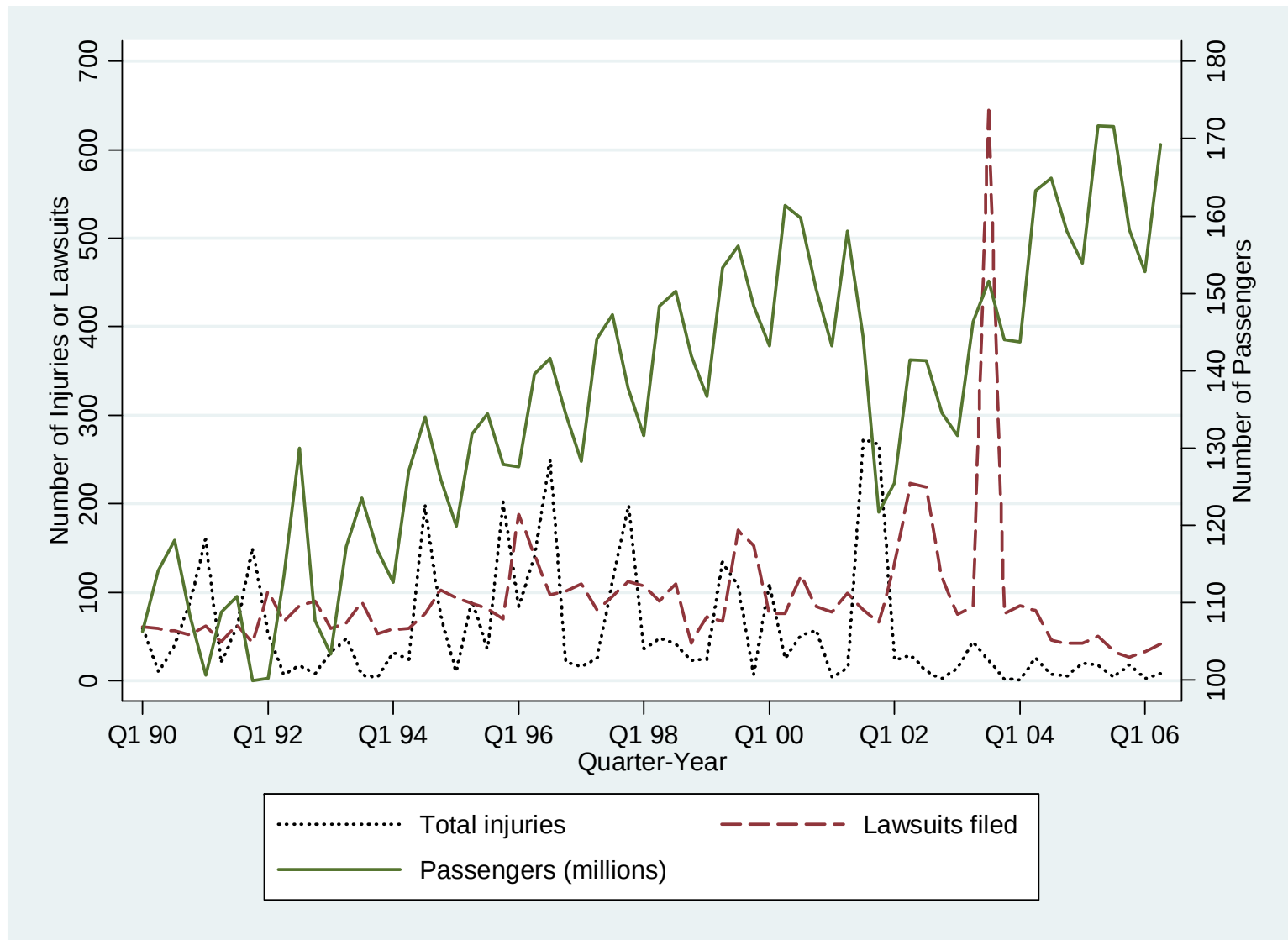


Figure 2.3. Graph of Departures, Events, and FAA Penalties over Time

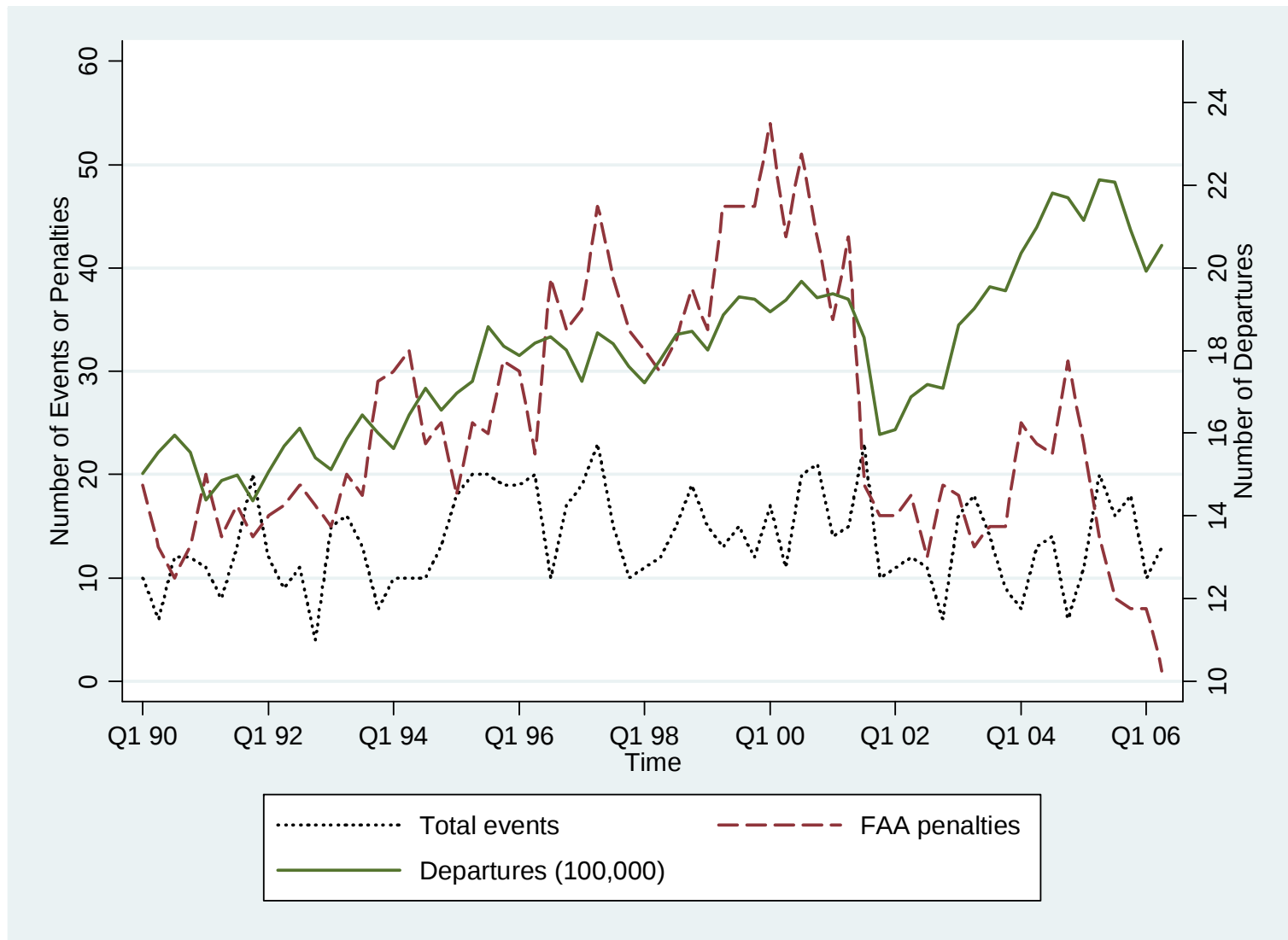


Figure 2.4. Deviations of Average FAA Penalties Leading up to Bankruptcy

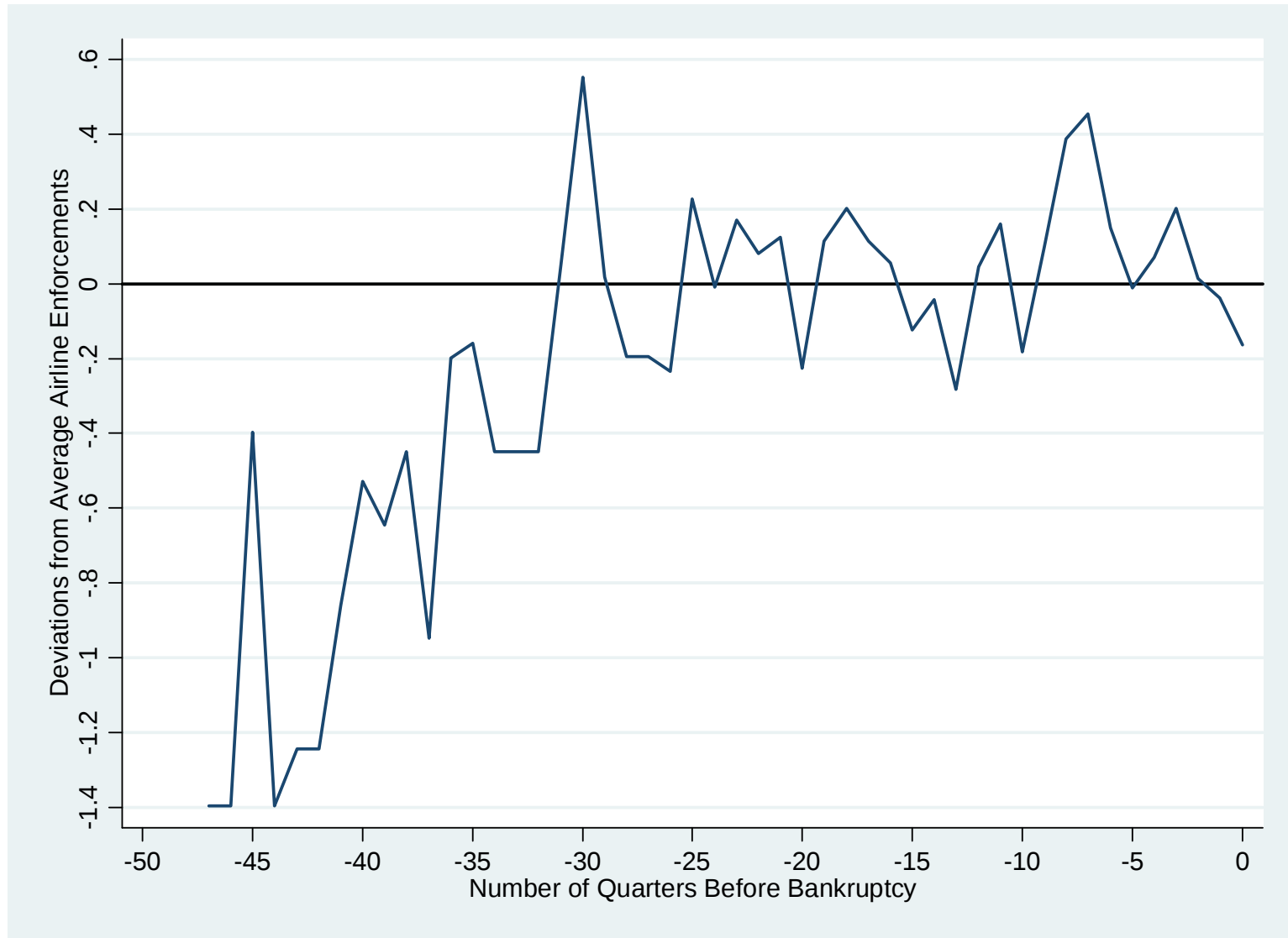


Figure 2.5. Deviations of Average FAA Penalty Amounts Leading up to Bankruptcy

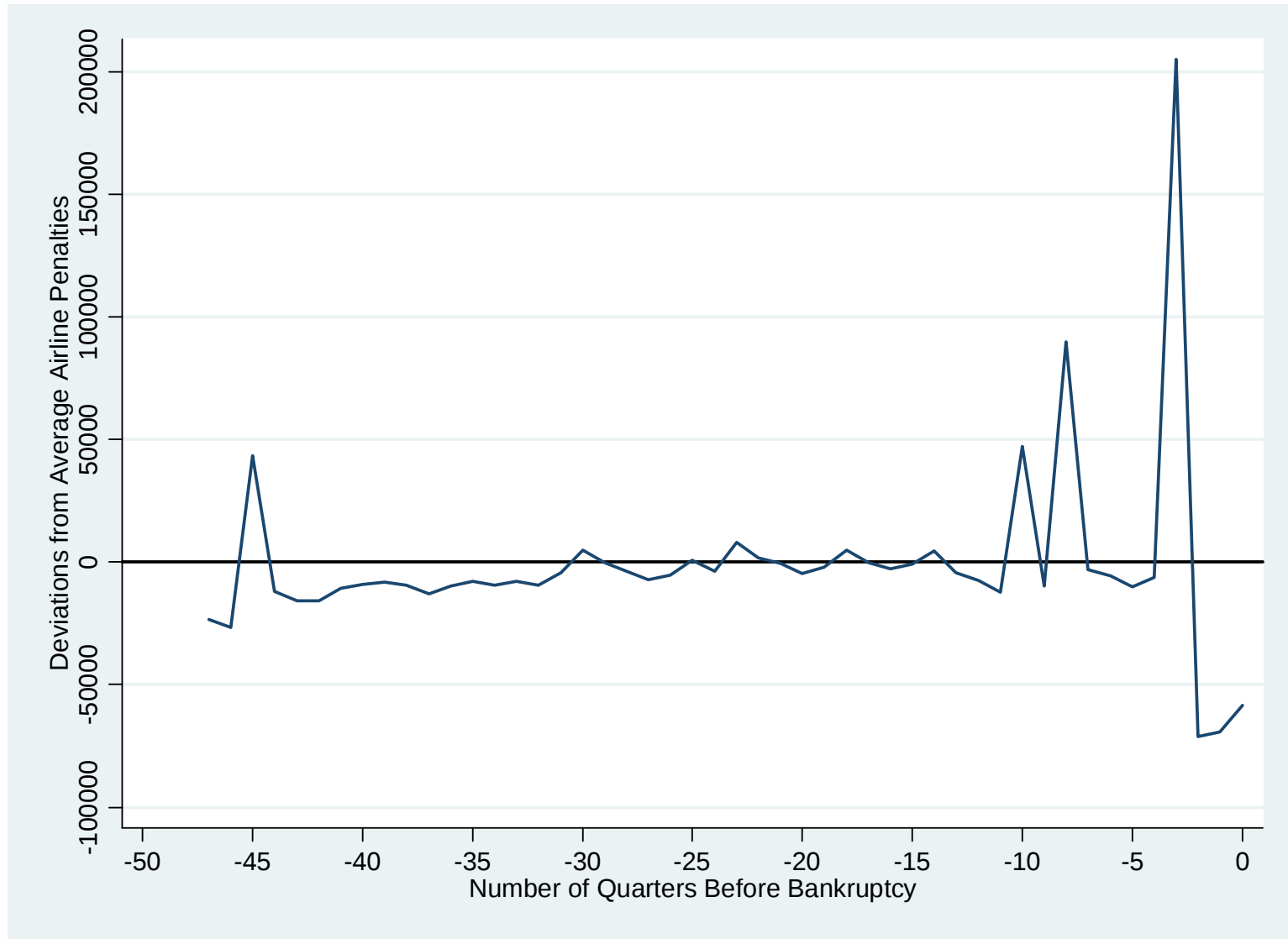


Figure 2.6. Deviations of Average Lawsuits Leading up to Bankruptcy

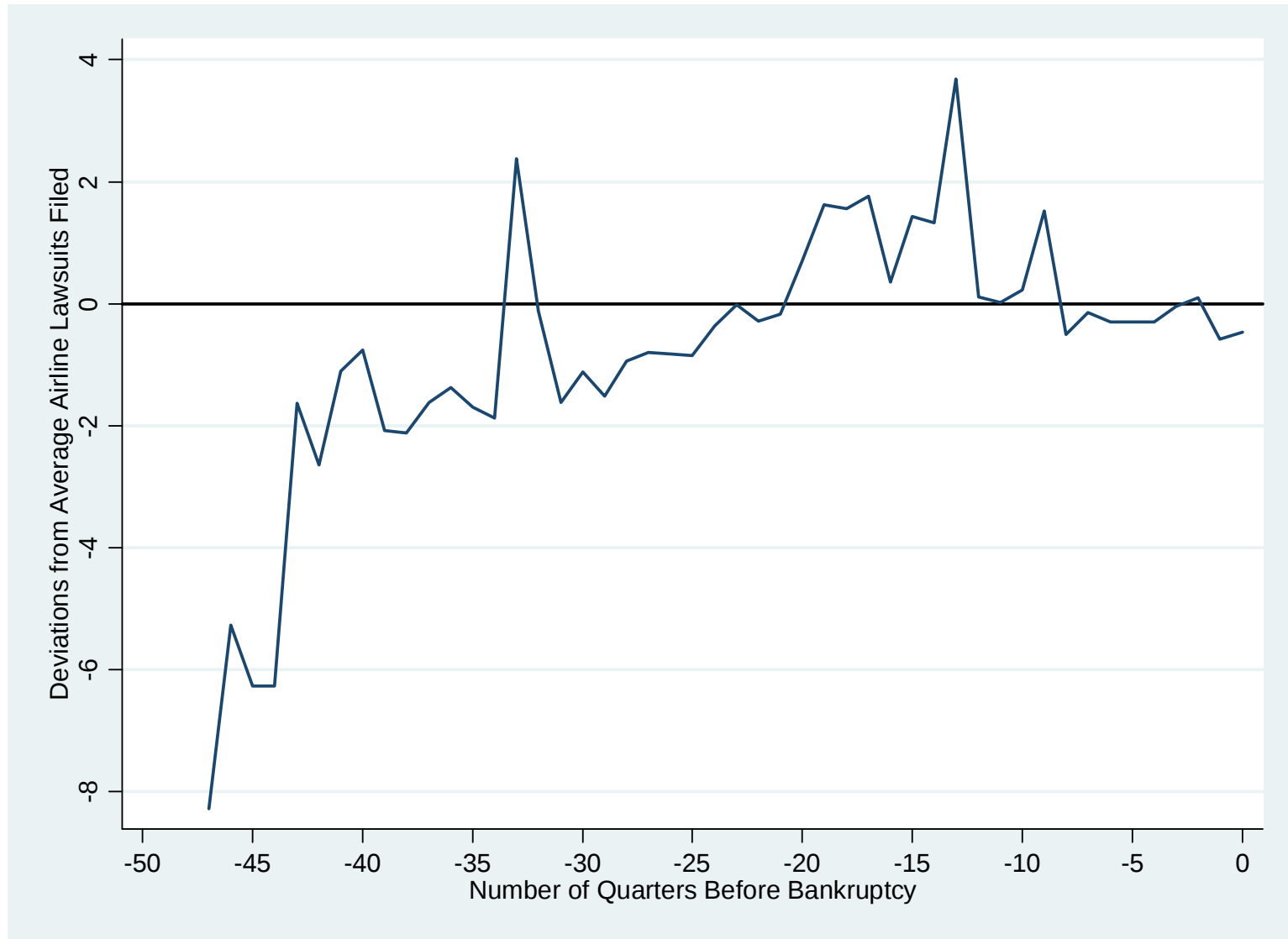


Table 2.1. Summary Statistics

Variable	Description	Obs	Mean	Median	Std. Dev.	Min	Max
Financial <i>revenue</i>	Total operating revenues in billions	2364	0.437	0.072	0.779	1.26E-05	3.768
Accidents <i>accident</i>	NTSB event—accident	2612	0.188	0	0.551	0	6
<i>incident</i>	NTSB event—incident	2612	0.156	0	0.479	0	4
<i>total events</i>	All NTSB events (accidents + incidents)	2612	0.345	0	0.821	0	8
Injuries <i>fatalities</i>	Any injury that results in death within 30 days	2612	0.596	0	9.664	0	265
	Any injury requiring hospitalization or						
<i>serious injuries</i>	damage to body	2612	0.173	0	1.314	0	45
<i>minor injuries</i>	Any injury not fatal or serious	2612	0.670	0	5.617	0	171
<i>no injuries</i>	No injury	2612	39.037	0	124.205	0	1653
<i>total injuries</i>	Sum of fatalities, serious, and minor injuries	2612	1.438	0	11.971	0	267
Lawsuits <i>lawsuits filed</i>	Filed lawsuits	2612	2.351	0	8.855	0	192
FAA Enforcement <i>penalty amount</i>	Dollar amount of penalties in millions	2612	0.019	0	0.208	0	9.5
<i>penalty number</i>	Number of penalties	2612	0.634	0	1.229	0	14
Traffic <i>departures</i>	Departures performed in hundred thousands	2612	0.452	0.142	0.623	1.00E-05	2.7106
<i>passengers</i>	Total passengers in millions	2612	3.432	0.798	5.767	3.00E-06	27.3434

Table 2.2. Regressions with Total Events as the Dependent Variable

	OLS	OLS	OLS	Poisson	Poisson
Lawsuits Filed Last Quarter	0.0149** (0.0032)	0.0061 (0.0031)	0.0057 (0.0033)	0.0124** (0.0018)	0.0051** (0.0018)
Lawsuits Filed 2 Quarters Ago	0.0024 (0.0035)	-0.0030 (0.0027)	-0.0031 (0.0028)	0.0052 (0.0028)	0.0001 (0.0026)
Lawsuits Filed 3 Quarters Ago	0.0034 (0.0041)	-0.0018 (0.0048)	-0.0019 (0.0049)	0.0024 (0.0025)	-0.0019 (0.0034)
