Liquidation Values and the Credibility of Financial Contract Renegotiation: Evidence from U.S. Airlines*

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Abstract

We examine how liquidation values and firm cash flows affect the credibility of financial contract renegotiation and its outcome. We develop an incomplete-contracting model of financial contract renegotiation and estimate it using data on the airline industry in the United States. We find that airlines successfully renegotiate their lease obligations down when their financial position is sufficiently poor, and when the liquidation value of their fleet is low. Our results show that strategic renegotiation is common in the airline industry. Moreover, the results emphasize the importance of the incomplete contracting perspective to real world financial contract renegotiation.

Introduction

The control rights that financial contracts provide over firms' underlying assets play a fundamental role in the incomplete contracting literature. In particular, the defining characteristic of debt contracts is the fact that they provide creditors the right to possess assets when firms default on promised payments (see e.g. Aghion and Bolton (1992), Bolton and Scharfstein (1996), Hart and Moore (1994), Hart and Moore (1998), and Shleifer and Vishny (1992)). The threat of asset liquidation then provides incentives to debtors to avoid default. Thus, in the incomplete contracting literature, asset liquidation values play a key role in the ex-post determination of debt payments. When liquidation values are low, debtors bargaining position improves vis-à-vis creditors, and all else equal, debt payments tend to decrease.

However, there is little empirical evidence analyzing the ability of firms to renegotiate their financial liabilities, and the role asset values play in such renegotiations. Previous research has analyzed some of the implications of the incomplete contracts approach for financial contracting (Kaplan and Stromberg (2003), Benmelech (2006), Benmelech, Garmaise and Moskowitz (2005), and Bergman and Nicolaievsky (2006)). However, there is no empirical analysis of ex-post financial contract renegotiation which is the essence of the incomplete contracts literature. This paper attempts to fill this gap. We develop a simple incomplete-contracts renegotiation model, and document empirically the conditions under which airlines renegotiate aircraft leases in the United States. We find that publicly traded airlines often renegotiate their lease contracts. Furthermore, aircraft lease renegotiations take place when both liquidation values and cash flows are low as predicted by our theoretical model.

Aircraft leases are a natural environment for testing renegotiations-based models. While the incomplete contracts literature focuses on debt contracts and assumes that creditors have the right to seize an asset if the debtor fails to make a promised payment, the automatic stay provision of the bankruptcy code protects debtors from collection activities that include foreclosures and repossessions. In contrast, in bankruptcy lessors are relieved from the automatic stay provision that affect most other creditors and thus have the ability to take possession of their assets if a firm defaults on its lease payments. Section 1110 of the bankruptcy code allows aircraft lessors to seize assets if 60 days after the Chapter 11 filing the lessee has not cured all defaults.[1]

[1] See for example Jacob (2003), Pulvino (1998), and Eisfeldt and Rampini (2006)

We begin our analysis by developing a theoretical model of contract renegotiation. To determine the credibility of firms' threat to renegotiate pre-existing financial contracts, we follow Bergman and Callen (1991) in explicitly modeling the renegotiation process between the firm and its liability holders. Our model has two testable implications. First, firms will be able to renegotiate their financial commitments only when their financial situation is sufficiently poor. Intuitively, when firms are doing well and future prospects are good, their threat to default on payments will not be credible. Defaulting involves a transfer of assets to creditors, and since the assets are necessary for ongoing firm activity, this would involve a large opportunity cost in foregone value. The second testable implication of the model is that when a firm's financial position is sufficiently poor – so that it can credibly renegotiate its financial commitments – a reduction in the liquidation value of the assets increases the concessions that the firm obtains in renegotiation. Thus, the positive relation between liquidation values and post-renegotiation firm payments to creditors predicted in Hart and Moore (1998) should be concentrated during times when firms are doing poorly.

As motivational evidence, we begin by providing a short case study which describes American Airlines's renegotiation of lease contracts subsequent to its takeover of TWA in January of 2001. We show that American substantially reduced lease payments on aircraft previosuly owned by TWA, and estimate the present value of the cost reductions due to lease renegotiation at 48 percent. Evidence from the period suggests that American could successfuly renegotiate the lease payments because of TWA's dire financial position and because of American's credible threat to reject TWA's leases and return the aircraft to lessors. This would result in a massive glut in the aircraft market which would naturally harm lessors in their search to find new operators for the returned aircraft.

We proceed by empirically analyzing renegotiation of leases amongst U.S. airlines. We collect data on all publicly traded, passenger-carriers and construct a dataset which includes information about expected and actual lease payments, and fleet composition by aircraft type. In addition, we construct four different measures of the ease of overall redeployability of an airline's leased aircraft. For example, according to one measure, an airline's fleet is more redeployable if there is a larger number of airlines which operate aircraft of similar type to the aircraft in the airline's fleet. Fleet redeployability serves as a proxy for the value of the outside option that lessors have when a lessee fails to make a promised payment, and hence as a proxy for liquidation values.

The results from the empirical analysis are consistent with our model. Since the model predicts that firms will be able to credibly renegotiate their lease payments only when their financial situation is comparatively poor, we focus on years in which an airline has a negative cash flow. We then examine how negative cash flow combined with the redeployability of the fleet affect lease renegotiation. As the model predicts, lease payments are reduced during periods of negative cash flows. Our regression analysis suggest that during years of negative cash the average ratio of an airline's actual lease payment to its previous years minimum expected lease payment is reduced by approximately nine percentage points as compared to years when cash flow is positive, after controlling for changes in the fleet size and its composition.

The results further show that, as predicted by our model, the ability to reduce payments due to low liquidation values is concentrated during periods of poor financial performance, when airlines' credibility to renegotiate is relatively high. This effect is also sizeable. During periods of negative cash flow, a one standard deviation decrease in the aircraft redeployability measure decreases an airline's lease payment by 8.9 percent as compared to its minimum expected lease payment. Our evidence is thus supportive of the ability of firms' to strategically renegotiate their obligations during periods of negative cash flow, insofar as firm payments are reduced when lessors' outside options deteriorate. In contrast, during periods of positive cash flow increased redeployability is either unrelated or slightly negatively related to lease payments, depending on the specification.

We supplement our analysis by studying airline bankruptcies. We use years in which an airline is in bankruptcy as a proxy for periods in which airlines can credibly renegotiate their lease payments. Consistent with our previous results, during bankruptcy, airlines appear to succeed in reducing lease payments. For example, while the average ratio of the actual lease payments to expected minimum lease payments is 1.05, bankrupt firms exhibit a ratio of only 0.71, indicating a 32.4 percent reduction in actual lease payments as compared to promised minimum lease payments. Regression analysis confirms this result. The average ratio of an airline's actual lease payment to its previous year's minimum expected lease payment is reduced by approximately 20 percentage points when a firm is in bankruptcy. Finally, as the model suggests, the ability of airlines to lower their lease payments when their fleets are less redeployable is concentrated in those years in which firms are in bankruptcy.

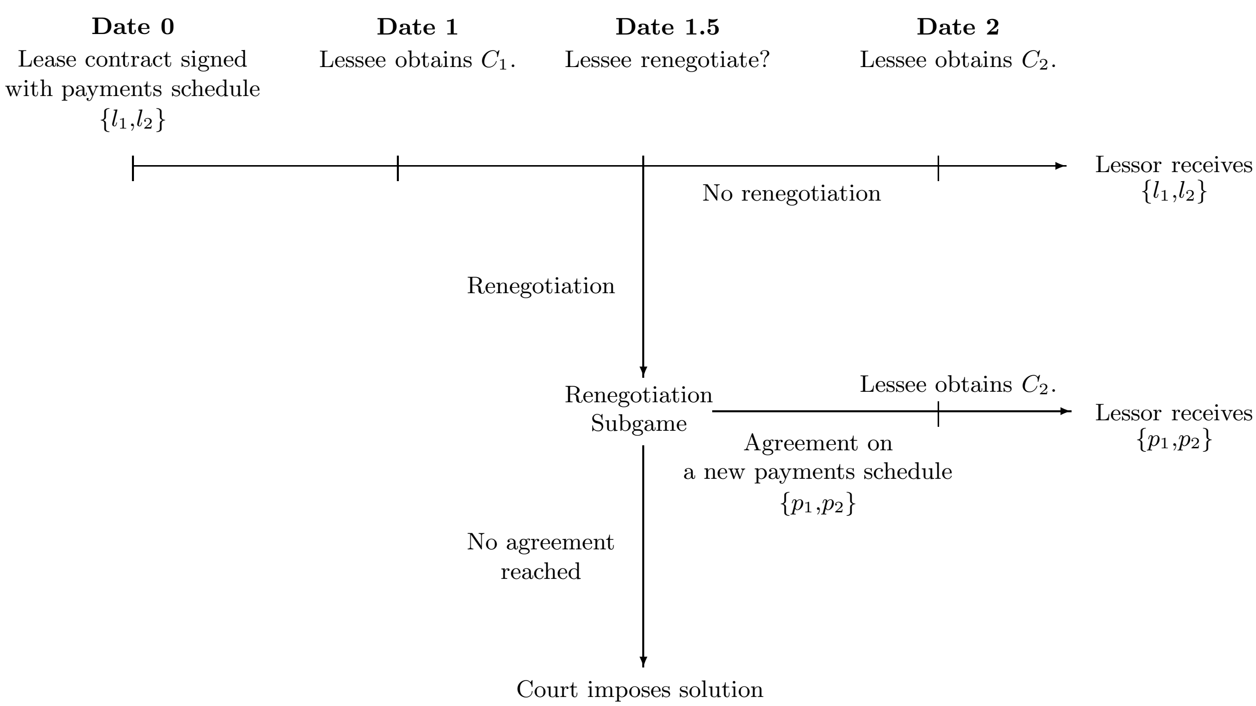
The rest paper is organized as follows. Section I analyzes a simple liability-renegotiation model. A case study that analyzes the acquisition of TWA by American Airlines in 2001 is presented in section II. Section III provides a description of our data sources and summary statistics. Section IV describes the empirical analysis. Section V concludes.

