Bankruptcy and Product-Market Competition: Evidence from the Airline Industry*

Federico Ciliberto†
University of Virginia

Carola Schenone‡
University of Virginia

First Version: November 2005.
This Version: September 2007

Abstract

Classical models of product market competition maintain that firms maximize their profits regardless of their financial condition. Yet over the last two decades a growing theoretical literature has examined whether a firm's capital structure impacts competition in the market for the firm's products. In this paper we ask whether a firm operating under bankruptcy protection significantly reshapes competition for the firm's product in markets where the bankrupt and the non-bankrupt firms are in direct competition, using evidence from the US airline industry. The first part of the paper shows that (1) the median price in markets where a bankrupt carrier operates significantly drops; (2) competitors of a bankrupt firm differ in the way they react to the bankruptcy. In the second part of the paper, we estimate a structural model of demand for air travel and a model of airline pricing behavior. The results show that (1) shifts in the pricing equations of the bankrupt firm and of its competitors explain the observed price changes; (2) there is no evidence that consumers substitute away from a bankrupt airline to its competitors. Finally, we present a counter-factual experiment, to study how prices and consumer welfare would have changed if bankrupt firms had to liquidate their assets and exit the industry, without the possibility of operating under Chapter11 protection. We show that consumers did not benefit significantly from the availability of Chapter 11 to United or USAir; but that consumers benefited substantially from the availability of Chapter 11 to ATA.

*We thank Ken Ayotte, Leora Friedberg, Rick Green, Vikas Mehrotra, Amalia Miller, Nicholas Rupp, Patrik Sandas, and David C. Smith for comments and suggestions. We also thank seminar participants at the University of Virginia Economics Department, and the Empirical Research in Corporate Finance Conference at the University of Oregon, Eugene, the International Industrial Organization Conference in Boston, the Southern Economic Association Conference in Washington. Lynn LoPucki generously shared his Bankruptcy Research Database. A previous version of this paper was circulated under the title "Financial Decisions, Bankruptcy, and Product-Market Competition in the Airline Industry". All remaining errors are our own.

†Department of Economics, University of Virginia, ciliberto@virginia.edu, ph: (434) 924-6755.
‡McIntire School of Commerce, University of Virginia, schenone@virginia.edu, ph: (434) 924-4184.

1 Introduction

Classical models of product market competition maintain that firms maximize their profits regardless of their financial condition. Yet over the last two decades a growing theoretical literature has examined whether a firm's capital structure impacts competition in the market for the firm's products.[1] This body of work deals primarily with the interaction between product market competition and *financial distress*. Very few theoretical and empirical papers examine whether a real linkage exists between product market competition and *bankruptcy*. In this paper we ask whether a firm operating under bankruptcy protection significantly reshapes competition for the firm's product in markets where the bankrupt and the non-bankrupt firms are in direct competition. We investigate the demand and supply shocks spurring from a bankruptcy filing as the main channels through which bankruptcy impacts product market competition.[2]

We examine the effects of bankruptcy on product market competition by studying the airline industry in the United States. This industry provides an interesting empirical framework for several reasons. First, it is an industry of strategic importance in the United States. Second, the airlines seeking bankruptcy protection form a heterogeneous group, including low cost carriers such as ATA, and national carriers such as United and USAir. The range of variation in the identities of the bankrupt airlines ensures that our empirical analysis provides insights on other industries as well. Third, because it is one industry where carriers interact over many distinct markets and over time, we can identify the effects of bankruptcy on product market competition, independent of potentially confounding market, firm, and time effects. Finally, because there are bankrupt and non-bankrupt carriers serving the same market, we can investigate different carriers' price reactions to one carrier's bankruptcy.

We collected data from the Air Transportation Association website, the Bankruptcy Database prepared by Lynn LoPucki, and Factiva and Lexis-Nexis reports to compile an original dataset on the identity of carriers filing for bankruptcy protection, the time window during which these carreirs operated under court protection, and whether the carrier emerged from bankruptcy or liquidated under Chapter 7. We merge this novel dataset with data from the Origin and Destination Survey (DB1B), covering the period from 1993 to 2006.