Lawsuits Filed 4 Quarters Ago	0.0155** (0.0015)	0.0063** (0.0013)	0.0063** (0.0016)	0.0092** (0.0016)	0.0023 (0.0013)
Penalty Occurred Last Quarter	0.1881** (0.0457)	0.0628 (0.0412)	0.0395 (0.0403)	0.5924** (0.0981)	0.1308 (0.1020)
Penalty Occurred 2 Quarters Ago	0.1277* (0.0509)	0.0024 (0.0317)	-0.0130 (0.0304)	0.4179** (0.1051)	-0.0155 (0.0849)
Penalty Occurred 3 Quarters Ago	0.1815** (0.0632)	0.0576 (0.0391)	0.0460 (0.0434)	0.6168** (0.1376)	0.1564 (0.0861)
Penalty Occurred 4 Quarters Ago	0.0915 (0.0533)	-0.0444 (0.0573)	-0.0530 (0.0579)	0.3301* (0.1369)	-0.1050 (0.1203)
Airline Dummies	No	Yes	Yes	No	Yes
Airline Dummies x Time Trend	No	No	Yes	No	No
Year-Quarter Dummies	Yes	Yes	Yes	Yes	Yes
Observations	2251	2251	2251	2251	1971
R-squared	0.25	0.40	0.41		
Number of unique carriers		78	78		52
Robust standard errors in parentheses					
* significant at 5%; ** significant at 1%					

Table 2.3. Regressions with Total Injuries as the Dependent Variable

	OLS	OLS	OLS	Poisson	Poisson	Poisson
Lawsuits Filed Last Quarter	0.0218 (0.0242)	-0.1003** (0.0259)	-0.1206** (0.0374)	0.0053 (0.0086)	-0.0238* (0.0117)	-0.0337 (0.0192)
Lawsuits Filed 2 Quarters Ago	0.0361 (0.0276)	-0.0371 (0.0253)	-0.0486** (0.0168)	0.0069 (0.0085)	-0.0098 (0.0106)	-0.0169 (0.0150)
Lawsuits Filed 3 Quarters Ago	0.0135 (0.0196)	-0.0604 (0.0318)	-0.0719 (0.0377)	0.0089 (0.0081)	-0.0085 (0.0106)	-0.0120 (0.0141)
Lawsuits Filed 4 Quarters Ago	0.0915** (0.0241)	-0.0302 (0.0268)	-0.0484 (0.0271)	0.0169** (0.0054)	0.0054 (0.0048)	0.0010 (0.0074)
Penalty Occurred Last Quarter	1.3306 (0.7090)	1.1554 (0.9845)	0.7902 (0.8406)	0.9698 (0.6228)	0.8653 (0.6202)	0.7001 (0.4890)
Penalty Occurred 2 Quarters Ago	0.3837 (0.4597)	0.1144 (0.4151)	-0.1518 (0.3391)	0.1967 (0.2648)	-0.1722 (0.3538)	0.0033 (0.2974)
Penalty Occurred 3 Quarters Ago	0.9499 (0.7873)	0.7248 (0.4360)	0.5224 (0.6510)	0.8425 (0.5695)	0.3221 (0.2965)	0.1454 (0.5044)
Penalty Occurred 4 Quarters Ago	1.1771 (0.7430)	0.8395 (0.8287)	0.5177 (0.5026)	1.0875* (0.5060)	0.3562 (0.6015)	0.2768 (0.4448)
Airline Dummies	No	Yes	Yes	No	Yes	Yes
Airline Dummies x Time Trend	No	No	Yes	No	No	Yes
Year-Quarter Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2251	2251	2251	2251	1506	1506
R-squared	0.05	0.12	0.14			
Number of unique carriers		78	78		33	33