I. The Model

In this section, we develop a model of financial contract renegotiation. Our main goals are to analyze the conditions under which a firm can credibly commit to renegotiate its liabilities with outside claimholders, and to analyze the payoffs to parties conditional on renegotiation occuring. In doing so, we depart from Hart and Moore (1998) by assuming that cash flows cannot be expropriated by firm insiders. Furthermore, in order to assess the credibility of renegotiation, we follow Bergman and Callen (1991) in explicitly modeling the renegotiation process between the firm and its liability holders. Our model is also related to Baird and Picker (1991) who study bargaining between a secured creditor and a debtor in bankruptcy.

In describing the model, we refer to the liabilities of the firm as leases. This is solely for consistency with the empirical section. The model is equally applicable to other forms of liabilities – such as debt or asset-backed receivables – where firms owe contractually specified payments to a claimholder, who upon breach of contract has the right to repossess collateral.

A. The Project Timeline and Assumptions



B. Setup

Consider a firm (The "Lessee") which has entered a contract to lease an asset for 2 periods from a Lessor. The contract stipulates that the Lessee will pay the Lessor l_1 in period 1, and l_2 in period 2. The Lessee will be using the asset to generate cash flow C_1 in period 1, and C_2 in period 2. We assume that these cash flows are not expropriatable by the firm.[2] At the end of period 1, the market value of the asset if liquidated is L, while at the end of period 2, this value collapses to zero. We assume that $L < C_2$, so that liquidation at $t = 1$ is inefficient.

The evolution of the game is as follows. In period 1 the Lessee decides whether to pay l_1 or instead to trigger renegotiation of the lease contract. To understand the credibility of the threat to renegotiate, we explicitly model the renegotiation process between the Lessor and the Lessee as a bargaining game in which the two parties engage in a series of alternating offers as in Rubinstein (1982). Without loss of generality, we assume that the Lessee makes the first offer in the game.

Between each successive round of offers, the value of the second period cash flow declines by an infinitesimal amount. Bargaining is therefore costly for the firm. This cost can be thought of as arising from the lack of optimal management during the bargaining period, or more broadly, as costs similar to those arising in financial distress. At any point during the bargaining process, if either party accepts an offer of its counterpart, bargaining ends and a new contract is signed with the agreed upon repayment schedule. Alternatively, if renegotiation is unsuccessful in that the second period cash flow has dwindled down to zero while neither party has agreed to an offer of its counterpart, a solution, to be described below, is imposed by a court.

Although cash flows cannot be expropriated, under certain conditions, the Lessee will still be able to successfully renegotiate lease contracts and pay less than the original stipulated obligation. This is because of the fact that in our setting contracts are incomplete in that, first, they cannot ban renegotiation, and second, they cannot ban managerial actions which during renegotiation lead to efficiency loss.[3] Thus, the lessee *can* credibly threaten to destroy future cash flow during the renegotiation process, and thereby deprive both parties of future benefits. It is this threat which allows the Lessee to extract benefits during renegotiation.

[2] As in most models of debt renegotiation we have implicitly assumed that the asset was financed through the use of a fixed obligation such as a lease or a debt contract instead of through the use of equity. This choice can be thought of as resulting from a variety of agency costs asscoiated with equity.

[3] The assumption that the existence of renegotiation is not verifiable is common in the incomplete contracting literature (for a discussion see Chapter 4 of Hart 1995).

For simplicity we assume that the court imposed solution attempts to provide full restitution to the Lessor.[4] According to this: (i) The Lessor repossesses the assets and can therefore sell the asset for L, and, in addition (ii) the court orders the Lessee to pay the Lessor damages $D = min\{C_1, l_1 + l_2 - L\}$.[5] This amount of damages guarantees that the Lessor obtains as payoff either the full promised scheduled payments, or the entire cash balance which the Lessee possesses at time 1 as well as the value L of the assets.

Finally, we allow the Lessee to cover period 1 lease obligations by raising capital against period 2 cash flow. In doing so, we assume that any incremental securities issued at t=1 are junior to pre-existing obligations. Also, for simplicity, we assume that the Lessee cannot pay out a dividend until all lease obligations are fulfilled. Our main results are robust to these two assumptions, although both can be seen as standard covenants arising endogenously in an optimal contract between the Lessor and the Lessee.[6]

As an alternate setting, we could follow Hart and Moore (1994) and assume that the firm's CEO has human capital which is crucial for the project, and can thus extract rents from lessors by threatening to leave the firm. Renegotiation payoffs would then be determined by Nash bargaining. The advantage of explicitly modeling the renegotiation process as an alternating offer game is that it allows us to determine the credibility of the renegotiation threat using the Subgame Perfect Equilibrium solution, thereby justifying the Nash bargaining payoffs. Put differently, without explicitly modeling the renegotiation game, it is not clear why lessors could not simply ignore the CEO's threat, essentially "calling his bluff" under the understanding that the CEO would never actually leave the firm.[7]

C. Contract Renegotiation, Liquidation Values and Cash Flows

In this section we solve for the subgame perfect equilibrium (SPE) of the game to analyze the conditions for contract renegotiation and the payoffs obtained therein. Using backward induction,

[4] The law allows a lessor to sue a lessee for damages upon breach of contract. While full restitution is not guaranteed, our results are robust to other forms of court awarded damages. For an introduction to Leasing law, see Whaley (2005)

[5] In the event that the liquidation value, L, is greater than $l_1 + l_2$ damages are assumed to be zero. This case, however, is not interesting, as it is clear that it will involve no renegotiation.

[6] Essentially, both provisions serve to increase the Lessee's pledgeable income. In a more complex model which includes agency costs such as a managerial private benefit from continuation, these covenants may no longer be optimal (For an example, see Hart and Moore (1994)).

[7] Appendix A of Hart and Moore (1994) presents a model in which, while parties disagree on the division of surplus, cash flows to the firm equal zero, and shows that the SPE of the game approximates the Nash bargaining outcome in continuous time.

we begin by solving for the SPE of the subgame beginning after the Lessee has decided to trigger renegotiation. In doing so, we need only consider the case when $C_1 + L < l_1 + l_2$. When this inequality does not hold, the lessee clearly never triggers renegotiation since the lessor can obtain *full* repayment through the court imposed solution.

Lemma 1. *Assuming that $C_1 + L < l_1 + l_2$, then in the SPE of the subgame that begins after the Lessee triggers renegotiation, the Lessee immediately offers the Lessor a new schedule of payments (p_1, p_2) with $p_1 + p_2 = C_1 + \frac{1}{2}(C_2 + L)$ and $p_1 \leq C_1$. The Lessor accepts the offer, so that payoffs to the parties as follows: The Lessee obtains $\frac{1}{2}(C_2 - L)$, and the Lessor obtains $C_1 + \frac{1}{2}(C_2 + L)$.*

Proof. *Lemma 1 is a particular example of a standard result in alternating offers games (see e.g. Rubenstein 1982) which shows that under certain conditions, the axiomatic Nash bargaining solution coincides with the subgame perfect equilibrium of the alternating offer game. For a formal proof, see the Appendix.*

Since the game assumes complete information, in the subgame perfect equilibrium the two parties immediately reach agreement. Also, as would be expected, since the outside option of the Lessor is increasing in L, assuming that renegotiation occurs, the Lessor is worse off and the Lessee is better off when L decreases.

Having calculated the payoffs from renegotiation, Proposition 1 identifies when the Lessee will choose to trigger renegotiation, rather than abide by the initial lease payment schedule.

Proposition 1. *The subgame perfect equilibrium of the game is characterized by the following two cases:*

(a) If $C_1 + C_2 < l_1 + l_2$, the Lessee always renegotiates the contract.

(b) If $C_1 + C_2 \geq l_1 + l_2$ the Lessee renegotiates the contract when

$$C_1 + \frac{1}{2}(C_2 + L) < l_1 + l_2, \tag{1}$$

Otherwise, the Lessee abides by the original contract, raising capital at $t = 1$ if necessary.

In all cases, if renegotiation occurs, payoffs to the parties are as in Lemma 1. If renegotiation does not occur, the Lessee obtains $(C_1 + C_2) - (l_1 + l_2)$ and the Lessor obtains $(l_1 + l_2)$.

Proof. If the lessee is in financial distress in that $(C_1 + C_2) < (l_1 + l_2)$, he will obviously choose to renegotiate and obtain a strictly positive payoff rather than abide by the original contract and obtain a payoff of zero. In contrast, when the Lessee is not in financial distress, he will trigger renegotiation when his payoff from doing so, $\frac{1}{2}(C_2 - L)$, is greater than his payoff from abiding by the contract $(C_1 + C_2) - (l_1 - l_2)$, which can be rearranged to yield Equation 1. If renegotiation does not occur and $C_1 < l_1$, the only way to pay l_1 at t=1 is by raising additional capital against t=2 cash flow. This is feasible, however, since case (b) has $C_1 + C_2 > l_1 + l_2$. □

The intuition behind Proposition 1 is that the Lessee can credibly renegotiate the initial contract when C_1, C_2 and L are small enough compared to the contractually specified payment $l_1 + l_2$. First, all else equal, when L or C_1 are small, the Lessee's effective bargaining position is high, since the Lessor's outside option – to sell the repossessed asset for L and seize the period one cash flow C_1 – is not very attractive. The Lessee can thus credibly commit to trigger renegotiation, knowing that by doing so, the Lessor will accept a more favorable payment schedule. Similarly, the Lessee can credibly commit to renegotiate the lease contract only if C_2 is sufficiently low. This is because the Lessee's ability to obtain concessions from the Lessor stem from the Lessee's willingness to accept the destruction of the firm's future earnings prospects during renegotiation, and in so doing, harm the firm's ability to repay the Lessor. However, if C_2 is too high, the Lessee's threat to accept future cash flow destruction is not credible, since in order to harm the firm's ability to repay the Lessor, the Lessee would need to destroy a large fraction of the firm's future earnings prospects. The Lessee would thus prefer instead to simply pay the prespecified lease payments.

Figure 1 exhibits the Lessee's renegotiation choice in (C_1, C_2) space. In area A, the firm is in financial distress $(C_1 + C_2 < l_1 + l_2)$, and hence, as stated in Proposition 1, can easily credibly renegotiate lease payments to obtain a positive payoff. In area B of Figure 1 the firm is not in financial distress and condition (1) holds. Thus, because C_1, C_2 and L are small enough compared to the initialy specified contract payment $l_1 + l_2$ the Lessee can credibly renegotiate a new, reduced payment schedule.[8] Intuitively, although the firm is *not* in financial distress, its financial position is poor enough to allow the Lessee to credibly renegotiate lease payments. Finally, in area C, prespecified lease payments are relatively small compared to both the liquidation value, L, and current and future firm cash flows. Thus, in this area the Lessee cannot credibly trigger renegotiation, and instead, abides by the originally signed contract.