We organized our empirical analysis in three parts. The first part uses reduced form regressions

[1]This literature focuses on how financial distress impacts the competitive interaction of distressed and non-distressed firms in an industry (Brander and Lewis (1986), Bolton and Scharfstein (1990), Hendel (1996), Dasgupta and Titman (1998)). Several empirical papers followed providing evidence of the interaction between financial distress and product market competition (Bolton and Scharfstein (1990), Chevalier and Scharfstein (1995, 1996), Chevalier (1995a, 1995b), Phillips (1995), Campello (2006), and Kovenock and Phillips (1995).

[2]Another important feature of a bankruptcy filing is the shift of control from equity to debt holders. We do not incorporate such a change in our model, as we assume that the objective of the firm is to maximize profits, regardless of the ownership structure. To facilitate this assumption, we drop observations from a few quarters before the bankruptcy filing, when to-be-bankrupt firms might try to maximize revenues to generate cash.

along the lines of Borenstein and Rose (BR, 1995), who were the first, to our knowledge, to provide empirical evidence on the relationship between bankruptcy filings and product market competition. BR used data from the airline industry between 1989 and 1993 to study price changes around the bankruptcies of Eastern, Continental, America West and TWA.[3] BR found no systematic evidence that bankrupt firms changed their prices after filing for Chapter 11. They also did not find any evidence that the bankrupt firms' competitors changed their prices after the filings. Similarly, Busse (2002) found that carriers operating under bankruptcy protection are neither more nor less likely to start a price war. Using a different time period, and estimating regressions that control for unobserved market, carrier, and time characteristics, we find quite different results.

First, we find that the median prices in markets where a bankrupt carrier is operating significantly drops across competitors and markets. For instance, in response to the second US Airways Chapter 11 filing, the price dropped by 8 percent.[4] Next, we tease apart the effects on the prices of a bankrupt carrier's competitors, classifying them in four groups: low cost carriers, large national carriers, and Southwest Airlines. We show that the bankrupt carrier and the large national carriers react in the same direction, lowering their prices. Low cost carriers do not systematically and significantly react to their competitor's bankruptcy. Southwest, though, behaves in a peculiar way, sometimes raising (lowering) prices while the bankrupt and large national carriers drop (increase) prices.

The second part of our study uses a structural model to estimate the demand and cost functions of airline firms before and after a bankruptcy filing. We follow Morrison and Winston (1989), Berry (1990), Berry, Carnall, and Spiller (BCS, 2006), Aguirregabiria and Ho (2006), Lederman [forthcoming], and Ciliberto and Williams (2007) and assume a nested logit model of demand for air travel. We jointly estimate it with the pricing equation of the airlines. Our main focus here is on the effect of bankruptcy filings on the demand and cost of airline service.

We do not find evidence that consumers substitute away from a bankrupt airline to its competitors.[5] Indeed, we show that the price changes documented by the reduced form regressions can be explained by shifts in the pricing equations of the bankrupt firm and of its competitors. For the bankrupt firm, we claim that the lower costs associated with operating under bankruptcy protection can explain the shifts in their pricing equations. While operating under bankruptcy protection, firms can take cost-reducing actions that would be hard, or outright illegal, to implement outside of bankruptcy. For instance, firms can renege on their debt payments, reject leases,

[3]BR use an ordinary least square regression to estimate the effect of bankruptcy on prices. The unit of observation is a carrier-route-quarter-year, as in our study.

[4]To understand the economic significance of these price changes, consider the following. In a recent article on the Wall Street Journal, the Chief Executive Officer of America West stated that a 10 percent boost in revenues would have turned a 100 millions loss in a 150 million profit in 2004.

[5]We do find some evidence that consumers are less willing to fly at all when a firm files for bankruptcy protection.

lay-off employees, reduce wages, and suspend pension contribution payments. This leeway, only granted while in bankruptcy protection, can significantly reduce the bankrupt carrier's costs. We do not find evidence that bankruptcy filing spawns real shocks to the demand of the bankrupt firm, suggesting that firms operating under bankruptcy protection do not face a significant reputation cost.[6] Finally, for the competitors of the bankrupt firm, shifts in the pricing equation shifts are not as straightforward to interpret, and is best left to future work to determine their causes.

The third, and final, part of our analysis presents a counter-factual experiment, where we study how prices and consumer welfare would have changed if firms that chose Chapter 11 reorganization had instead had to liquidate under Chapter 7. In practice, our exercise consists of excluding a bankrupt firm (e.g. United) from the markets in which it operates, and recompute the equilibrium prices, shares, and consumer welfare that would have resulted without that firm.