Robust standard errors in parentheses

* significant at 5%; ** significant at 1%

Table 2.4. Airlines Exiting the Sample

Airline	Date of Exit	Reason
Eastern	Q4 1990	Bankrupt
Aspen	Q1 1991	Acquired by Air Wisconsin
Midway	Q2 1991	Suspended operations
Pan American World (1)	Q3 1991	Bankrupt
Trans Continental	Q3 1991	Ponzi scheme
Braniff International	Q1 1992	Bankrupt
Key	Q1 1993	Bankrupt
Westair	Q2 1993	Acquired by Mesa
Empire	Q2 1994	Ended passenger service
Morris	Q3 1994	Acquired by Southwest
Private Jet Expeditions	Q3 1994	Bankrupt
Worldwide	Q3 1994	Certificate revoked by the FAA
Markair	Q2 1995	Bankrupt
Evergreen Int'l	Q3 1995	Cargo
Business Express	Q1 1996	Acquired by American
Viscount Air Ser	Q2 1996	Bankrupt
Av Atlantic	Q3 1996	Certificate revoked by the FAA
Rich International	Q3 1996	Certificate revoked by the FAA
Great American	Q4 1996	Certificate revoked by the FAA
Air South	Q2 1997	Bankrupt
Western Pacific	Q3 1997	Bankrupt
Carnival	Q1 1998	Bought by Pan Am, later went bankrupt
Flagship	Q1 1998	Merged into American Eagle
Pan American World (2)	Q1 1998	Bankrupt
Valujet Airlines	Q1 1998	Merged with Air Tran
Kitty Hawk International	Q4 1998	Bought out of bankruptcy by Conrad Kalitta
Kiwi International	Q4 1998	Bankrupt
Sun Pacific International	Q1 1999	Certificate revoked by the FAA
Eastwind	Q2 1999	Bankrupt
Reno Air Inc.	Q3 1999	Acquired by American
Tower Air Inc.	Q3 1999	Bankrupt
Express One International	Q4 1999	Bankrupt
UFS Inc.	Q1 2000	Acquired by American
Pro Air Inc.	Q2 2000	Certificate revoked by the FAA
USAir Shuttle	Q2 2000	Merged into US Airways
Legend Airlines	Q3 2000	Bankrupt
Reeve Aleutian	Q4 2000	Bankrupt
United Parcel Service	Q3 2001	Cargo airline
Trans World	Q4 2001	Bought by American Airlines
Midway	Q2 2002	Bankrupt
National	Q2 2002	Bankrupt
Vanguard	Q2 2002	Bankrupt
Air Transport	Q4 2002	Cargo airline
Pan American	Q1 2004	Bankrupt
Southeast	Q2 2004	Bankrupt
Freedom	Q4 2004	Contracted as Delta Connection
Transmeridian	Q2 2005	Bankrupt

Table 2.4 (cont'd)

Airline	Date of Exit		Reason
Independence	Q4 2005	Bankrupt	
Falcon Air Express	Q1 2006	Bankrupt	

Table 2.5. Type of Early Exit

Bankrupt		34
Acquired out of Bankruptcy	4	
Grounded by the FAA	6	
Acquisition		5
Merger		3
Cargo		4
Other		2
Total		49