The model thus generates two sets of predictions:

[8] It is easy to see that whenever $l_1 + l_2 > L$ there exists C_1 and C_2 for which, although the Lessee is not in financial distress, strategic renegotiation occurs.

Prediction 1. *All else equal, the credibility of contract renegotiation, and hence its likelihood, will decrease with the Lessee's current and future cash flow.*

Prediction 2. *Firms' ability to renegotiate down their lease payments when liquidation values are low will be concentrated during periods of relatively poor financial performance.*

Both predictions are a direct result of Proposition 1. First, when C_1 and C_2 are relatively high, condition (1) will not hold and so the firm will not be able to credibly threaten to renegotiate its contracted lease payments. Put differently, as Prediction 1 states, firms will be able to renegotiate financial contracts only when their financial condition is sufficiently poor. Prediction 2 states that firms will be able to renegotiate and lower their lease payments when the liquidation value of their assets, L, decreases, but that this effect will be concentrated in times when firms' financial position is relatively poor because only then can firms credibly renegotiate their payments. Figure 2 provides an illustration of this effect, plotting the sum of the firm's realized lease payments as a function of its liquidation value for different values of $C_1 + C_2$. When $C_1 + C_2$ is sufficiently high – formally, when $C_1 + 0.5 * C_2 > l_1 + 0.5 * l_2$ – the firm can never credibly renegotiate its lease contract, and so realized lease payments are independent of L. As the financial position of the firm deteriorates (C_1 and C_2 decrease), the region in which the firm can credibly renegotiate increases, as does the region in which lease payments decrease with reductions in L.

II. The Acquisition of Trans World Airlines by American Airlines: A Case Study

In this section, we briefly describe the acquisition of Trans World Airlines (TWA) by American Airlines (AA) in January 2001, and the lease renegotiation process that subsequently ensued. We argue that AA had the ability to credibly threaten to reject many of TWA's leases, and that the outcome of the lease renegotiation in this case is consistent with the predictions of the model presented in Section I.

A. TWA's Financial Difficulties and American Airlines Purchase Plan

On January 10, 2001 TWA filed a chapter 11 bankruptcy petition as part of a deal with AA. Under the deal, AA acquired almost all of TWA's assets by paying \$625 million in cash and assumed obligations of TWA that exceeded \$5 billion. The acquisition marked the end of more than a decade of financial difficulties for TWA which included two previous chapter-11 reorganizations.

AA purchased substantially all of TWA assets subject to section 363 of the Bankruptcy Code. Section 363 of the Bankruptcy Code authorizes the sale of property of a debtor's estate under certain conditions. Baird and Rasmussen (2003) find that assets sales subject to section 363 of the Bankruptcy Code account for 56% of the large businesses that completed their Chapter 11 proceedings in 2002. According to Baird and Rasmussen (2002): "Many use Chapter 11 merely to sell their assets and divide up the proceeds. TWA filed only to consummate the sale of its planes and landings gates to American Airlines".

AA acquired a total of 173 aircraft from TWA, in addition to a new hub in St. Louis, key gates, maintenance facilities, and a 26% stake in the Worldspan computer-reservations system. According to AGIFORS (2001)[9], one of the primary benefits of the TWA acquisition was the complementarity between the fleets of the two airlines – a fact confirmed by the large overlap in aircraft type operated by AA and TWA (see Table 1).

B. American Airlines's Threat to Reject TWA Leases.

Although AA assumed most of TWA's obligations, it was not obligated by law to assume all lease payments. According to Section 365 of the bankruptcy code, AA had the ability to reject TWA's aircraft leases[10] resulting in the leased aircraft being returned to the lessors, and leaving the lessors with an action for damages.[11] Furthermore, upon rejection, lessor's claim for damages would be against *TWA* cash flow. Consistent with prediction 1 of the model, since TWA had not generated positive earnings for more than a decade, and by January 3, "TWA was down to its last $20 million in cash" (Carey 2001), AA's ability to threat to reject the aircraft leases were deemed to be quite credible. Indeed, according to Buhler (2003):

> *The aircraft market conditions, and the disparity between American's credit and TWA's allowed American to approach the aircraft lessors and lenders with the choice of accepting American's purchase offers/deeply discounted lease rates, or taking the aircraft back in their then-current condition...To my knowledge, all of the lenders and lessors agreed, resulting in new lease rates, in some cases 50 percent or more under TWA's.*

[9] The Airline Group of the International Federation of Operational Research Societies Ocho Rios, May 13-17, 2001 AA Update

[10] Rejection of leases is not equivalent to a breach of a contract outside of bankruptcy, but is akin to abandoning an asset, (Baird (2001)).

[11] These damages are treated as unsecured claims.

Moreover, since TWA's fleet was quite large, rejecting TWA's leases could have flood the aircraft market, and thus force lessors to sell their repossessed aircraft at 'fire sale' prices. Table 2 displays the top-ten operators of each of the main aircraft types in TWA's fleet: MD-80, DC-9, Boeing 757,and Boeing 767, as of 1/10/2001. While all of these models are popular aircraft, AA was the top user of MD-80s in the world (276 aircraft representing 23.45% of the total number of MD-80s in the world), and the second largest user worldwide of both Boeing 757s (102 aircraft representing 10.81% of total number of Boeing 757s) ,and Boeing 767s (70 aircraft representing 9.83% of total number of Boeing 767s). Thus, AA was able to amplify the threat of 'fire sales' and reduce further aircraft market prices by refusing to purchase the repossessed MD-80s, Boeing 757s, and Boeing 767s from TWA's lessors. The combination of limited demand for a large number of aircraft and TWA's low cash flows increased the bargaining position of AA vis-à-vis TWA's lessors during the lease renegotiation process.

C. Estimates of the Value of Lease Renegotiation

Eventually most of the DC-9s were rejected and the leases of the MD-80s, Boeing 757s, and Boeing 767s, were renegotiated. AGIFORS (2001) estimate that AA renegotiated the lease agreements on TWA aircraft, and reduced the expected cost of the leases from $5 billion to approximately $2.8 billion. Indeed, according to Buhler (2003):

> *When the American acquisition of the TWA assets closed in April 2001, American assumed most of TWA's leases and purchased a number of its aircraft. In TWA's case, the large number of aircraft created justifiable fears of a massive glut on the market if American's offers refused... The [TWA case] demonstrates one simple rule: the bargaining positions of the parties and the value of the subject matter dictate the result.*

We continue by estimating the value of the renegotiations to AA. We obtain data on current and expected lease payments from the 10Ks of AA and TWA. Since airlines are required to report their future lease obligations as specified by pre-existing lease contracts, we can compare the expected lease expenses before the acquisition of TWA to the actual cost of the leases after the acquisition was completed. We begin by estimating the expected lease obligations of TWA as of as of 12/31/1999.[12] Using TWA's cost of capital for different maturities as reported in TWA's 10K (between 11.8%

[12] TWA's last financial reports was filed on 2/23/2000 and corresponds to the fiscal year that ended on 12/31/1999. TWA did not file financial reports for the fiscal year 2000 since they filed a bankruptcy petition on January 2001.

and 14.7%) to discount TWA's future lease commitments, we calculate the present value of TWA's future lease commitments to be \$3,877 million. (See Panel A of Table 3). Since AA assumed leases on 78% of TWA's seat capacity, absent renegotiation, we would expect the present value of AA's lease expenses to increase by $0.78 \times 3,877 = \$3,027$ million (see Panel B). This was not the case.

Panel C of Table 3 calculates the present value of the *expected* lease payments of AA during 2001 and onwards as of 12/31/2000, using a discount rate of 7% (corresponding to the average yield on AA's bonds during the year 2000). To estimate the increase in AA's present value of lease obligations during 2001, Panel C calculates the present value of AA's *actual* 2001 lease payment combined with the expected lease obligations from 2002 and onwards as of 12/31/2001. In calculating this value, we adjust the difference between AA's expected lease payments as of 12/31/2000 and the sum of the actual payments during 2001 and the expected lease payments as of 12/31/2001 for the number of AA's aircraft that were dismissed during 2001.[13] Thus, while AA assumed TWA's leases with an estimated present value of \$3,027 million, Panel C shows that the present value of AA's lease expense increased by only \$1,571 million. The difference, \$1,455.3 million, representing a cost reduction of 48.1%, is the estimate of the amount saved by AA due to successful lease renegotiation.[14]

Our estimate is consistent with Buhler's (2003) anecdotal evidence and suggest that, as our model predicts, AA was able to accept a favorable payments schedule given the credible threat to reject the leases, due to TWA's low cash flow, and the threat to and flood the market with aircraft. In the next section, we provide formal empirical analysis of these effects.

III. Data and Summary Statistics

This section outlines summary statistics for airline characteristics and measure of fleet redeployability.

A. Airline Characteristics

To construct our sample, we collect data from a number of sources. We start with all publicly traded firms with a four-digit SIC code equal to 4512 (Scheduled Air Transportation) during the period 1990-2005. We then search for all annual reports of each of these firms as recorded in the online SEC-Edgar database. From each annual report, we collect the following information.

[13] AA dismissed about 3% of its seats capacity during 2001.

[14] It should be noted that the difference between the lease expenses of AA and TWA are not driven by the superior credit quality of AA since risk-adjusted discount rates are used in the present value calculations

First, from the Properties section of the annual report, we construct an account of the composition of each airline's leased fleet. Thus, we record the number of aircraft which are leased by each airline *by aircraft type*. Second, from the income statement, we record the amount paid by each airline in the form of aircraft lease expenses.[15] Third, from each annual report, we collect information on future lease payments owed by airlines. According to FAS regulation 13 a firm must report in the 'Notes to Financial Statements' section its pre-existing lease commitments for each of the five years following the filing of an annual report. In addition, the firm must report the sum of future scheduled lease commitments from year six and on. We therefore collect for each firm-year the schedule of future expected minimum lease payments owed by each firm. Also, we use Thomson's SDC Platinum Restructuring database to identify airlines that are in chapter 7 or chapter 11. Our final sample consists of 212 airline-year observations, representing 21 airlines during the period 1995 to 2005.