Before we summarize the results of our counter-factual analysis, we want to state up front two important caveats. If firms could file for only Chapter 7, then more banks might be willing to rescue a firm, forestalling any bankruptcy filing. Yet, in deciding whether to do so, it is likely that banks would want to know the counterfactual we examine. The second caveat is that in the long run, we expect entry in the markets from which the bankrupt firm exited. We do not model this long run market equilibrium because integrating an entry model is beyond the scope of this paper. This caveat would be important if we found evidence that Chapter 11 is strongly and systematically beneficial to consumers. Instead, we find strong but circumscribed evidence on the benefits of Chapter 11 to consumers.

Our counter-factual experiment shows that consumers did not benefit significantly from the availability of Chapter 11 to United or USAir: aggregate consumer welfare would have dropped by only few thousands dollars if United and USAir had to file for Chapter 7. On the contrary, we find that consumers benefited substantially from the availability of Chapter 11 to ATA, a low cost carrier: in markets served by ATA, consumer welfare would drop by tens of thousands of dollars if firms could only file for Chapter 7. This result is explained by lower average prices, and the different values of the elasticities of demand in the markets where ATA is in and in the other markets. In light of the two caveats discussed above, our results suggest that Chapter 11 is beneficial to consumers only to the extent that it keeps low cost carriers in the industry, at least in the short run.

The organization of the rest of the paper is as follows. Section (2) describes bankruptcies in the airline industry. In Section (3) we describe the model. Section (4) describes the data. Section (5) specifies the reduced form and structural econometric model. Section (6) deals with the identification issues that arise in the estimation. The reduced form results are presented in Section

[6] See Rose (1990), Borenstein and Zimmerman (1988), and Opler and Titman (1994).

(7), and the structural form results in Section (8). In Section (9) we ask whether consumer benefit from the possibility firms have to file for bankruptcy under Chapter 11 protection, as opposed to being forced into liquidation under Chapter 7. Finally, Section (10) summarizes our results and provides concluding remarks.

2 Bankruptcies in the Airline Industry

2.1 The Legal Setting

The United States Bankruptcy Code contemplates two alternative solutions for firms in financial distress filing for Court protection: filing under Chapter 7 or under Chapter 11.

Chapter 7, entitled Liquidation, allows for an orderly, court-supervised procedure by which a trustee collects the assets of the firm, reduces them to cash, and makes distributions to creditors, subject to the debtor's right to retain certain exempt property and the rights of secured creditors.

Firms desiring to continue operations, and which have the ability to repay creditors concurrently through a court-approved plan of reorganization, file for Court protection under Chapter 11 of the Bankruptcy Code, entitled Reorganization.[7] The reorganization plan must provide creditors with a disclosure statement containing information adequate to enable creditors to evaluate the plan. The court ultimately approves or disapproves the reorganization plan. Under the confirmed plan, the debtor can reduce its debts by repaying a portion of its obligations and discharging others. The debtor can also terminate burdensome contracts and leases, recover assets, and re-scale its operations in order to return to profitability.[8]

Under Chapter 11, the debtor reorganizes its business plan, seeking alternative ways to run the business and to emerge from bankruptcy as a profitable enterprise. As the firm restructures its business, it faces supply and demand shocks inherent to operating under bankruptcy protection. These shocks can change the competitive interaction of firms in the industry. In the empirical analysis these shocks are captured by bankruptcy categorical variables. This is because the available accounting data on costs report exactly those liabilities which are renegotiated under bankruptcy

[7] The automatic stay protects the debtor by suspending collection activities, foreclosures, and repossessions of property by the creditors on any debt that arose before the filing of the bankruptcy petition.