Table 2.6. Comparison of Means for Airlines Exiting the Panel Early

Variable	No Early Exit	Early Exit	Difference
revenue	0.558 (0.021)	0.095 (0.007)	**
accidents/departures	29.572 (25.602)	4.117 (2.713)	
incidents/departures	25.985 (25.510)	1.251 (.482)	
annual events	1.666 (0.060)	0.406 (0.040)	**
total injuries/departures	55.557 (36.131)	5.368 (2.802)	
fatalities/passenger	0.150 (0.071)	0.227 (0.176)	
total injuries/passenger	5.765 (4.727)	0.687 (0.289)	
annual injuries	6.725 (0.663)	3.127 (0.925)	**
lawsuits filed	2.813 (0.223)	0.960 (0.173)	**
annual lawsuits filed	11.598 (0.734)	4.126 (0.639)	**
FAA penalty amount	0.018 (0.002)	0.024 (0.015)	
FAA penalty number	0.714 (0.284)	0.393 (0.043)	**
annual FAA penalties	0.076 (0.005)	0.057 (0.019)	
Number of Observations	1960	652	
Number of unique carriers	48	49	

Note: The number of observations for revenue is lower: 1744 for “no early exit” and 620 for “early exit”

Standard errors in parentheses

* significant at 5%; ** significant at 1%

Table 2.7. Regressions of the Probability of Whether Airline Exits the Sample in the Next Quarter

	Total Events		Total Injuries		Enforcement	
Total Events over Prior Year	0.0129 (0.0154)	0.0274 (0.0160)				
Total Injuries over Prior Year			-0.0001 (0.0003)	0.0005* (0.0002)		
Lawsuits Filed over Prior Year					-0.0004 (0.0005)	0.0022** (0.0005)
Penalty Dollars over Prior Year					-0.0782 (0.0481)	-0.0217 (0.0361)
Airline Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Airline Dummies x Time Trend	No	Yes	No	Yes	No	Yes
Year-Quarter Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Observations	557	557	557	557	557	557
R-squared	0.37	0.55	0.33	0.55	0.33	0.56
Number of unique carriers	38	38	38	38	38	38
Robust standard errors in parentheses						
* significant at 5%; ** significant at 1%						

Table 2.8. Regressions of the Probability of Whether an Airline Goes Bankrupt in the Next Quarter

	Total Events		Total Injuries		Enforcement	
Total Events over Prior Year	0.0156 (0.0155)	0.0239 (0.0161)				
Total Injuries over Prior Year			-0.0002 (0.0003)	0.0004 (0.0002)		
Lawsuits Filed over Prior Year					-0.0001 (0.0005)	0.0018** (0.0005)
Penalty Dollars over Prior Year					-0.0535 (0.0567)	-0.0693 (0.0614)
Airline Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Airline Dummies x Time Trend	No	Yes	No	Yes	No	Yes
Year-Quarter Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Observations	501	501	501	501	501	501
R-squared	0.36	0.57	0.36	0.57	0.36	0.57
Number of unique carriers	33	33	33	33	33	33
Robust standard errors in parentheses						
* significant at 5%; ** significant at 1%						

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Chapter Three

DOES THE MARKET PAY ATTENTION TO THE FAA?

Does The Market Pay Attention To The FAA?

3.1. Introduction

Safety in the air transportation industry is based on the creation of effective incentives for airlines to remain safe. Airlines have a strong market incentive to remain safe, as well as a regulatory structure administered by the Federal Aviation Administration (FAA) to promote safety. This paper examines the incentives provided by one of the tools of the FAA, namely, the public announcement of a large civil penalty. While the FAA regularly issues civil penalties, in certain cases the agency also chooses to issue a press release to announce a proposed penalty levied against an airline. The purpose of issuing a press release is to heighten the effect of the monetary loss by alerting the public to problematic behavior on the part of a commercial airline. The FAA states that it expects the publicity of the penalty to be a larger deterrent than the penalty itself (FAA FO 2150.3B, 2007).

In order for a public release to be a deterrent, it must encourage an airline to resolve safety problems and/or provide information to the public about an airline's safety practices. In Chapter 2, *Why Be Safe?*, I found little evidence that FAA penalties have had a substantial effect in encouraging safer practices for the individual airline. In this chapter, I examine the change in an airline's stock price following a public release. Stock prices may decrease if releases cause the public to become concerned about aviation safety. I use 55 press releases from 1998 to 2006 to measure changes in stock prices after a release. I find no statistically significant evidence that penalties act to decrease stock prices for the airline that is the target of a release, above the industry effect.

Previous work also indicates that safety information about one airline has spillover effects on other airlines. Using event-study methodology, Borenstein and Zimmerman (1988), Mitchell and Maloney (1989), and Bosch, Eckard, and Singal (1998) all find decreases in stock value for *other* passenger airlines when one airline experiences a fatal crash.

I use an event study to measure the industry-wide effect on stock prices. The results from the event study in this paper also show a spillover effect. Looking at the cumulative two-day stock return, passenger airlines experience an average decline in stock returns of 0.09 percent following a press release. These results indicate that notifying the press about an FAA enforcement penalty for an airline may have a deterrent effect for the industry as a whole, although the penalty does not seem to have an added deterrent effect on the individual airline. The estimated impact of an enforcement penalty is greatest when it is publicized in a press release and allowed to provide information to the market about the industry.

3.2. Literature Review

The literature on event studies is long and varied. Chapter Two refers to event studies concerned with measuring the effect of fatal accidents on airlines' stock prices. The papers are revisited here since they pertain to the methodology of event studies. Measurements of the market reaction to various corporate events are a common way to ascertain the impact of such events on a firm's finances. Event studies are useful in that they allow researchers to study both the effect of an event on a specific airline and on the industry as a whole. In addition to the studies on fatal accidents, the literature relating to air transportation includes event studies on the effects of airline deregulation, competition in the industry, and the September 11 terrorist attacks.

Shortly after deregulation of the industry in 1978, researchers started to analyze the effect of deregulation announcements on airlines' stock prices to discover whether deregulation had effects on the industry and whether these effects were felt uniformly throughout the industry. These papers consider industry-wide events: deregulation announcements may have differential effects, but it is likely that all airlines will be affected in some way. They employ the standard market model for returns, where an airline's return is benchmarked to the average market return. The abnormal return is calculated as the difference between the actual return and the expected return that is predicted by the market model. For the most part, the consensus is that returns were negative in anticipation of deregulation (Davidson, Chandy and Walker (1984), Vetsuypens and Helmuth (1988), Beneish (1991), and Banker, Das, and Ou (1997)), although two papers found positive abnormal returns under certain conditions (Michel and Shaked (1984) and El-Gazzar and Sannella (1996)).

The central issue of deregulation was whether the addition of price competition would hurt airlines' profitability. Early papers on deregulation measured only the overall effect. Beneish's paper in 1991 refocused attention on measuring a differential effect by type of airline. This difference-in-difference analysis was especially applicable in the concurrent research on competition. Following deregulation, researchers were able to look at this issue directly, by measuring the effect of changes in competition on individual airlines. These event studies identify a specific group of rival airlines likely to experience an increase (or decrease) in competition and measure their abnormal returns. Competition can be increased by new entry (Whinston and Collins (1992)) or by improved efficiency at an airline (Eckel, Eckel, and Singal (1997)) which is shown to hurt rival airlines. Hergott (1997) tells a similar story; a decrease in

competition due to a merger raises fares and generates positive returns for rival regional airlines. The most recent paper to look at market concentration is by Flouris and Swindler (2004), and analyzes the effect of the change on the airline itself. This is in contrast to previous papers that only looked at rivals. Flouris and Swindler found that the market predicted that the merger, announced in January 2001, between American Airlines and a bankrupt, under-capitalized TWA would be negative for American.

Event studies are used to show how market values are affected by changes in the extent of competition in the industry, but this is not their only use. They have also been used to look at the issue of aviation safety. In this case, an event study can measure the effect of a fatal accident on an airline and on the industry. By measuring an industry-wide effect, researchers can determine whether rival airlines benefit following a fatal accident, or whether all airlines lose as customers perceive an increase in the risk from flying. Early work by Chalk (1986) used event-study methodology to measure the effect of fatal accidents on returns for aircraft *manufacturers*. Subsequent work (Borenstein and Zimmerman (1988), Mitchell and Maloney (1989), and Bosch, Eckard, and Singal (1998)) has focused on airlines, rather than manufacturers. In these studies, traditional event-study methodology was used to compare, in first stage, the returns of airlines with a fatal accident to the returns of airlines without a fatal accident. Then, in an additional stage, the abnormal returns were analyzed using cross-sectional analysis. This analysis estimated the amount of the market loss attributed to loss in demand, litigation costs, and increased insurance costs.

Most recently, researchers have turned to the terrorist attacks of September 11, 2001 to measure losses to airlines as a result of perceived safety issues. These papers are similar to those

on fatal crashes in that they use cross-sectional analysis in a second stage to determine what types of airline were most likely to be affected by the terrorist attacks (Gillen and Lall (2003)) and the subsequent bailout by the U.S. government (Carter and Simkins (2004)).

The cross-sectional analysis of abnormal returns provides some insight into the relationship between industry safety and industry market value, but no consensus has been reached in the literature. While Borenstein and Zimmerman do not find that a negative safety shock is transmitted to other airlines, Bosch *et al.*, Gillen and Lall, and Carter and Simkins all estimate significant losses to airlines that are in close competition with the airline experiencing the shock. Furthermore, Mitchell and Maloney argue that fatal accidents in which an airline is not at fault¹⁶ have no effect on market returns. However, all the papers in the literature on the terrorist attacks find that returns for United Airlines and American Airlines suffered significantly more than the returns for other airlines, and that the negative shock was felt by most major international airlines as well.