Panel A of Table 4 displays descriptive statistics for a selected set of variables. As the panel demonstrates, annual lease payments are sizeable, with mean annual lease payment equaling $250.4 million, and the maximum annual lease payment exceeding $1 billion. Annual lease payments represent, on average, 14.9% of airline's assets with a standard deviation of 18.5%. To measure the degree of lease contract concession obtained by firms, we construct three variables of lease payments. Our first measure is the ratio of actual lease payments paid during year t to the minimum expected year t lease payment as of year $t-1$. As can be seen in Panel A, the mean ratio of actual to minimum expected lease payment in the full sample is 1.05. On average, lease payments are greater than the previous year's minimum expected lease payment, indicating increased payments due to fleet growth. Our second measure is simply the rate of change of lease payments from year $t-1$ to year t. Table 4 shows that this average rate is 9.1%. The final measure we use to measure possible renegotiation of lease payments is simply the annual lease payments divided by the book value of the assets.

The mean number of aircraft leased by airlines in our sample is 139, of which, on average, 7 percent were wide-bodied aircraft.[16] The maximum number of leased aircraft in our sample is 483 (Continental Airlines in 2005). The average airline profitability (operating income before

[15] In a few cases, firms do not report aircraft lease payments separately from other lease payments – such as those for ground facilities – and instead report the value of aggregate lease payments. Since we are interested in aircraft lease payments, the relevant data for these firms is coded as missing.

[16] A wide-bodied aircraft is an aircraft with passenger seats divided by two lengthwise aisles such as a Boeing 747 or an Airbus 300.

depreciation divided by the book value of assets) is 9.13 percent.

We also define a dummy variable $Low\,Cash\,Flow$ that equals one for airlines with negative cash flow from operations (income before extraordinary items + depreciation and amortization), and zero otherwise, as a measure of financial difficulties. There are 44 airline-year observations, representing 20.7% of our sample, with negative cash flow. Panel A of Table 4 reports summary statistics for cash flow divided by the book value of the assets, for firms with negative earnings ($Low\,Cash\,Flow$=1).

B. Redeployability Measures

Due to economies of scale in fleet operation, airlines tend to limit the number of aircraft types which they operate in order to reduce costs associated with pilot training, mainatence, and spare parts. We take advantage of this fact in developing our measures of redeployability by assuming that the potential secondary market buyers of any given type of aircraft are likely to be airlines already operating the same type of aircraft. According to Pulvino (1998), the market for used commercial aircraft is 'extremely thin', with approximately 20 used commercial aircraft transactions per month worldwide. Likewise, Gavazza (2006) finds that between May 2002 and April 2003, 720 commercial aircraft were traded, representing 5.8% of the total stock of commercial aircraft. The thinness of the market for used aircraft reinforces the importance of the size of the set of potential buyers in determining aircraft redeployability.

Our approach to measuring redeployability is motivated by the industry equilibrium model of Shleifer and Vishny (1992), and is similar to the empirical approach developed in Benmelech (2006) for 19th century American railroads, and to Gavazza (2006) for U.S. aircraft. Benmelech (2006) exploits the diversity of track gauges in 19th century American railroads to identify potential buyers for railroad tracks and rolling stock. Gavazza (2006) uses the number of aircraft per type, and the number of operators per type to proxy for asset liquidity.

B.1 Proxies for Aircraft Redeployability

We use the Ascend CASE database which contains ownership and operating information about every commercial aircraft in the world to construct our measures of airline fleet redeployability. We begin by constructing redeployability measures at the yearly level for each aircraft type, where aircraft type is defined using the broad-type category in the Ascend CASE database. To do so, we compute for every sample-year 1) the number of aircraft per type; 2) the number of operators per type, and 3) the number of operators who operate at least 5 aircraft per type. This process yields three redeployability measures for each aircraft-type and each sample-year.

To construct the redeployability measures for an entire fleet of an airline, we aggregate the aircraft-type redeployability measures across all leased aircraft in each airline's fleet. Specifically, we define the redeployability of the leased airline fleet to be the weighted average of the redeployability index corresponding to each of the leased aircraft in the airline's fleet. We calculate in this manner three measures of fleet redeployability corresponding to each of the three measures of aircraft-type redeployability. The three measures are given by:

$$Redeployability_{i,t}^{aircraft} = \sum_{a}^{A} \omega_{i,t,a}(Redeployability_{a,t}^{aircraft})$$

$$Redeployability_{i,t}^{operators} = \sum_{a}^{A} \omega_{i,t,a}(Redeployability_{a,t}^{operators})$$

$$Redeployability_{i,t}^{operators>5} = \sum_{a}^{A} \omega_{i,t,a}(Redeployability_{a,t}^{operators>5})$$

where t represents sample year, a denotes an aircraft type, and $\omega_{i,t,q}$ is defined as

$$\omega_{i,t,a} = number_{i,t,a} \times seats_a \Bigg/ \sum_{a}^{A} number_{i,t,a} \times seats_a$$

Since we do not have data on aircraft market values, we use the number of seats in an aircraft model as a proxy for its size (and value) in our weighted average calculations. Furthermore, in calculating the first redeployability measure, since we want to account for the *residual demand* for the aircraft in each fleet, we do not include each airline's own aircraft. Likewise, in our number-of-operators based proxies we subtract the airline for which we calculate the measure - since we look into residual demand.

As suggested in the TWA case, the fleets of large airlines are less sellable in periods of market illiquidity. Using the Ascend CASE database we construct our fourth measure of redeployability as the ratio between the number of leased aircraft per type that an airline has and the total number of aircraft per type. As before, to construct the fourth proxy at the airline-fleet level, we calculate the weighted average of the redeployability index corresponding to each of the leased aircraft in the airline's fleet:

$$Fleet\ share_{i,t} \quad = \quad number\, of\, aircraft_{i,t,a} \Big/ \sum_{a}^{A} \omega_{i,t,a}(number\, of\, aircraft_{t,a}).$$

Panel B of Table 4 presents descriptive statistics for the redeployability proxies. As Panel B shows, the redeployability measure based on aircraft number has an average value of 1,253.8 with a median of 664. There are on average 153.7 potential buyers for an airline leased aircraft but only 50.8 when operators with more than 5 aircraft of the same type are considered (the median number is 22.2). Finally, on average, an airline in our sample operates 7.4% of the world's fleet of an aircraft type, with a median of 2.1%.

IV. Empirical Analysis

In this section we analyze empirically the ability of airlines to renegotiate their contractual lease obligations. Our goal is to estimate the magnitude of concessions that airlines extract during renegotiation and analyze the factors that affect these concessions.

A. Cash Flow and Lease Expenses

Our model predicts that firms can credibly renegotiate scheduled payments only when their financial condition is relatively poor. Since measuring the degree of financial difficulty of a firm is not easy, we use years in which firms have negative cash flow as a proxy for periods in which their threat to renegotiate lease payments is credible ($Low\, Cash\, Flow$=1). While renegotiation itself is unobservable, we test the model's prediction by estimating the outcomes of renegotiation. Specifically, to understand the determinants of lease payment renegotiation we run the following baseline regression:

$$(Actual/Expected_{-1})_{it} = Low\, Cash\, Flow_{it} + Redeployability_{it} + \mathbf{X}_{it} + \epsilon_{it}, \qquad (2)$$

where $(Actual/Expected_{-1})_{it}$ is the ratio of an airline's actual lease expenses to its previous year's minimum expected lease payments, Low Cash Flow is a dummy variable indicating whether an airline has negative cash flow, Redeployability is one of our four measures of the redeployability of an airline's fleet, and X_{it} is a vector of control variables. The control variables include the size of the airline's fleet, the percentage change in the size of the airline's fleet, the percent of wide bodied aircraft in an airline' fleet, and year fixed effects. Controlling for the change in an airline's fleet is particularly important since during periods of financial difficulties airlines may be reducing their fleet size.

The first four columns in Table 5 report the results of regression 2 for each of our four measures of the redeployability. All the regressions include year fixed-effects with robust standard errors that assume group-wise clustering at the year level. The coefficients on the variable of interest, Low Cash Flow, indicate that during years of negative cash flow, the average ratio of an airline's actual lease payment to its previous years minimum expected lease payment is reduced by approximately nine percentage points as compared to years when cash flow is positive. These results suggest that as predicted, on average, during periods of negative cash flow airlines can successfully renegotiate their aircraft leases, lowering their actual payments as compared to their pre-contracted payments by an economically significant amount.

Finally, the results in Table 5 also show that the four measures of redeployability are negatively related to the ratio of actual to expected less payments, suggesting that firms with highly redeployably fleets have lower lease expenses potentially due to the redeployability of the aircraft.[17]

We repeat the analysis in regression 2 using the yearly change in lease payments as dependent variable instead of Actual/Expected$_{-1}$. We therefore run the following regression:

$$Ln\Big(\frac{Lease\,Expenses}{Lease\,Expenses_{-1}}\Big)_{it} = Low\,Cash\,Flow_{it} + Redeployability_{it} + \mathbf{X}_{it} + \epsilon_{it}, \qquad (3)$$

where all independent variables are defined as above. Essentially, in this specification we are proxying for the lease payments that the airline owes by using lagged lease payments. The last four columns of Table 5 report the results corresponding to each of the four redeployability measures. Consistent with our previous results, airlines with negative cash flows exhibit a yearly change in lease payments that is between 4.4 and 6.7 percentage points smaller than those with positive cash flows, after controlling for changes in fleet size. Airlines in financial difficulties appear, therefore, to reduce their lease payments. As above, the relation between the change in lease payments and the four redeployability measures is either negative or not statistically significant.

[17]Note that when our fleet-share redeployability measure is high, the fleet is less redeployable and hence the positive coefficient.