[8] Two important Sections of Chapter 11 give airlines filing for bankruptcy protection a greater ability to renegotiate contracts with employees and with aircraft lessors: Sections 1113 and 1110. Under Section 1113, the airline can unilaterally modify labor agreements if negotiations turn out to be unsuccessful. For instance, if the carrier's unions do not agree to any labor renegotiation, the carrier can request that the bankruptcy Judge impose new contracts and force the unions to accept them. Clearly, the threat that the bankruptcy carrier can resort to Section 1113 gives the carrier an upper hand in the negotiations, allowing the airline to achieve reductions in the labor costs. Under Section 1110, a carrier that has defaulted on its aircraft lease payments has a 60 day grace period to find funds to make lease payments and keep the aircraft. Past the 60 day grace period, if the carrier has not paid its outstanding lease charges, the lessor can re-possess the aircraft. Rarely have lessors reposed their aircraft. In most occasions, the carrier finds some financing. If no financing is available, carriers either renegotiate lower lease payments, and if this fails, the airlines return the aircraft before repossession is forced. Repossessions have occurred for smaller carriers such as MarkAir (2^{nd}), Western Pacific, and Sun Country Airlines.

and hence do not reveal exogenous cost shocks. Demand shocks, such as changes in the reputation of a firm, are not observable. Before discussing the nature of the demand and cost shocks associated with a bankruptcy filing, we summarize the information that we use to construct the bankruptcy categorical variables.

2.2 Stylized Facts of Airline Bankruptcies

We first identified airlines that have filed for bankruptcy protection between 1993 and 2005 from the Air Transportation Association (ATA) website[9]. This website provides a list of the names of air carriers that have filed for bankruptcy protection, the date of the bankruptcy filing, and the type of protection the airline requested (reorganization under Chapter 11 or liquidation under Chapter 7). We cross check this data with the Bankruptcy Research Database compiled by Professor Lynn LoPucki.[10]

We enrich this data with information from news reports recorded in Factiva and Lexis-Nexus. For each of the airlines that filed for bankruptcy protection between 1993 and 2005, we manually search Factiva and Lexis-Nexus for any news report dating back to about one year prior, and two years after, the firm's bankruptcy filing. This allows us to include items such as: Whether the filing is voluntary or not, whether the airline originally filed for Chapter 11 protection but was forced to convert its filing to Chapter 7, whether the carrier emerged from bankruptcy or not, the date of emergence or liquidation, the way the carrier emerged (e.g., reorganizing on its own or merging with another carrier), if the carrier was gounded and if so, we record the date it stopped flying and if this was a voluntary decision or a requirement by the FAA based on safety concerns.

These news searches revealed stylized facts of bankruptcy in the airline industry. **Table 1** summarizes our main findings.

Columns 3 and 4 show that almost all airlines first file for Chapter 11 protection. Large airlines immediately begin developing a reorganization plan. Smaller carriers first attempt to keep the business alive seeking an investor who would buy the carrier's flying certificate and any other assets the carrier might still posses. If the carrier's management is unsuccessful at finding such investor(s) the carrier converts its Chapter 11 filing into a Chapter 7 one. For instance, in the case of MarkAir's second filing the U.S. Bankruptcy Court involved in the proceedings, changed

[9] The data is complied from ATA research, DOT records, "The Bankruptcy Virus in the U.S. Airline Industry: Causes and Cures," Aviation Forecasting and Economics and The George Washington University, Lehman Brothers Equity Research, BankruptcyData.com, Chicago Tribune.

[10] This database includes all Chapter 11 bankruptcy cases that satisfy the following two requirements. First, the debtor group filing for Chapter 11 protection must have assets worth at least $100 million at the time of filing, measured in 1980 dollars, and as listed on the last 10-k filed prior to bankruptcy (provided that 10k is for a year ending within three years prior to bankruptcy). Second, the debtor group is required to file 10-ks with the SEC. For the airlines satisfying these requirements, we double check the filing dates, the type of filing, and the date of emergence where available.

MarkAir's Chapter 11 protection filing to a Chapter 7 liquidation after the carrier spent about 8 months under Chapter 11 protection; this allowed the closed airline to start selling its assets to pay off creditors.

Column 5 shows that in the only two cases of the Sun Country and Eastwind when airlines had to file for protection under Chapter 7, the filing was initiated by the carrier's creditors who take the airline to Court - making this an involuntary filing.[11]

Column 6 shows that there are airlines that filed multiple times for Chapter 11 protection. Columns 7 to 11 show that the probability that airlines emerge as an independent entity declines with the number of filings in the past and with the shorter time span between filings. For example, USAir emerged in 2005 after merging with America West, and TWA emerged in 2001 after being acquired by American. We should then expect the competitive behavior to change differently when carriers file for the first time, or for subsequent times. This, indeed, is what we find in our empirical analysis.