This lack of consensus highlights some of the limitations of event studies. Event studies that measure abnormal returns in the industry or to an individual airline can answer questions about changes in the market for air travel. However, event studies are not as helpful in measuring the mechanisms that lead to these changes. Cross-sectional analysis on abnormal returns can suffer from a lack of information, and relies on very strong assumptions. There are fewer than 30 publicly traded airlines in the U.S., and few events about which abnormal returns are generated. Consequently, the sample of returns to analyze in a cross-section is small. Additionally, airlines

¹⁶ Mitchell and Maloney define only accidents caused by pilot or maintenance error according to the National Transportation Safety Board as ones where the airline is at fault. Thirty-four of 56 crashes were identified as at-fault.

differ substantially from each other, even when controlling for certain financial or physical characteristics. Assuming that airlines are the same, or that untreated groups of airlines don't change over time, is problematic in an industry dominated by a few major players that grow, merge, go bankrupt, and enter new markets regularly over time.

3.3. Data and Summary Statistics

In this chapter, I use 55 press releases issued by the FAA over the period 1998 to 2006. These press release dates are matched to stock price data from the Center for Research in Security Prices (CRSP).

3.3.1. *FAA Press Releases*

Much of what the FAA does is either not known to the public, or not made public in a timely manner. This limits the ability of the market to incorporate FAA enforcement actions in its forecast of an airline's finances. However, if an airline receives a penalty of over \$50,000, the FAA makes this penalty public in an enforcement report. In special cases, the FAA issues a press release about the enforcement action. The FAA makes the decision to issue a release when the agency feels it is in the public interest (FAA FO 2150.3B, 2007). From 1998 to 2006, the FAA issued 55 of these releases for 28 publicly traded airlines, as shown in Table 3.1.

The stated intention of the FAA to make penalties public is to inform consumers and strengthen deterrence (FAA FO 2150.3B, 2007). The FAA believes "the adverse publicity and concomitant public reaction to regulatory violations serve more effectively to deter future violations by an entity than the loss of funds caused by a civil penalty" (FAA FO 2150.3B, 2007). Thus, the FAA predicts a loss to the company in excess of the civil penalty. I use each of

these press releases as an event to measure the market loss to the airline and the other publicly traded airlines.

3.3.2. Stock Prices

Using stock data from the CRSP, I have compiled a database of 28 airlines—all publicly traded passenger airlines during the period from 20 days before the first event until the day after the last event (January 6, 1998 to January 6, 2006). However, not all airlines are present at every date. A stock can become delisted for many reasons, such as mergers, bankruptcies, or privatization. Table 3.2 shows daily stock prices for each airline in the time period. Prices were relatively high for the airlines in 1998, when they began to decline. Stock returns show this same decline in 1998 in Figure 3.1. Returns during this period were not consistently positive or negative, reflecting the unstable financial conditions for the industry following the September 2001 terrorist attacks, the subsequent periods of bankruptcy (leading to delisting in several cases), and consolidation of the industry. Table 3.3 shows the market capitalization over this time. Southwest Airlines' average market capitalization was the highest, at over \$10.9 billion.

Taken together, we can see that FAA penalties are quite small when compared with the market value of airlines. Penalties below \$1 million are likely to impact only the smallest (or weakest) of carriers. In the next section, I test to see whether press releases about penalties represent information to the market about an airline.

3.4. Results

3.4.1. Airline Price Changes

The first test of whether press releases affect stock prices is given in Table 3.4. This basic test compares the average percentage change in the stock price on the days when there is a press release with the average percentage change on days with no press release. I use the notation that day 0 is the day of a press release; positive numbers are assigned to the subsequent days.

Negative numbers are assigned to the days preceding a release. The first row of Table 3.4 shows the one-day percent change from the day before the release (day -1) to the day of the release (day 0). The second row shows the change between the day before the release (day -1) and the day after (day 1). The sample does show a decline in prices on the day of the release of 0.18%. Given a sample average share price of \$21.54, this represents a loss of approximately \$0.039 per share. For an airline like Comair, which has an average price of \$27.77 and an average market capitalization of \$2.062 billion, this represents a loss of \$2.98 million, which is 7.7 times as large as the average penalty in the sample of \$388,928.

Next, regression analysis is used to test whether a press release affects the stock price of the penalized airline disproportionately, relative to its counterparts. This is done by regressing the percent change in the stock price on a dummy for whether an airline has a press release. The sample is restricted to the 55 dates on which press releases occur and the days surrounding those releases. I estimate the change in price from the day before the release (day -1) to the day of the release (day 0) and from the day before (day -1) to the day after (day 1) using pooled ordinary least squares, as shown in equations (3.1) and (3.2).

$$\left(\frac{p_0 - p_{-1}}{p_{-1}} * 100 \right)_{i,t} = \alpha + \delta_{press\ release}_{i,t} + \beta_{day_t} + \varepsilon_{i,t} \quad (3.1)$$

$$\left(\frac{p_1 - p_{-1}}{p_{-1}} * 100 \right)_{i,t} = \alpha + \delta_{press\ release}_{i,t} + \beta_{day_t} + \varepsilon_{i,t} \quad (3.2)$$

In the equations above, i indexes airlines and t indexes time. The dependent variable in equation 3.1 is the percentage change in the stock price on the day in which a press release occurs (day 0). The dependent variable in equation 3.2 is the percentage change in the stock price from the day before (-1) to the day after. The second equation is necessary if press releases are made later in the day, causing the effect to either spill over or not occur until the day after the release. The regression tests whether the one-day price change is different for the airline that has a press release on that day compared to the price change for the other airlines. One important feature of the FAA data is that releases are made disproportionately on Monday and Tuesday. Figure 3.2 shows a histogram of the number of releases made on each weekday. Over 56% of releases were made on the first two days of the work week; therefore, I include the day of the week as a control variable.

In addition to treating each penalty as unique, I group press releases by the amount of the penalty as shown in the following equations.

$$\left(\frac{p_0 - p_{-1}}{p_{-1}} * 100 \right)_{i,t} = \alpha + \delta_1 quintile\ 1_{i,t} + \delta_2 quintile\ 2_{i,t} + \delta_3 quintile\ 3_{i,t} + \delta_4 quintile\ 4_{i,t} + \delta_5 quintile\ 5_{i,t} + \beta_1 day_t + \varepsilon_{i,t} \quad (3.3)$$

$$\left(\frac{p_1 - p_{-1}}{p_{-1}} * 100 \right)_{i,t} = \alpha + \delta_1 \text{under } \$100,000_{i,t} + \delta_2 \$100,000 \text{ to } \$500,000_{i,t} + \delta_3 \$500,000 \text{ to } \$1\text{million}_{i,t} + \delta_4 \text{over } \$1\text{million}_{i,t} + \beta_1 \text{day}_t + \varepsilon_{i,t} \quad (3.4)$$

In equation 3.3, the penalties are broken out into five quintile bins: under \$71,000 (quintile 1), between \$71,001 and \$90,000 (quintile 2), between \$90,001 and \$231,500 (quintile 3), between \$231,501 and \$601,525 (quintile 4), and greater than \$601,525 (quintile 5). These variables convert the single dummy variable for a press release into five separate dummy variables. Each variable represents the occurrence of a press release associated with a penalty amount in that quintile. Stock price changes are compared for airlines that have no release on that day and for airlines that have a release associated with a certain amount. The same is done by fixed dollar amounts in equation 3.4.

Table 3.5 shows regression results using the day before as the base price. In Table 3.6, the base price is the average stock price over the period of 10 days before the release. For a release of any amount, the point estimates in Table 3.5 are a change of approximately 0.2 percent on the day of the release, and a change of approximately 0.5 percent on the day after the release. However, it is important to note that the coefficients are not statistically significant, failing to meet a ten-percent confidence interval in the one-sided test that the estimates are negative.

These tables also show the penalties broken out by dollar amounts—either using quintile bins (equation 3.3) or fixed dollar bins (equation 3.4). For the most part, the estimates are signed negative. This is consistent with later results showing a negative effect on prices industry-wide. In this case, estimates should be negative, but the lack of statistical significance points to the fact

that airline experiencing the press release does not have an estimated effect different from the rest of the industry.

The point estimates for penalties of the second largest dollar amounts in Table 3.5 are positive, counter to intuition. The point estimates do not show a pattern that higher penalties are more costly. The fourth quintile shows the largest coefficient estimates. For penalties in the fourth quintile range, several hundreds of thousands of dollars, the effect of an additional penalty is associated with a price decline of 1.3%. Using the sample averages again, this is a decline of \$0.28 per share, and \$19.2 million in market capitalization. Using round dollar figures instead of quintiles also leads to estimates of market value losses far in excess of the amount of the penalty itself. In both cases, the estimates on the larger penalties are at times smaller in magnitude than the estimates for penalties in a lower category.

I use an average of ten days before the FAA press release (day -10 to day -1) to reduce the probability that the day before happens to be an outlier for an airline. These results are shown in Table 3.6. The results show an increase the magnitude of the estimates. However, there is little gain in precision, since most of the estimated coefficients are not statistically significant. As in the previous table, no consistent story is told by the estimates when they are broken out by release amount. The estimates are not all signed negative, and they do not increase in magnitude as penalties increase. This seems to confirm the results in Chapter 2 that penalties, even when publicized, do not provide a significant deterrent effect for an individual airline.