B. Lease Renegotiation and Aircraft Redeployability

According to Prediction 2 of the model, the negative relation between liquidation values and the ability of firms to obtain concessions in renegotiation should be concentrated in those periods when firms can credibly renegotiate their lease payments. Thus, we expect that airlines will be able to reduce their lease expenses when their fleet is less redeployable during periods of relative financial difficulty. We therefore refine the specification in regressions 2 & 3 by including an interaction term between each measure of the four measures of redeployability and the Low Cash Flow dummy variable:

$$\begin{aligned}(Actual/Expected_{-1})_{it} &= Low\,Cash\,Flow_{it} + Redeployability_{it} + Fleet_{it} \times Low\,Cash\,Flow_{it} \\ &+ Redeployability_{it} \times Low\,Cash\,Flow_{it} + \mathbf{X}_{it} + \epsilon_{it}, \qquad (4)\end{aligned}$$

The first four columns in Table 6 report the results of regression 4 for each of our four measures of redeployability. All regressions include robust standard errors that assume group-wise clustering at the year level, and X_{it} is a vector of control variables that include year fixed-effects, the size of the airline's fleet, the percentage change in the size of the airline's fleet, and the percent of wide bodied aircraft in an airline' fleet.

As can be seen, negative cash flow is still associated with a drop in actual as compared to expected lease payments. Moreover, consistent with the model, the results indicate that reduced fleet redeployability is associated with lower lease payments when a firm has negative cash flows. As the interaction term between Redeployability and Low Cash Flow indicates, in years with negative cash flow, the relation between redeployability and Actual/Expected$_{-1}$ is now positive using each of our four different measures of redeployability. For example, if a firm has negative cash flow, a one standard deviation decrease in the aircraft redeployability measure, decreases an airline's lease payment by 8.9 percent as compared to its minimum expected lease payment.

Similarly, a one standard deviation decrease in the operators redeployability measure in a firm with negative cash flow decreases an airline's lease payments by 3.3 percentage points. Finally, the effect of a one standard deviation decrease in the large operators redeployability measure decreases the ratio of Actual/Expected$_{-1}$ by five percentage points. The coefficient on the interaction between the fourth redeployability measure, fleet-share, and the Low Cash flow dummy variable also implies a positive relation between redeployability and Actual/Expected$_{-1}$ but is not statistically significant. We also include the interaction between Fleet and Low Cash Flow to capture the threat of a 'massive glut' in the market for used aircraft. However while the coefficient on this interaction has the right sign (negative), it is not statistically significant.

We repeat our analysis again using changes in lease payments as the dependent variable and report the results in the last four columns of Table 6. We estimate the following modified version of regression 4:

$$\begin{aligned} Ln\Big(\frac{Lease\,Expenses}{Lease\,Expenses_{-1}}\Big)_{it} &= Low\,Cash\,Flow_{it} + Redeployability_{it} + Fleet_{it} \times Low\,Cash\,Flow_{it} \\ &+ Redeployability_{it} \times Low\,Cash\,Flow_{it} + \mathbf{X}_{it} + \epsilon_{it}, \qquad (5) \end{aligned}$$

As Table 6 demonstrates, consistent with the results above, when airlines have negative cash flow, change in lease payments and redeployability are positively related across three of the four measures of redeployability. Thus, the results show again that airlines' ability to lower lease payments during periods of low cash flow *increases* when their fleet is less redeployable.

As a final robustness check, Table 7 presents the analysis in regressions 4 and 5, this time using the level of lease payment (divided by the book value of the assets) as the dependent variable. In this specification, we find no statistically significant relation between the level of lease payments and the negative cash flow dummy variable. However, our main result holds: during periods of low cash flow, decreased fleet redeployability is associated with decreased lease payments. Moreover, in this specification, the interaction between Fleet and Low Cash Flow is negative and statistically significant at the 1 percent level in 2 out of 3 cases, potentially capturing the effect of a market meltdown in the market for used aircraft.

C. Lease Renegotiation in Bankruptcy

We continue our analysis by studying airline bankruptcies. We use years in which an airline is in bankruptcy as a proxy for periods in which airlines can credibly renegotiate their lease payments. The main difficulty with this analysis is that, although we include all airline bankruptcies for which we have available data, our sample contains only 11 airline-year observations in which an airline is in bankruptcy.[18] However, due to the natural importance of bankruptcy in the airline industry, and since some of the airlines who file for Chapter-11 protection are the largest in the industry, we devote a subsection for the renegotiation of leases in bankruptcy.

[18] We include both bankruptcies of U.S. Airways (2002-2003, and 2004-2005), and the bankruptcies of ATA, Comair Delta Airlines, Mair, Northwest, and United Airlines. We were not able to obtain data for the second bankruptcy of TWA (1995), and for the bankruptcies of Hawaiian Airlines and Tower. We do not include the third bankruptcy of TWA since it was acquired by American Airlines.

The first 4 columns in Table 8 presents the results of running the following regression for each of the four redeployability measures:

$$(Actual/Expected_{-1})_{it} = Bankruptcy_{it} + Redeployability_{it} + \mathbf{X}_{it} + \epsilon_{it}, \tag{6}$$

where Bankruptcy is a dummy variable taking on the value of one in those years in which an airline is under the protection of chapter-11, and zero otherwise. Redeployability is one of our four measures of the redeployability of an airline's fleet and X_{it} is the vector of usual control variables. As can be seen, when an airline is in bankruptcy, its ratio of actual lease payments to the previous year's expected minimum lease payments is reduced by approximately 20 percentage points, consistent with a significant ability to renegotiate and reduce lease payments during this period.[19] Estimating regression 6 using changes in lease payments as a dependent variable instead of Actual/Expected$_{-1}$ yields similar results, as reported in the last four columns of Table 8.

We continue by analyzing the effect that fleet redeployability has on lease payments during periods of bankruptcy by running the following specification:

$$\begin{aligned}(Actual/Expected_{-1})_{it} &= Bankruptcy_{it} + Redeployability_{it} + Fleet_{it} \times Bankruptcy_{it} \\ &+ Redeployability_{it} \times Bankruptcy_{it} + \mathbf{X}_{it} + \epsilon_{it}, \end{aligned} \tag{7}$$

Our model predicts that when firms are in Chapter 11, they can credibly renegotiate their lease payments, and that, in doing so, if their fleets are less redeployable they will obtain greater concessions from their lessors. The coefficient on the interaction between the redeployability meausre and the bankruptcy dummy variable is predicted, therefore, to be positive.

The first four columns in Table 9 report the results of regression 7 for each of our four measures of the redeployability. All the regressions include year fixed-effects with robust standard errors that assume group-wise clustering at the year level, and $\mathbf{X}_{it}$ is, again, our standard vector of control variables.

Consistent with our previous results, during bankruptcy, the relation between redeployability and Actual/Expected$_{-1}$ is now positive using all four measures of redeployability. Thus, when a firm is in bankruptcy, if its fleet is less redeployable, it has a greater ability to reduce lease payments.

[19] In addition, during bankruptcy some airlines renegotiate early termination of lease contracts and return leased aircraft to their lessors. Controlling for the change in fleet size therfore ensures that the Bankruptcy dummy variable does not capture changes in lease payments that result from renegotiated changes in fleet size. However, our specification *underestimates* the concessions airlines obtain during renegotiation because it does not include the benefit stemming from early contract termination.

Indeed, as would be expected, the effect of reduced fleet redeployability is stronger in bankruptcy as compared to in periods of negative cash flow since an airline's threat to return aircraft to lessors should be more credible. We find that in bankruptcy, a one standard deviation decrease in the aircraft redeployability measure decreases an airline's lease payment by 20 percent as compared to its minimum expected lease payment. Table 9 also shows that the interaction between the fleet size and the Bankruptcy variable is negative and significant in 2 out of the 4 redeployability measures, suggesting that the threat of massive liquidation (as in the case of TWA's acquisition) is more realistic in bankruptcy than is in the case of an airline with only negative cash flow.

To supplement the analysis, the last four columns of Table 9 use the change in lease payments as a dependent variable. As can be seen, we obtain similar results using this alternative specification.[20]

V. Conclusion

In this paper we analyze theoretically and empirically firms' ability to renegotiate financial obligations from an incomplete contracting perspective. Our theoretical model shows that firms will be able to renegotiate for better terms only when their financial position is relatively poor, and that firms' ability to reduce their pre-specified commitments will increase when the liquidation values of their assets decrease, but that this effect will be concentrated in those times when renegotiation is credible. We proceed by analyzing lease renegotiation in a sample of publicly traded, U.S. airlines. Our empirical results indicate that, consistent with the model, airlines in relatively poor financial position are able to renegotiate and reduce their lease payments with lessors. Furthermore, using measures of fleet redeployability as a proxy for the liquidation value lessors would obtain upon the default of an aircraft lease, we show that when firms are in poor financial condition, lower fleet redeployability increases their ability to reduce lease payments. Our evidence supports the incomplete contracting literature in that the ability of firms to renegotiate their financial commitments depends heavily on their bargaining position vis-à-vis liability holders. This bargaining position is determined, in turn, by the credibility of threats made during renegotiation and by the outside option of the bargaining parties.

[20] We also repeat the analysis using lease expenses levels and obtain similar results which are not reported for brevity.

VI. Appendix - Proof of Lemma 1

Proof. We prove the lemma by backward induction. First, suppose that the value of the second period cash flow has deteriorated to a level below L. In this case, the only offer that the Lessor will accept is one in which the Lessee liquidates the firm and pays out all proceeds, along with C_1, to the Lessor, for a total payment of $C_1 + L$. This is because of the fact that the Lessor can guarantee $C_1 + L$ by refusing all offers and waiting for the court imposed solution, while the Lessee cannot offer more than this amount due to the deterioration of the second period cash flow.[21]

By backward induction, to solve for the subgame perfect equilibrium we can consider a revised game in which the subgame following the point in which second period cash flow equals L is replaced with a terminal node having a payoff of $C_1 + L$ to the Lessor and a payoff of zero to the Lessee. Consider, therefore, the game in which after a rejection by either party, period 2 cash flow is reduced by $(1/N) * (C_2 - L)$ (with N large) so that after N rejected offers, period 2 cash flow equals L and parties receive their terminal payoffs of $C_1 + L$ and zero. Assume that, without loss of generality, the Lessor makes the final offer prior to second period cash flow deteriorating to L and that N is even. Finally, for convenience, we number the N rounds of alternating offers in *reverse* order with round N referring to the round in which the first offer is made, and round N referring to the round in which the last offer is made, i.e. prior to second period cash flow deteriorating to L. Because the Lessee is not allowed to pay dividends until all lease obligations are fullfiled, we can analyze repayment schedules (p_1, p_2) based on their sum $(p_1 + p_2)$. It should also be noted that since cash flows obtained by the firm are not expropriatable, at $t = 2$ the Lessee will never be able to renegotiate lease payments.