Finally, Column 12 show that there is large variation in the duration of bankruptcy protection in the airline industry. There does not seem to be any clear relationship between the duration and the probability of emergence from bankruptcy.

2.3 Supply Shocks

Bankruptcy protection allows the distressed carrier to implement cost-saving actions that would be illegal outside of court protection. For airline carriers some of the most important cost-saving strategies involve lease rejection and renegotiation, pension payments renegotiations or rejections, forcing labor union concessions.

Leases. Under Section 1110 of Chapter 11, a bankrupt carrier that has defaulted on its aircraft lease payments is granted a 60 day grace period to find funds to make lease payments and keep the aircraft. Past the 60 day grace period, if the carrier has not paid its outstanding lease charges, the lessor can re-possess the aircraft. Rarely though, have lessors repossessed their aircraft.[12] Most lessors are willing to renegotiate payments with the bankrupt carrier, because the lessor who takes back a plane would have to redeploy the plane elsewhere, and in an industry in distress, that might be more costly than, for example, extending payment schedules, or renegotiating payment terms. Further, since rescinded leases become a general unsecured claim on the carrier, the carrier has a strong bargaining position with their lessor.[13] In rare instances, the lessor takes the carrier to

[11]For Sun Country Airlines, it took the the carriers lessors' to file for involuntary liquidation. In few occasions the FAA grounds the airline for safety concerns, or for training and maintenance violations, as in the case of Kiwi Airlines, MarkAir, and ProAir. Unless the airline is already under Court protection, the FAA grounding precipitates the carrier's bankruptcy filing.

[12]Repossessions have occurred for small carriers such as MarkAir (second bankruptcy), Western Pacific, and Sun Country Airlines.

[13]For instance, during Continental's second bankruptcy filing 12 aircraft leasing companies agreed to defer, reduce,

court over missed lease payments, forcing a Chapter 11 filing.[14]

A carrier's lease is not restricted to aircrafts. Commonly, carriers lease airport facilities, such as gates and hangars. These leases can also be renegotiated and rejected under Chapter 11 protection.[15]

Pension Payments and the PBGC. One of the largest burdens affecting most carriers are obligations to employees and retirees through the defined benefit pension programs. Most legacy carriers under bankruptcy protection use their bankruptcy filings to renegotiate or renege on their defined benefit pension obligations, transferring the burden of pension obligations to tax payers via the Federal Pension Benefit Guarantee Corporation (PBGC), a government run insurance company.[16]

Reneging on pension obligations, or renegotiating with employees and retirees on pension payments, can substantially lower the carrier's operating cost.

Labor Renegotiations. The airline industry is heavily burdened by labor union contracts. Renegotiations with labor unions and employees is one of the most important cost-saving strategies airlines operating under bankruptcy protection take. The threat that the carrier can be forced into liquidation, leaving employees jobless, makes labor unions and employees more willing to renegotiate than they would otherwise be. Furthermore, Chapter 11 status gives companies the ability to void labor contracts with a judge's approval.[17]

2.4 Demand Shocks

There are reputation costs associated with a bankruptcy filing, that might affect the demand for a bankrupt carrier's flights. For example, Opler and Titman (1994) show that highly leveraged firms lose substantial market share to their more conservatively financed competitors during industry downturns. More specific to the airline industry, Rose (1990) shows that airline profitability is

or forgive lease payments on 98 planes in Continental's fleet. America West negotiated rent relief on the planes it leased with lessor Ansett Worldwide Aviation Services. ATA returned 18 planes to lessor General Electric. Delta Airlines requested, as part of its bankruptcy filing, court approval to reject leases on Delta aircrafts.

[14] Lessors of US Air were considering filing a lawsuit against the carrier, but Brad Gupta, the president of Chicago-based Ameriquest Holdings which leases aircrafts to US Airways, publicly recognized in a statement on July 25, 2002 that such an action would leave the lessor facing other problems: lower lease rates and lower demand for rejected leases thus discouraging the lessor's lawsuit.

[15] Delta has rejected or restructured dozens of leases at airports, including Tampa, Dallas and Orlando

[16] For instance, under United Airline's reorganization plan, the PBGC took over all four of the airline's under-funded pension plans. Immediately after filing for Chapter 11, Delta Airlines sought permission to cut off payments to a bulk of the retirement annuities received by thousands of former employees, in order to save $80 million a year. Northwest Airlines, which filed on the same day as Delta airlines, sought similar protection from the PBGC.