Given these results using basic regression methodology, there are a couple of issues that need to be addressed. I cannot control for airline-specific characteristics by including an airline fixed effect, since airlines are the source of identification. In the absence of a fixed-effects

specification, one issue is whether size is a factor. Airlines in the sample have market capitalizations ranging from \$1.7 million to \$16 billion. The large coefficients could be driven by large penalties aimed at small airlines. Other issues may be affecting estimates due to missing controls for airline-specific characteristics.

3.4.2. Industry Price Changes

The results for the effect of FAA press releases on the subject airline do not indicate that the information provided by the release is sufficiently important to have an effect on market values. However, the FAA explicitly states that while unpublished penalties only act as a deterrent for the violator airline, “publicizing the action acts as a deterrent for others similarly situated” (FAA FO 2150.3B, 2007). The FAA hopes to send a negative signal to the industry in addition to the monetary loss at the target airline. This would cause investors to downgrade their views of the industry due to fears regarding the current level of safety.

To determine whether penalties are acting as a signal, I use event-study methodology. This treats each penalty as an event and measures the industry’s stock reaction to the event (benchmarked to the entire market). To obtain the results shown earlier in this chapter, I looked at each press release as an event that happens to a specific airline, and restricted the analysis to the dates when press releases occur. The change in stock price when a press release occurs for a particular airline is compared to the change in stock price for others that do not have a press release. With an event study, I measure the change in return for all airlines on the day of the release, and compare it with expected returns for that day. This allows the sample to include all dates over the time period to compare the change in stock returns when press releases occur

against the change in stock returns on dates when no press releases occur. I use the market model as my specification:

$$R_{i,t} = \alpha_i + \beta_i R_{m,t} + \delta D_t + \varepsilon_{i,t} \quad (3.5)$$

where i indexes airlines, m indexes the market, and t indexes time. The variable R is the return on the stock, calculated as the one-day change in stock price, and D is a dummy for the event. D takes on the value of one on the date of a press release for *all* airlines, and not just the airline that was the subject of the release. The dummy variable *press release* takes on the value of one for the airline to which the press release refers. As before, I disaggregate the dummy variable into dummies for quintiles or for dollar amounts, to reflect the dates of press releases associated with penalties of different sizes. I calculate the abnormal return for each airline as the difference between the actual return and the predicted return estimated by the market model

$(R_{i,t} - [\hat{\alpha}_i + \hat{\beta}_i R_{m,t}])$. This measures the difference between the actual stock price and what the stock price *would have been* if no release had occurred.

I use event windows of 10 days and 20 days. Abnormal returns are calculated for every day in the event windows, from day -10 to day -1 or from day -20 to day -1, respectively. Abnormal returns are calculated for the day of the release, day 0, and cumulative abnormal returns are calculated on the day of the release and the day after (day 1). If the market reacts to the release by lowering the value of airlines, the abnormal return should be negative on day 0 and zero for the days in the event window, on average.

The results are shown in Tables 3.7 and 3.8. The one-day return on any amount of penalty is a very small positive. These coefficients are much smaller than those estimated in Table 3.5 and oppositely signed. This indicates that the market is not able to fully react to the press release on the day of the event, since cumulative returns are negative in Table 3.8. The coefficients estimated in Tables 3.7 and 3.8 are also statistically significant at the one-percent level, whereas the estimates were not statistically significant in Table 3.5. The abnormal return shows an increase of 0.04% or 0.05% with a 20-day window. The increase is equivalent to an average one-day price increase in the range of \$0.009 per share to \$0.011 per share, which is equivalent to an increase in average market capitalization of \$741,000 to \$756,000.

In terms of quintiles, there is no consistent pattern. Quintiles 2 and 3 are signed negative, while quintiles 1, 4, and 5 are signed positive. Intuition would say that if medium-sized penalties send a negative signal to the market, larger penalties should send a negative signal also. The estimates run counter to this intuition. A pattern does emerge when the penalties are broken out by dollar amounts. Penalties under \$100,000 are estimated to have a near-zero effect on abnormal returns, while larger penalties have an increasingly positive effect. The largest measured effect is on penalties between \$500,001 and \$1 million. The estimated price increase is \$0.69 per share, and the estimated market capitalization increase for a typical airline is \$47.4 million. This is consistent with the interpretation that the market sees press releases in a positive light— as an indicator that the FAA is improving safety for the industry, rather than as a negative signal of the current state of safety. However, this result assumes that the market reacts to the information in the press release within one day.

The effect of a press release may not be confined to the day of the release. Depending on the time of the press release, the market may not be able to react to the information until the following day. Table 3.8 shows the cumulative abnormal returns on the subsequent days. Whereas the one-day abnormal return was a very small positive, the two- through five-day returns are all negative. Abnormal returns are increasing in magnitude until the third day, which indicates that the effect has dissipated by day 4. The estimates are all statistically significant at least at the one-percent level.

Using the two-day cumulative return, I estimate the effect of the press releases. Generally, the cumulative returns show a negative signal to the market from press releases. These results are presented in Table 3.9. The average effect of a press release of any amount is a reduction in stock price by 0.06% to 0.09%. This is equivalent to a decrease in the range of \$0.013 per share to \$0.019 per share at the average stock price, and in the range of \$788,000 to \$1.15 million in market capitalization for a typical airline. Unlike the results that were derived by using the one-day abnormal return, these results are consistent across quintiles and dollar amounts. However, it appears that the market does not place differential value on the information based on the amount of the penalty. The coefficient estimates are approximately the same regardless of size, and only one of them is statistically significant. The estimates suggest that the press release does act as the FAA intends by sending a negative signal about the safety level of the industry, although the penalties themselves do not appear to be a substantial deterrent.

3.5. Conclusion

The stated intent of the FAA's civil-penalty program is to act as a deterrent to unsafe practices. One of the central conclusions of this dissertation is that there is little evidence that these civil penalties are large enough to act as a substantial deterrent. In Chapter Two of this dissertation, I find that civil penalties do not have a statistically significant effect on safety events or injuries for an airline. In this chapter, I examine whether civil penalties send a negative signal to the market about the safety level at an airline. For the subset of civil penalties that were publicized by press releases, no consistent evidence emerges that civil penalties provide negative information to the market about an airline.

Although the civil penalties themselves do not appear to be having much of an effect, the act of publicizing higher dollar-amount penalties does seem to send a negative signal to the market. When looking at cumulative abnormal returns for the industry, a more consistent story emerges. The estimates indicate that issuing a press release about a civil penalty sends a negative signal to the market, downgrading prices by 0.06% to 0.09%, on average. To put these figures in context, Borenstein and Zimmerman (1988), Mitchell and Maloney (1989), and Bosch, Eckard, and Singal (1998) estimate a two-day cumulative drop in stock prices of 0.97% to 1.1% following a fatal accident. While civil penalties do not provide as strong a negative signal to the industry as a fatal accident, it does provide some information to the market as to the current level of safety. Thus, the civil penalty program's publicizing of penalties may be one of its strongest tools.