In the last round of the alternating offer process (round 1), second period cash flow equals L+$(1/N) * (C_2 - L)$. The Lessor's optimal repayment-schedule offer has $p_1 + p_2 = C_1 + L + (1/N) * (C_2 - L)$, which leaves zero for the Lessee. It is optimal because the Lessee is indifferent between accepting this offer and refusing it, since if he refuses, cash flow will deteriorate to L and he will obtain a terminal payoff of zero anyway. Without loss of generality we assume that the Lessee accepts the offer. In round 2, in which it is the Lessee's turn to make an offer, second period cash flow equals $L + (2/N) * (C_2 - L)$. In order to induce the lessor to accept a round 2 offer, the lessee must offer the lessor a payment schedule (p_1, p_2) with $p_1 + p_2 \geq C_1 + L + (1/N) * (C_2 - L)$, as this

[21] Since $C_1 + L$ is assumed to be less than $l_1 + l_2$, the lessee obtains $C_1 + L$ under the court imposed solution.

is what the Lessor can guarantee by refusing the round 2 offer and proceeding to round 1. The Lessee therefore offers $p_1 + p_2 = C_1 + L + (1/N) * (C_2 - L)$ leaving $(1/N) * (C_2 - L)$ for himself, and the Lessor accepts. The backward induction solution continues to unravel in a similar manner; in round i, the party making the offer – be it Lessor or Lessee – offers to his counterpart the amount that the counterpart will obtain in round $i - 1$ and keeps the remaining surplus to himself. Since in each round no rents are left on the table, every period the offerer will increase his payoff by $(1/N) * (C_2 - L)$, while the offeree will see no change in his payoff as compared to the previous round. By induction, therefore, at every even numbered round i, the subgame perfect equilibria has the Lessee offering the Lessor a repayment schedule of $p_1 + p_2 = C_1 + L + (i/2N) * (C_2 - L)$, and the Lessor accepting. Thus, at round N (the first round), the Lessor offers the Lessee a payment schedule with a total payment of $C_1 + L + 1/2(C_2 - L)$. Payoffs to the parties are as in Lemma 1. □

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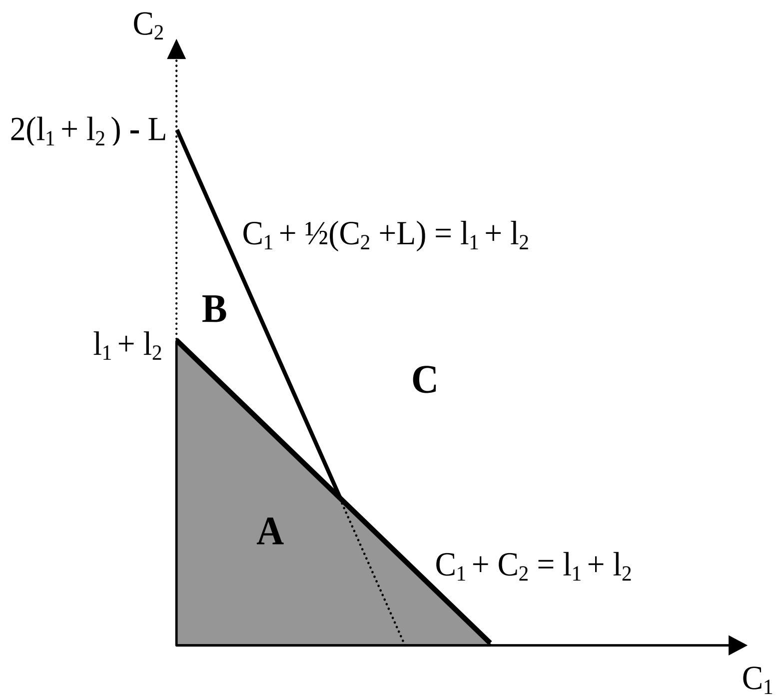

FIGURE 1: Lessee's renegotiation choice in (C_1, C_2) space.

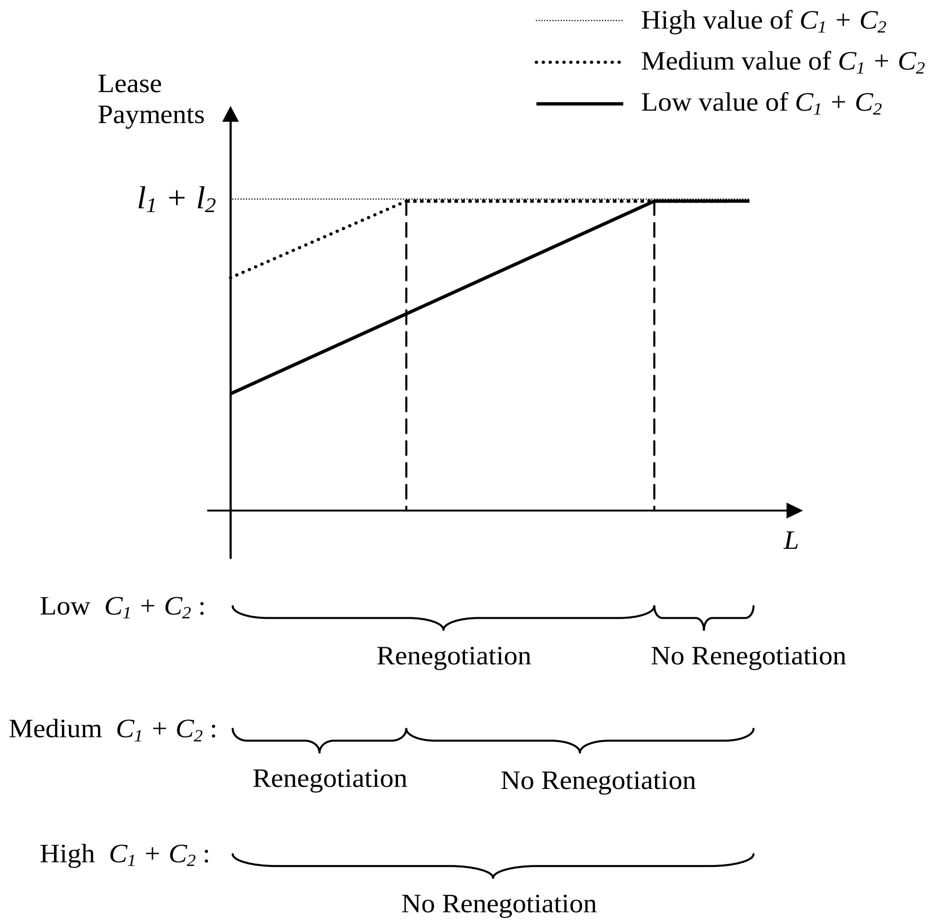

FIGURE 2: Firm's lease payments as function of liquidation value of assets, for three different levels of $C_1 + C_2$.

Table 1:
American Airlines and TWA Fleets

This table summaries the fleets of American Airlines and TWA as on 12/31/1999 and 1/10/2001.

	TWA's fleet as of 1/10/2001		**American Airlines' fleet as of 1/10/2001**	
Aircraft	in service	on order	in service	on order
Airbus 300	-	-	35	0
Airbus 318	0	25	-	-
Airbus 319	0	20	-	-
DC-9	27	0	-	-
DC-10	-	-	8	0
MD-11	-	-	7	0
MD-80	103	0	276	0
MD-90	-	-	5	0
Boeing 717	15	29	-	-
Boeing 727	2	0	61	0
Boeing 737	-	-	51	63
Boeing 757	27	1	102	22
Boeing 767	16	0	79	0
Boeing 777	-	-	27	20
Fokker 100	-	-	75	0
Lockheed 1011	1	0	-	-
Total	191	75	726	105

Table 2:
The Market for TWA's aircraft as of 1/10/2001

This table lists the 10 largest operators for the main aircraft types operated by TWA as of 1/10/2001; MD-80, DC-9, B757, and B767. The table reports the number of aircraft per type, and the ratio between the number of aircraft per type that an airline operates and the total number of aircraft per type.

	Top-ten Operators of MD-80s				**Top-ten Operators of DC-9s**		
#	Airline	Number of Aircarfts	% of Total aircraft	#	Airline	Number of Aircarfts	% of Total aircraft
1	American Airlines	276	23.45%	1	Northwest Airlines	137	19.68%
2	Delta Airlines	120	10.20%	2	ABX Air	66	9.48%
3	TWA Airlines	103	8.75%	3	US Airways	46	6.61%
4	Alitalia	89	7.56%	4	AirTran Airways	35	5.03%
5	SAS	68	5.78%	5	TWA Airlines	30	4.31%
6	Continental Airlines	66	5.61%	6	US Navy	29	4.17%
7	Aeromexico	41	3.48%	7	Iberia	25	3.59%
8	Iberia	37	3.14%	8	Midwest Airlines	24	3.45%
9	Spainair	35	2.97%	9	US Air Force	23	3.30%
10	Alaska Airlines	34	2.89%	10	SAS	23	3.30%
	Top-ten market share	869	73.83%		Top-ten market share	438	62.93%
	Total aircraft	1,177	100.00%		Total aircraft	696	100.00%

	Top-ten Operators of B757s				**Top-ten Operators of B767s**		
#	Airline	Number of Aircarfts	% of Total aircraft	#	Airline	Number of Aircarfts	% of Total aircraft
1	Delta Airlines	118	12.50%	1	Delta Airlines	113	14.05%
2	American Airlines	102	10.81%	2	American Airlines	70	9.83%
3	United Airlines	98	10.38%	3	United Airlines	54	6.72%
4	UPS Airlines	75	7.94%	4	ANA	53	6.59%
5	British Airways	52	5.51%	5	Qantas	36	4.48%
6	Northwest Airlines	48	5.08%	6	Air Canada	32	3.98%
7	Continental Airlines	41	3.34%	7	UPS Airlines	30	3.73%
8	US Airways	34	3.60%	8	Japan Airlines	22	2.74%
9	TWA Airlines	27	2.86%	9	British Airways	21	2.61%
10	Iberia	23	2.44%	10	Canadian Airlines Int.	20	2.49%
	Top-ten market share	618	65.47%		Top-ten market share	460	52.71%
	Total aircraft	944	100.00%		Total aircraft	804	100.00%

Table 3:
Estimates of the Savings from Lease Negotiations in American Airlines' Acquisition of TWA

This table summaries the savings from lease negotiation in the acquisition of TWA by American Airlines. Panel A presents TWA's Actual and Expected Lease Payments for 2001 and onward as of 12/31/1999. Panel B displays American Airlines' Expected Lease Payments for 2001 and onward as of 12/31/2000. Panel C presents American Airlines' Actual and Expected Lease Payments for 2001 and onward as of 12/31/2001, and provides an estimate of the risk-adjusted savings from lease negotiation on American Airlines's acquisition of TWA.