[17] For instance, David Siegel, CEO of US Airways, took the carrier into Chapter 11 when the airline's mechanics wouldn't join other unions in making voluntary sacrifices. Once in Chapter 11, the ability to void labor contracts with a judge's approval, helped Siegel win concessions from the mechanics labor union. Another clear example is United Airlines, which filed a motion in U.S. Bankruptcy Court in Chicago to start the process of voiding the unions' labor contracts and imposing new terms that would significantly cut the carrier's expenses, on December 30, 2002 just 20 days after its Chapter 11 filing.

directly correlated with airline safety. Bankrupt carriers tend not to be profitable, thus the safety of flying a bankrupt carrier is questionable. It is possible that consumers who recognize this might shift their demand away from the bankrupt carrier to the non-bankrupt carriers.[18]

Safety consideration aside, passengers might still prefer to fly non-bankrupt carriers. Customers fear that a bankrupt carrier might not emerge from bankruptcy protection and therefore any miles accumulated in the carrier's frequent flier program would be lost. Furthermore, passengers have shown concern that, even if the carrier emerges from bankruptcy, frequent flier miles might not be honored by the emerging carrier.[19] This would drive demand away from the distressed carrier to its non-distressed competitor.

3 The Model

We consider a model with two firms, $j = 1, 2$. The firms' strategic variables are prices, and the firms produce differentiated goods. The equilibrium notion that we use to solve the game played by the two firms is the Bertrand-Nash equilibrium in prices. For each one of the two firms, we can draw its reaction function. The reaction functions of the two firms are graphically presented in **Figure 1**.[20]

Figure 1 shows two graphs, each presenting comparative statics on the reaction functions of the two airline firms.[21]

We start from a situation where the two airline firms choose equilibrium prices $\left(p_j^O, p_{-j}^O\right)$. This is the pre-bankruptcy situation. Then, we consider what happens when firm j files for bankruptcy protection.

Figure 1a considers the case where j's bankruptcy filing impacts only its costs. The nature of the cost shocks, described in Section (2.3), suggests that we should expect firm j to be able to lower its costs. This shifts j's reaction curve to the left: for any price of its competitor, p_{-j}, firm j is now going to choose a lower price. As a result, firm j will lower its prices, and its competitor will also lower p_{-j}. The new equilibrium is at $\left(p_j^N, p_{-j}^N\right)$, where both firms charge lower prices for

[18] Yet, the evidence of Borenstein and Zimmerman (1988) might suggest the opposite. The authors investigate the impact of accidents on demand for an airline's services. They find virtually no effect of safety on demand for an airline's services (following a crash, the demand effects on the airline that crashed are small and short term-lived). The authors also find very small effects on the demand on the competitors of the carrier that experienced an accident. This indicates that that passengers who chose not to fly a carrier following an accident, decline to fly *any* airline. For our purpose, this suggests that safety concerns following bankruptcy might have little effects on the demand of the bankrupt and non-bankrupt carrier.

[19] For example, an article in the Wall Street Journal on December 11, 2002, shows United's concern with customer loses due to reputation effects following its bankruptcy filing: "United Airlines has launched a national advertising campaign to reassure customers that it will keep flying following its bankruptcy-law filing,..." "The all-text, black-and-white ads assure customers that United, a unit of UAL, is honoring tickets and frequent-flier miles."

[20] See the appendix for the presentation of a simple model that leads to these graphical representations of the reaction functions of the firms.

[21] The reaction functions are represented as linear only for sake of simplicity.

the same service.

Figure 1b considers two cases. First, the filing for bankruptcy protection changes the demand faced by the firms in the market. When firm j files for bankruptcy protection, its demand drops and the demand for travel on carrier $-j$ will increase. Now, the reaction function of firm j will further contract, and shift even more to the left. In addition, the reaction curve of firm $-j$ expands and shifts to the left. While p_j clearly drops, the prediction on p_{-j} is ambiguous. If the demand shocks are large enough the price of the competitor might actually increase after the filing. The ambiguity of the theoretical results suggest that the question of the effect of bankruptcy on market competition is primarily an empirical question. The second of the cases considered occurs if a bankrupt firm's competitors change their pricing behavior independently of what happens to their demand functions. For example, Borenstein and Rose (1995) discuss how bankruptcy may alter the strategic position of the firm, committing to more aggressive competition. If the competitors soften the way they compete with a bankrupt firm, then their reaction functions expand, and they raise their prices. If they compete more aggressively, then their reaction functions contract and they lower their prices.[22]

The empirical framework described in Section (5.2) takes the model represented in **Figure 1,** and its predictions, to the data.