Appendix

Figures and Tables

Figure 3.1. Average Airline Stock Returns Over Time

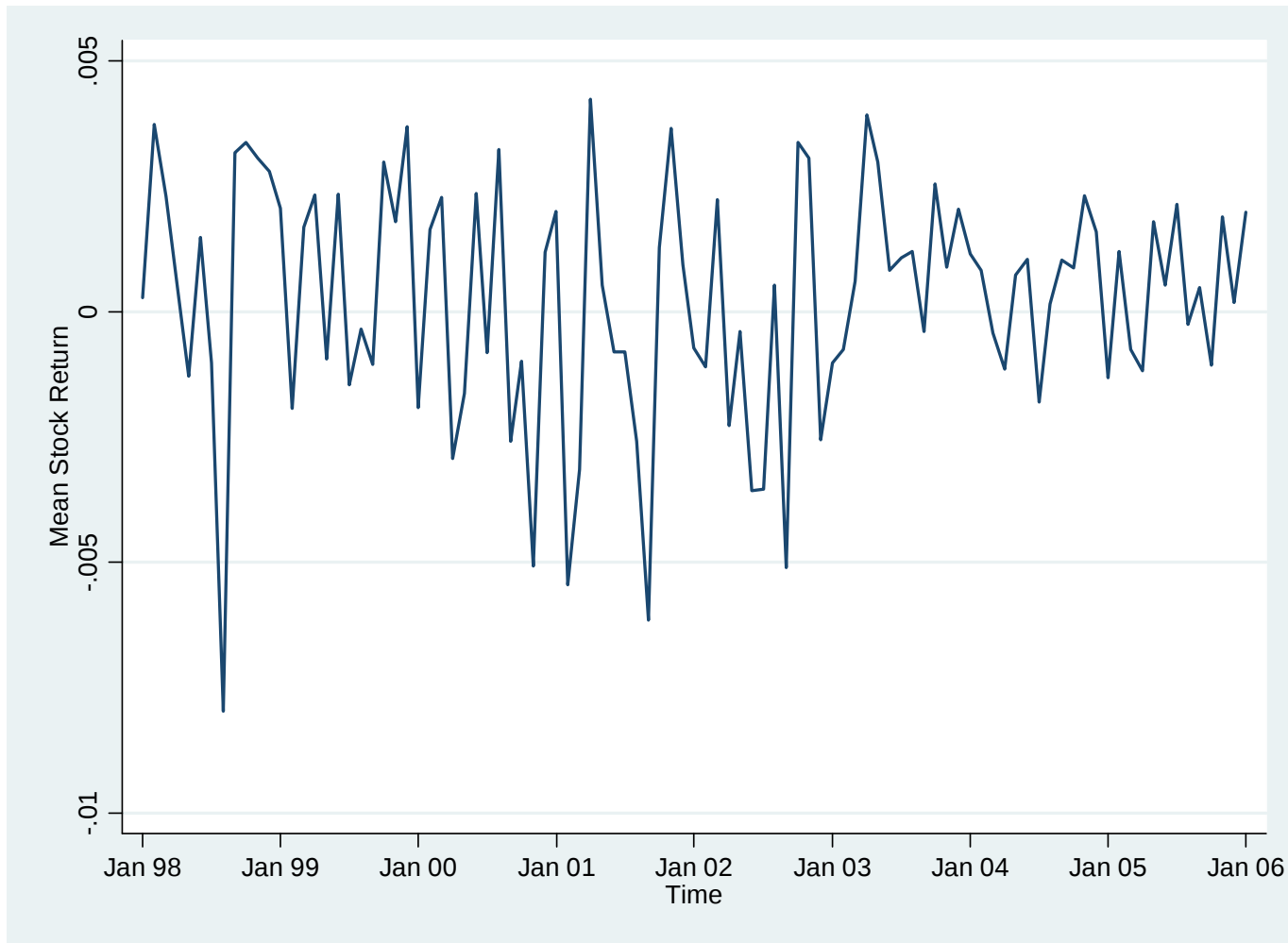


Figure 3.2. Histogram of Press Releases

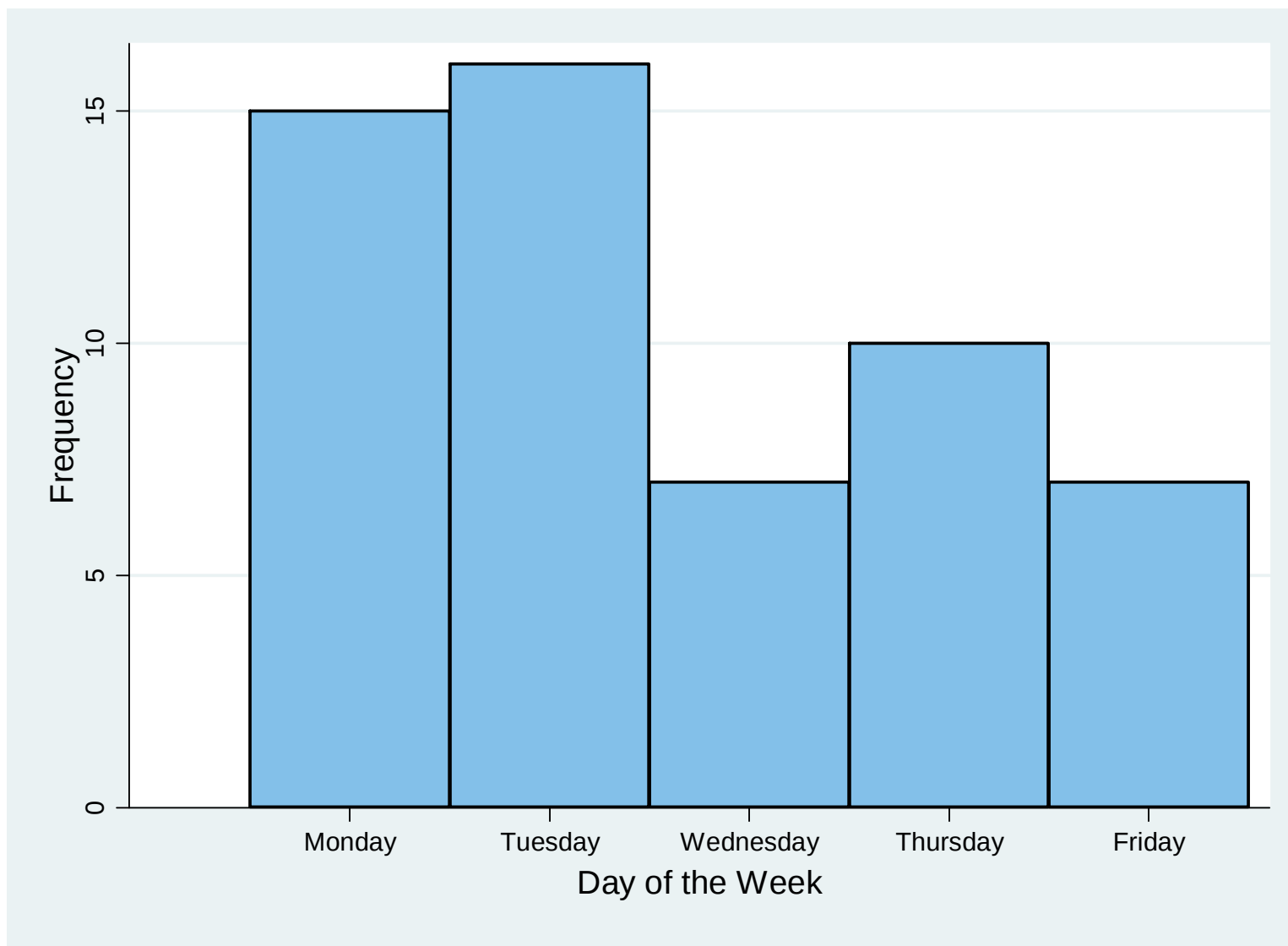


Table 3.1. Press Releases

Date	Airline	Market Capitalization (millions)	Penalty Amount	Percent of Market Capitalization
02/04/98	Mesa Air Lines	223	50,000	0.022%
02/03/98	Tower Air	68	276,000	0.406%
02/20/98	Mesa Air Lines	222	90,000	0.041%
02/23/98	American Airlines	11,545	85,000	0.001%
02/26/98	American Airlines	11,704	60,000	0.001%
05/04/98	Southwest Airlines	5,969	90,000	0.002%
06/25/98	Atlantic Coast Airlines	568	55,000	0.010%
07/14/98	America West Airlines	1,358	2,500,000	0.184%
08/19/98	Midway Airlines	146	70,000	0.048%
12/01/98	Alaska Airlines	1,026	55,000	0.005%
12/11/98	Northwest Airlines	1,839	375,000	0.020%
12/18/98	America West Airlines	668	125,000	0.019%
12/21/98	Northwest Airlines	1,889	233,000	0.012%
12/29/98	American Airlines	10,792	190,000	0.002%
12/29/98	Delta Air Lines	7,175	80,000	0.001%
03/24/99	Atlantic Southeast Airlines	990	397,500	0.040%
05/03/99	Northwest Airlines	2,809	90,000	0.003%
05/19/99	Tower Air	43	50,000	0.116%
05/19/99	World Airways	12	90,000	0.750%
06/01/99	American Airlines	12,258	82,500	0.001%
06/21/99	Northwest Airlines	2,825	80,000	0.003%
07/08/99	American Airlines	11,008	250,500	0.002%
08/31/99	American Airlines	8,825	396,000	0.004%
03/07/00	Southwest Airlines	8,323	90,000	0.001%
03/13/00	American Airlines	8,487	170,000	0.002%
04/27/00	Northwest Airlines	2,074	55,000	0.003%
05/09/00	United Air Lines	3,037	72,000	0.002%
05/26/00	Southwest Airlines	9,513	70,000	0.001%
06/21/00	American Airlines	4,163	698,000	0.017%
07/21/00	American Airlines	4,865	698,000	0.014%
09/21/00	Northwest Airlines	2,242	80,000	0.004%
10/31/00	USAir	2,532	70,000	0.003%
12/04/00	Alaska Airlines	719	988,500	0.137%
02/08/01	Delta Air Lines Inc	5,522	77,000	0.001%
05/01/01	Alaska Airlines	740	211,000	0.029%
06/11/01	USAir	1,608	245,000	0.015%
06/21/01	American Airlines	5,372	1,000,000	0.019%
07/19/01	American Airlines	5,559	285,000	0.005%
07/31/01	American Airlines	5,402	99,000	0.002%
10/22/01	America West Airlines	71	667,050	0.940%
11/06/01	United Air Lines	601	200,000	0.033%
01/29/02	Delta Air Lines Inc	3,898	100,000	0.003%

Table 3.1. Press Releases, (cont'd)

Date	Airline	Market Capitalization (millions)	Penalty Amount	Percent of Market Capitalization
08/20/02	United Air Lines	180	1,500,000	0.833%
11/04/02	Frontier Airlines	192	200,000	0.104%
11/11/02	Northwest Airlines	603	230,000	0.038%
12/02/02	United Air Lines	217	805,000	0.371%
04/28/03	Delta Air Lines Inc	1,545	60,000	0.004%
06/01/04	American Airlines	1,812	2,500,000	0.138%
06/07/04	Atlantic Coast Airlines	281	1,500,000	0.534%
04/01/05	Southwest Airlines	10,973	107,500	0.001%
07/21/05	Atlantic Coast Airlines	36	1,500,000	4.167%
01/05/06	Alaska Airlines	986	500,000	0.051%

Table 3.2. Summary Statistics for Daily Stock Prices, January 1998 to January 2006