Panel A: TWA's Actual and Expected Lease Payments for 2001 and onward as of 12/31/1999

	2001	2002	2003	2004	2005 and after
Operating Leases	553	538	528	518	3,263
Capital Leases	46	31	23	23	37

Present value of operating leases (@ various rates b/w 11.8% and 14.7%)= 3,717
Present value of capital leases = @ various rates b/w 11.8% and 14.7%) = 161
Present value of future lease payments = 3,877
Fleet-share taken by American (value-weighted)=0.78
Leases value taken by American =0.78*3,877=3,027

Panel B: American Airlines' Expected Lease Payments for 2001 and onward as of 12/31/2000

	2001	2002	2003	2004	2005	2006 and after
Operating Leases	950	898	910	893	880	11,268
Capital Leases	280	236	154	206	135	835

Present value of operating leases (@ 7%)= 11,232
Present value of capital leases (@ 7%)= 1,403
Present value of future lease payments = 12,596

Panel C: American Airlines' Actual and Expected Lease Payments for 2001 and onward as of 12/31/2001

	2001	2002	2003	2004	2005	2006	2007 and after
Operating Leases	799	1,314	1,256	1,180	1,119	1,054	11,622
Capital Leases	189	288	205	256	187	208	1,223

Present value of operating leases (@ 9.75%)= 12,015
Present value of capital leases = (@ 9.75%)= 1,774
Present value of future lease payments = 13,789

During the year 2001 American Airlines dismissed 3% of its leased aircraft (value-weighted)
Difference between Expected Lease Payments=13,789-0.97*12,596=1,571
Amount American saved on TWA leases (adjusted for risk)=3,027-1,571=1,455.3

Table 4:
Summary Statistics

This table provides descriptive statistics for the variables used in the empirical analysis, Panel A displays that characteristics of the airline. Panel B provides summary statistics for each of the four redeployability measures used in the paper. Lease expenses are total aircraft lease expenses (in $ million), Lease Expenses/Assets are total aircraft lease expenses divided by the book value of the assets, Actual/Expected$_{-1}$ Lease Payments is the ratio of an airline's actual lease expenses to its previous year's minimum expected lease payments, ln(Lease Expenses/Lease Expenses$_{-1}$) is the yearly change in lease payments, Leased-fleet size is the number of aircraft leased by the airline, Wide-body is the fraction of wide-bodied aircraft leased by the airline, Profitability is operating income before depreciation divided by the book value of assets, Cash Flow is income before extraordinary items + depreciation and amortization divided by assets, *Low Cash Flow* is a dummy variable that equals one for airlines with negative cash flow from operations, and zero otherwise. Redeployability (# of aircraft) is the number of aircraft per type; Redeployability (# of operators) is the number of operators per type, Redeployability (# of operators with more than 5 aircraft) is the number of operators who operate at least 5 aircraft per type. Redeployability (fleet-share) is the ratio between the number of leased aircraft per type that an airline has and the total number of aircraft per type.

	Mean	25th Percentile	Median	75th Percentile	Standard Deviation	Min	Max
Panel A: Airline Characteristics							
Lease Expenses ($m)	250.4	40.3	136.3	437.7	263.2	0.312	1009.0
Lease Expenses/Assets	0.149	0.040	0.088	0.156	0.185	0.008	1.260
Actual/Expected$_{-1}$ Lease Payments	1.051	0.851	1.057	1.194	0.293	0.458	2.809
ln(Lease Expenses/ Lease Expenses$_{-1}$)	0.091	-0.022	0.058	0.184	0.254	-0.907	1.309
Leased-fleet size	139	31	95	253	128	2	483
Wide-body	0.070	0.00	0.000	0.078	0.166	0.000	1.000
Profitability	9.13%	3.17%	10.41%	16.97%	17.55%	-100.10%	52.42%
Cash Flow if Low Cash Flow==1	-18.71%	-16.03%	-7.30%	-2.21%	31.01%	-128.84%	-0.1%
Panel B: Redeployability Measures							
Redeployability (# of aircraft)	1,253.8	664.0	990.0	1753.6	893.4	60.8	4,083.0
Redeployability (# of operators)	153.7	68.6	124.0	219.1	110.8	12.0	548.0
Redeployability (# of operators with more than 5 aircraft)	50.8	22.2	42.5	80.0	35.9	4.1	176.0
Redeployability (fleet-share)	7.37%	2.11%	4.33%	7.25%	9.35%	0.23%	52.60%

Table 5:
Changes in Lease Expenses and Financial Distress

The dependent variable in the regressions is either the ratio of an airline's actual lease expenses to its previous year's minimum expected lease payments - Actual/Expected$_{-1}$ (columns 1-4), or the yearly change in lease payments - Change - (columns 5-8). Fleet is the number of aircraft leased by the airline, Fleet change is the annual change in fleet size. Wide body share is the fraction of wide-bodied aircraft leased by the airline. *Low Cash Flow* is a dummy variable that equals one for airlines with negative cash flow from operations, and zero otherwise. Redeployability (aircraft) is the number of aircraft per type; Redeployability (operators) is the number of operators per type, Redeployability ($\geq$ 5 aircraft) is the number of operators who operate at least 5 aircraft per type. Redeployability (fleet-share) is the ratio between the number of leased aircraft per type that an airline has and the total number of aircraft per type. All regressions include an intercept (not reported) and year fixed-effects. t-statistics are calculated using standard-errors that are clustered by year and reported in parenthesis.

Dependent Variable=	Actual/ Expected$_{-1}$	Actual/ Expected$_{-1}$	Actual/ Expected$_{-1}$	Actual/ Expected$_{-1}$	Change	Change	Change	Change
Fleet	-0.0008	-0.0008	-0.0008	-0.0009	-0.0003	-0.0002	-0.0002	-0.0003
	(-5.03)	(-5.00)	(-5.00)	(-5.57)	(-2.71)	(-2.67)	(-2.66)	(-3.17)
Fleet change	0.111	0.103	0.115	0.114	0.335	0.325	0.335	0.311
	(0.80)	(0.72)	(0.82)	(0.83)	(4.10)	(3.95)	(4.12)	(3.59)
Wide body share	-0.212	-0.218	-0.201	-0.116	-0.017	-0.029	-0.014	0.033
	(-1.06	(-1.08)	(-1.01)	(-0.65)	(-0.09)	(-0.16)	(-0.08)	(0.19
Low Cash Flow	-0.093	-0.09	-0.096	-0.079	-0.067	-0.064	-0.067	-0.044
	(-3.10)	(-2.99)	(-3.10)	(-2.21)	(-2.62)	(-2.56)	(-2.61)	(-1.85)
Redeployability (aircraft)	-0.00007				-0.00002			
	(-3.77)				(-1.49)			
Redeployability (operators)		-0.0005				-0.0003		
		(-3.94)				(-2.16)		
Redeployability ($\geq$ 5 aircraft)			-0.002				-0.0007	
			(-3.80)				(-1.81)	
Redeployability (fleet-share)				0.409				0.486
				(2.01)				(2.97)
Adjusted R^2	0.23	0.22	0.23	0.24	0.17	0.18	0.17	0.20
Observations	177	177	177	177	185	185	185	185

Table 6:
Changes in Lease Expenses, Financial Distress and Fleet's Redeployability

The dependent variable in the regressions is either the ratio of an airline's actual lease expenses to its previous year's minimum expected lease payments - Actual/Expected$_{-1}$ (columns 1-4), or the yearly change in lease payments - Change - (columns 5-8). Fleet is the number of aircraft leased by the airline, Fleet change is the annual change in fleet size. Wide body share is the fraction of wide-bodied aircraft leased by the airline. *Low Cash Flow* is a dummy variable that equals one for airlines with negative cash flow from operations, and zero otherwise. Redeployability (aircraft) is the number of aircraft per type; Redeployability (operators) is the number of operators per type, Redeployability ($\geq$ 5 aircraft) is the number of operators who operate at least 5 aircraft per type. Redeployability (fleet-share) is the ratio between the number of leased aircraft per type that an airline has and the total number of aircraft per type. Regressions also include interactions between Fleet and *Low Cash Flow*, and between each of the Redeployability measures and *Low Cash Flow*. All regressions include an intercept (not reported) and year fixed-effects. t-statistics are calculated using standard-errors that are clustered by year and reported in parenthesis.