	Observations	Mean Price	Minimum Price	Maximum Price	Standard Deviation	Coefficient of Variation
Alaska Airlines	795	33.20	14.11	62.50	10.66	0.32
America West Airlines	774	12.82	1.20	31.31	7.82	0.61
American Airlines	795	44.80	2.10	162.00	35.35	0.79
ATA Airlines	732	14.99	3.20	27.50	6.60	0.44
Atlantic Coast Airlines	774	24.14	0.73	62.50	11.29	0.47
Atlantic Southeast Airlines	194	37.96	27.13	50.00	5.12	0.13
Comair	261	27.77	18.38	43.00	5.46	0.20
Continental Airlines	1,031	37.55	3.65	64.63	15.18	0.40
Delta Air Lines	774	51.00	3.38	142.19	34.66	0.68
Expressjet	203	11.22	7.61	16.15	1.77	0.16
Frontier Airlines	795	11.57	1.88	36.25	6.60	0.57
Hawaiian Airlines	795	2.93	0.45	7.03	0.92	0.31
Jetblue Airways	207	31.85	14.43	50.30	10.49	0.33
Mesa Air Lines	795	7.37	2.71	12.50	1.98	0.27
Mesaba Airlines	795	12.58	4.54	34.00	6.56	0.52
Midway Airlines	527	9.51	2.75	21.63	5.81	0.61
Midwest Airlines	795	20.58	1.29	49.81	11.59	0.56
Northwest Airlines	774	24.55	4.13	61.25	12.83	0.52
Reno Air	152	6.79	4.56	8.38	0.97	0.14
Skywest	795	28.59	10.25	59.94	10.30	0.36
Southwest Airlines	795	21.73	11.60	35.13	6.40	0.29
Tower Air	261	3.16	1.53	6.63	1.17	0.37
Trans World Airlines	429	5.29	1.33	13.44	3.30	0.62
United Air Lines	686	48.25	1.71	94.50	26.41	0.55
USAir	671	36.76	1.46	81.63	21.77	0.59
Valujet Airlines	795	6.29	2.63	16.78	2.90	0.46
Vanguard Airlines	559	1.95	0.35	7.25	1.47	0.75
World Airways	935	2.08	0.13	13.80	2.56	1.23
Sample	17,660	21.54	0.13	162.00	20.80	0.97

Table 3.3. Market Capitalization (in Millions) by Airline, January 1998 to January 2006

	Mean Market Cap	Minimum Market Cap	Maximum Market Cap
Alaska Airlines	827	375	1,393
America West Airlines	501	39	1,401
American Airlines	6,562	328	16,274
ATA Airlines	178	38	326
Atlantic Coast Airlines	602	36	1,309
Atlantic Southeast Airlines	1,128	801	1,496
Comair	2,062	1,544	2,792
Continental Airlines	1,593	237	3,252
Delta Air Lines	5,599	486	10,770
Expressjet	673	437	1,034
Frontier Airlines	261	17	677
Hawaiian Airlines	108	13	209
Jetblue Airways	2,003	1,270	3,015
Mesa Air Lines	229	87	411
Mesaba Airlines	238	92	549
Midway Airlines	90	41	185
Midwest Airlines	276	20	520
Northwest Airlines	2,160	360	6,357
Reno Air	73	48	89
Skywest	984	316	1,920
Southwest Airlines	10,876	5,297	16,240
Tower Air	48	24	102
Trans World Airlines	296	93	684
United Air Lines	2,613	97	5,437
USAir	2,998	76	8,235
Valujet Airlines	444	170	1,474
Vanguard Airlines	26	9	55
World Airways	28	2	328
Sample	1,728	2	16,274

Table 3.4. Summary Statistics for Stock Price Changes

Percent Change in Stock Price	No Press Release		Press Release		Difference
	Observations	Mean	Observations	Mean	
Day of Release	1,145	0.012% (0.135)	55	-0.180% (0.749)	0.192% (0.636)
Day After Release	1,144	0.534% (0.197)	55	0.019% (0.694)	0.515% (0.912)

Table 3.5. Regressions Measuring One-Day Price Change for an Airline

	Day of Release (%)	Day After Release (%)	Day of Release (%)	Day After Release (%)	Day of Release (%)	Day After Release (%)
Any Amount	-0.1829 (0.5176)	-0.5081 (0.6694)				
Quintile 1			1.3617 (0.8469)	1.1133 (0.9754)		
Quintile 2			-1.6910 (0.9003)	-2.0994* (0.8929)		
Quintile 3			-1.5537 (1.3763)	-1.6075 (1.5892)		
Quintile 4			-1.3270** (0.2674)	-2.4434 (1.3144)		
Quintile 5			2.3101 (2.7074)	2.5433 (1.5649)		
Under \$100,000					-0.3238 (0.6365)	-0.6156 (0.6512)
Between \$100,001 and \$500,000					-1.2902 (0.8340)	-2.0765 (1.3713)
Between \$500,001 and \$1,000,000					4.0635 (5.1115)	4.1854 (3.5697)
Over \$1,000,000					-1.4057 (1.0527)	-1.2677 (1.1755)
Constant	-1.4396** (0.2920)	-1.5183** (0.3161)	-1.4814** (0.2997)	-1.5601** (0.3238)	-1.4565** (0.3006)	-1.5363** (0.3196)
Days of the Week	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1200	1199	1200	1199	1200	1199
R-squared	0.0232	0.0268	0.0293	0.0309	0.0290	0.0305
Robust standard errors in parentheses						
* significant at 5%; ** significant at 1%						

Table 3.6. Regressions Measuring the Price Change Averaged Over the Ten Previous Days for an Airline

	Day of Release (%)	Day After Release (%)	Day of Release (%)	Day After Release (%)	Day of Release (%)	Day After Release (%)
Any Amount	-0.2160 (1.0989)	-0.4930 (1.2768)				
Quintile 1			4.9919 (3.1678)	4.7211 (3.0601)		
Quintile 2			-0.9789 (1.4512)	-1.3740 (1.2925)		
Quintile 3			-0.4148 (2.4819)	-0.4539 (2.6917)		
Quintile 4			- 3.1029** (0.7272)	-4.2355** (1.3115)		
Quintile 5			-1.5188 (1.6864)	-1.0343 (2.6385)		
Under \$100,000					1.7054 (1.8324)	1.4068 (1.7601)
Between \$100,001 and \$500,000					-1.5937 (1.5019)	-2.3688 (1.8353)
Between \$500,001 and \$1,000,000					-2.2222** (0.7008)	-1.7607 (1.1023)
Over \$1,000,000					-1.6599 (2.7584)	-1.5246 (2.8636)
Constant	-1.4017* (0.5378)	-0.7985 (0.6254)	-1.5119* (0.5666)	-0.7761 (0.6203)	-1.4449* (0.5413)	-0.7714 (0.6263)
Days of the Week	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1197	1196	1197	1196	1197	1196
R-squared	0.0150	0.0239	0.0208	0.0288	0.0175	0.0258
Robust standard errors in parentheses						
* significant at the 5% level; ** significant at the 1% level.						

Table 3.7. Market Model Regressions Measuring Industry Price Changes

	10-Day Window	20-Day Window	10-Day Window	20-Day Window	10-Day Window	20-Day Window
Market Return (Beta)	1.1638** (0.0070)	1.1481** (0.0077)	1.1637** (0.0072)	1.1478** (0.0069)	1.1640** (0.0069)	1.1482** (0.0069)
Any Amount	0.0004** (0.0000)	0.0005** (0.0001)				
Quintile 1			0.0014** (0.0001)	0.0018** (0.0001)		
Quintile 2			-0.0009** (0.0001)	-0.0008** (0.0001)		
Quintile 3			-0.0014** (0.0001)	-0.0013** (0.0001)		
Quintile 4			0.0006** (0.0002)	0.0007** (0.0003)		
Quintile 5			0.0017** (0.0002)	0.0019** (0.0002)		
Under \$100,000					-0.0001** (0.0000)	0.0000 (0.0000)
Between \$100,001 and \$500,000					0.0005** (0.0001)	0.0006** (0.0001)
Between \$500,001 and \$1,000,000					0.0032** (0.0001)	0.0032** (0.0001)
Over \$1,000,000					0.0004* (0.0002)	0.0005* (0.0002)
Constant	0.0012** (0.0001)	0.0010** (0.0001)	0.0013** (0.0001)	0.0010** (0.0001)	0.0011** (0.0001)	0.0010** (0.0001)
Days of the Week	Yes	Yes	Yes	Yes	Yes	Yes
Observations	10,270	17,894	10,270	17,894	10,270	17,894
R-squared	0.7124	0.7244	0.7135	0.7250	0.7133	0.7248
Robust standard errors in parentheses						
* significant at 5%; ** significant at 1%						

Table 3.8. Cumulative Abnormal Returns

	10-Day Window	20-Day Window
Two-Day Return	-0.0009** (0.0004)	-0.0006** (0.0004)
Three-Day Return	-0.0021** (0.0004)	-0.0015** (0.0004)
Four-Day Return	-0.0024** (0.0004)	-0.0018** (0.0003)
Five-Day Return	-0.0015** (0.0004)	-0.0007 (0.0004)
* significant at 5%; ** significant at 1%		

Table 3.9. Cumulative Abnormal Returns Over Two Days

	10-Day Window	20-Day Window	10-Day Window	20-Day Window	10-Day Window	20-Day Window
Any Amount	-0.0009** (0.0004)	-0.0006** (0.0004)				
Quintile 1			-0.0008 (0.0007)	-0.0005 (0.0008)		
Quintile 2			-0.0008 (0.0007)	-0.0005 (0.0008)		
Quintile 3			-0.0008 (0.0008)	-0.0005 (0.0009)		
Quintile 4			-0.0008 (0.0029)	-0.0005 (0.0032)		
Quintile 5			-0.0008 (0.0007)	-0.0005 (0.0008)		
Under \$100,001					-0.0008* (0.0005)	-0.0005 (0.0005)
Between \$100,001 and \$500,000					-0.0008 (0.0006)	-0.0005 (0.0006)
Between \$500,001 and \$1,000,000					-0.0008 (0.0009)	-0.0005 (0.0008)
Over \$1,000,000					-0.0008 (0.0010)	-0.0005 (0.0011)
Days of the Week	Yes	Yes	Yes	Yes	Yes	Yes
* significant at 5%; ** significant at 1%						

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