Dependent Variable=	Actual/ Expected	Actual/ Expected	Actual/ Expected	Actual/ Expected	Change	Change	Change	Change
Fleet	-0.0007	-0.0007	-0.0007	-0.0008	-0.0002	-0.0002	-0.0002	-0.0003
	(-3.67)	(-3.64)	(-3.67)	(-4.21)	(-2.28)	(-2.16)	(-2.22)	(-2.79)
Fleet change	0.318	0.088	0.091	0.097	0.121	0.315	0.322	0.314
	(3.55)	(0.62)	(0.65)	(0.69)	(0.87)	(3.63)	(3.65)	(3.56)
Wide body share	-0.210	-0.216	-0.197	-0.104	-0.016	-0.029	-0.012	0.036
	(-1.07)	(-1.11)	(-1.00)	(-0.60)	(-0.10)	(-0.17)	(-0.07)	(0.21)
Low Cash Flow	-0.283	-0.268	-0.254	-0.027	-0.219	-0.210	-0.194	-0.028
	(-3.22)	(-3.45)	(-2.92)	(-0.40)	(-2.09)	(-2.09)	(-1.90)	(-0.55)
Fleet	-0.0002	-0.0002	-0.003	-0.00003	0.00001	0.00001	-0.002	-0.0001
×Low Cash Flow	(-0.74)	(-0.60)	(-0.82)	(-0.08)	(0.04)	(0.02)	(-0.09)	(0.27)
Redeployability	-0.0001				-0.00004			
(aircraft)	(-5.64)				(-2.33)			
× Low Cash Flow	0.0002				0.0001			
	(5.46)				(2.00)			
Redeployability		-0.0007				-0.0004		
(operators)		(-6.88)				(-2.91)		
× Low Cash Flow		0.001				0.0008		
		(5.82)				(2.03)		
Redeployability			-0.002				-0.0011	
($\geq$ 5 aircraft)			(-5.42)				(-2.50)	
× Low Cash Flow			0.004				0.0023	
			(4.46)				(1.70)	
Redeployability				0.428				0.494
(fleet-share)				(2.08)				(3.19)
× Low Cash Flow				-1.136				-0.715
				(-0.85)				(-0.52)
Adjusted R^2	0.30	0.25	0.25	0.20	0.18	0.19	0.18	0.19
Observations	177	177	177	177	185	185	185	185

Table 7:
Lease Expenses Levels, Profitability, and Fleet's Redeployability

The dependent variable in the regressions is total aircraft lease expenses divided by the book value of the assets - Lease Expenses/Assets. Fleet is the number of aircraft leased by the airline, Fleet change is the annual change in fleet size. Wide body share is the fraction of wide-bodied aircraft leased by the airline. *Low Cash Flow* is a dummy variable that equals one for airlines with negative cash flow from operations, and zero otherwise. Redeployability (aircraft) is the number of aircraft per type; Redeployability (operators) is the number of operators per type, Redeployability ($\geq$ 5 aircraft) is the number of operators who operate at least 5 aircraft per type. Redeployability (fleet-share) is the ratio between the number of leased aircraft per type that an airline has and the total number of aircraft per type. Regressions also include interactions between Fleet and *Low Cash Flow*, and between each of the Redeployability measures and *Low Cash Flow*. All regressions include an intercept (not reported) and year fixed-effects. t-statistics are calculated using standard-errors that are clustered by year and reported in parenthesis.

Dependent Variable= Lease Expenses/Assets								
Fleet	-0.0004	-0.0002	-0.0004	-0.0002	-0.0004	-0.0002	-0.0004	-0.0003
	(-5.87)	(-3.73)	(-5.91)	(-3.55)	(-5.71)	(-3.52)	(-7.92)	(-6.62)
Wide body share	-0.209	-0.193	-0.221	-0.208	-0.206	-0.186	-0.152	-0.132
	(-5.68)	(-6.15)	(-5.59)	(-5.96)	(-5.62)	(-5.93)	(-5.54)	(-5.88)
Low Cash Flow	0.015	-0.123	0.019	-0.089	0.015	-0.105	0.033	0.104
	(0.48)	(-1.77)	(0.54)	(-0.92)	(0.50)	(-1.43)	(1.20)	(2.34)
Fleet		-0.0004		-0.0004		-0.0004		-0.0003
×Low Cash Flow		(-1.77)		(-2.40)		(-2.62)		(-1.72)
Redeployability	-0.00003	-0.00006						
(aircraft)	(-3.22)	(-7.63)						
× Low Cash Flow		0.0001						
		(4.24)						
Redeployability			-0.0004	-0.0006				
(operators)			(-3.80)	(-6.60)				
× Low Cash Flow				0.001				
				(2.65)				
Redeployability					-0.0010	-0.0016		
($\geq$ 5 aircraft)					(-3.55)	(-7.57)		
× Low Cash Flow						0.0031		
						(3.94)		
Redeployability							0.507	0.525
(fleet-share)							(8.17)	(8.02)
× Low Cash Flow								-0.734
								(-1.31)
Adjusted R^2	0.07	0.14	0.10	0.15	0.08	0.15	0.10	0.11
Observations	212	212	212	212	212	212	212	212

Table 8:
Changes in Lease Expenses and Bankruptcy

The dependent variable in the regressions is either the ratio of an airline's actual lease expenses to its previous year's minimum expected lease payments - Actual/Expected$_{-1}$ (columns 1-4), or the yearly change in lease payments - Change - (columns 5-8). Fleet is the number of aircraft leased by the airline, Fleet change is the annual change in fleet size. Wide body share is the fraction of wide-bodied aircraft leased by the airline. profitability is operating income before depreciation divided by the book value of assets. Bankruptcy is a dummy variable taking on the value of one in those years in which an airline is under the protection of chapter-11, and zero otherwise. Redeployability (aircraft) is the number of aircraft per type; Redeployability (operators) is the number of operators per type, Redeployability ($\geq$ 5 aircraft) is the number of operators who operate at least 5 aircraft per type. Redeployability (fleet-share) is the ratio between the number of leased aircraft per type that an airline has and the total number of aircraft per type. All regressions include an intercept (not reported) and year fixed-effects. t-statistics are calculated using standard-errors that are clustered by year and reported in parenthesis.

Dependent Variable=	Actual/ Expected	Actual/ Expected	Actual/ Expected	Actual/ Expected	Change	Change	Change	Change
Fleet	-0.0008	-0.0008	-0.0008	-0.0008	-0.0002	-0.0002	-0.0002	-0.0003
	(-4.67)	(-4.68)	(-4.65)	(-5.44)	(-2.06)	(-2.00)	(-2.03)	(-2.38)
Fleet change	0.110	0.103	0.115	0.110	0.332	0.325	0.331	0.310
	(0.79)	(0.72)	(0.81)	(0.79)	(4.19)	(4.09)	(4.21)	(3.72)
Wide body share	-0.197	-0.201	-0.185	-0.105	0.004	-0.006	0.004	0.034
	(-0.97)	(-0.98)	(-0.92)	(-0.61)	(0.03)	(-0.04)	(0.02)	(0.20)
Profitability	0.057	0.077	0.071	0.108	0.336	0.313	0.329	0.290
	(0.43)	(0.60)	(0.55)	(0.92)	(1.17)	(2.98)	(3.09)	(2.60)
Bankruptcy	-0.203	-0.199	-0.198	-0.191	-0.143	-0.142	-0.142	-0.132
	(-1.76)	(-1.78)	(-1.74)	(-1.84)	(-1.77)	(-1.70)	(-1.73)	(-1.62)
Redeployability	-0.00007				-0.000001			
(aircraft)	(-3.42)				(-0.58)			
Redeployability		-0.0005				-0.0002		
(operators)		(-3.41)				(-1.52)		
Redeployability			-0.002				-0.0003	
($\geq$ 5 aircraft)			(-3.33)				(-0.91)	
Redeployability				0.383				0.362
(fleet-share)				(1.78)				(2.26)
Adjusted R^2	0.24	0.23	0.24	0.22	0.23	0.23	0.23	0.25
Observations	177	177	177	177	185	185	185	185

Table 9:

Changes in Lease Expenses, Bankruptcy and Fleet's Redeployability

The dependent variable in the regressions is either the ratio of an airline's actual lease expenses to its previous year's minimum expected lease payments - Actual/Expected$_{-1}$ (columns 1-4), or the yearly change in lease payments - Change - (columns 5-8). Fleet is the number of aircraft leased by the airline, Fleet change is the annual change in fleet size. Wide body share is the fraction of wide-bodied aircraft leased by the airline. profitability is operating income before depreciation divided by the book value of assets. Bankruptcy is a dummy variable taking on the value of one in those years in which an airline is under the protection of chapter-11, and zero otherwise. Redeployability (aircraft) is the number of aircraft per type; Redeployability (operators) is the number of operators per type, Redeployability ($\geq$ 5 aircraft) is the number of operators who operate at least 5 aircraft per type. Redeployability (fleet-share) is the ratio between the number of leased aircraft per type that an airline has and the total number of aircraft per type. Regressions also include interactions between Fleet and Bankruptcy, and between each of the Redeployability measures and Bankruptcy. All regressions include an intercept (not reported) and year fixed-effects. t-statistics are calculated using standard-errors that are clustered by year and reported in parenthesis.

Dependent Variable=	Actual/ Expected	Actual/ Expected	Actual/ Expected	Actual/ Expected	Change	Change	Change	Change
Fleet	-0.0007	-0.0008	-0.0007	-0.0008	-0.0002	-0.0002	-0.0002	-0.0003
	(-4.55)	(-4.57)	(-4.53)	(-5.40)	(-2.32)	(-2.28)	(-2.29)	(-2.83)
Fleet change	0.103	0.095	0.106	0.113	0.315	0.306	0.313	0.296
	(0.72)	(0.65)	(0.74)	(0.79)	(4.13)	(4.01)	(4.15)	(3.64)
Wide body share	-0.197	-0.199	-0.186	-0.118	0.003	-0.008	0.002	0.030
	(-0.96)	(-0.97)	(-0.91)	(-0.64)	(0.02)	(-0.05)	(0.01)	(0.17)
Profitability	0.050	0.072	0.064	0.105	0.328	0.305	0.321	0.280
	(0.38)	(0.55)	(0.49)	(0.87)	(3.04)	(2.85)	(2.96)	(2.47)
Bankruptcy	-0.300	-0.280	-0.292	0.389	-0.506	-0.514	-0.511	0.063
	(-2.02)	(-1.64)	(-2.09)	(1.00)	(-7.34)	(-6.83)	(-8.42)	(0.49)
Fleet	-0.002	-0.002	-0.002	-0.002	-0.0002	-0.0003	-0.001	-0.0001
$\times$Bankruptcy	(-1.90)	(-1.68)	(-1.99)	(-1.48)	(-0.05)	(-0.05)	(-0.26)	(-0.32)
Redeployability	-0.00007				-0.00001			
(aircraft)	(-3.87)				(-0.98)			
$\times$ Bankruptcy	0.0003				0.00024			
	(4.30)				(3.95)			
Redeployability		-0.0005				-0.0002		
(operators)		(-3.71)				(-1.97)		
$\times$ Bankruptcy		0.003				0.002		
		(3.42)				(3.12)		
Redeployability			-0.002				-0.0005	
($\geq$ 5 aircraft)			(-3.73)				(-1.32)	
$\times$ Bankruptcy			0.008				0.0061	
			(4.12)				(3.82)	
Redeployability			0.405				0.423	
(fleet-share)				(1.79)				(2.91)
$\times$ Bankruptcy				-2.697				-2.799
				(-2.15)				(-7.92)
Adjusted R^2	0.26	0.24	0.25	0.23	0.24	0.19	0.24	0.27
Observations	177	177	177	177	185	185	185	185