4 The Data

4.1 Market and Carrier Definitions

Market and Carrier Definition. Following Ciliberto and Williams (2007), we define a market as a *unidirectional* trip between two cities, here defined as Metropolitan Statistical Areas (MSAs), regardless of the number of stops that the traveler had to make in between. Thus, a market is a pair of MSAs. Trips to the same city but to different airports are treated as different products. This definition of market is consistent with the analysis of demand in Borenstein (1991). The dataset includes a sample of markets between the top 50 MSAs, ranked by the population size.[23] Data on ticket prices are from the Origin and Destination Survey (DB1B), which is discussed in the Appendix.

We identify 12 national carriers operating at some point during the our sample window: American, Continental, Delta, America West (until the third quarter of 2005), Northwest, TWA (until the second quarter of 2001), United, USAir, Southwest, Markair, ATA, National. We combine all

[22] See also Khanna and Tice (2005) for a study of how firms might strategically lower prices during recessions to force exit of efficient, financially constrained rivals. Kovenock and Phillips (1997) for a study on how leveraged buyouts impact plant closing decisions.

[23] To construct the sample, we take all the markets between the top 50 MSAs, and then we draw a 10 percent sample of them. For each one of these markets we include any year-quarter observation that is in the original dataset. We consider a smaller sample to alleviate the computational burden in the structural analysis.

the remaining low cost carriers in one group, which we call the LCC type (e.g., the LCC category includes Jet Blue and Frontier). For each market-year-quarter, we take the averages across the low cost carriers for the variables of interest. This allows us to keep small carriers that are present in only a few markets. Further, it allows us to use a meaningful grouping capturing the impact of small carrier presence in the market. We exclude Markair, ATA, and National from the LCC type to study the effect of their bankruptcies.

There are $52,394$ market-carrier-year-quarter specific observations. In the following, markets are indexed by $m = 1, ..., M$ and year-quarter combinations by $t = 1, ...T$. Airport-to-airport routes are denoted by $r = 1, ..., R_{mt}$. The subindex $j = 1, ..., J_{mt}$ denotes an airline in market m at time t. A single product is then denoted by a combination $jrmt$, which indicates that airline j (e.g. American) transports its passengers on the route r (Chicago O'Hare to Fort Lauderdale Airport) in the market m (Chicago-Miami) at time t (e.g. the second quarter of 2002). The number and identity of carriers changes by market, route, and time. In any market m and time t, the consumer can choose among C_{mt} choices, which is related to the number of airlines in a market (J_{mt}) and the number of airports in the two cities.

Bankrupt Carriers. In our sample period, the carriers that filed for bankruptcy protection at some point are UA, $US(1^{st})$, $US(2^{nd})$, NW, DL, TZ, $TW(1^{st})$, $TW(2^{nd})$, $TW(3^{rd})$, $N7$, $BF(1^{st})$, $BF(2^{nd})$, HP, CO. Notice that TWA filed for Chapter 11 three times, USAir and Markair filed twice. We will investigate the effect on prices for each one of these filings.[24] **Table 2** provides summary statistics for these categorical variables. Using **Table 1**, we build a series of categorical variables, illustrated in **Table 3**, to indicate whether one of the firms in the industry is operating under Chapter 11 protection. For example, $KisBkt_{mt}$ is a categorical variable equal to 1 if carrier K serving market m is under bankruptcy protection at time t. Otherwise, $KisBkt_{mt}$ is equal to zero. The subscript m indicates whether firm K is an active participant in market m. If K is not in the market, then $KisBkt_{mt} = 0$.

4.2 Itinerary Fare

We follow Borenstein (1989) and Ciliberto and Williams (2007), and summarize the airline pricing behavior using the median, the 25th, and the 75th percentiles of the fares.[25] By doing so, we use some information on the distribution of prices available from the DB1B dataset while using as few statistics as possible.[26] The difference between the 75th percentile of the fares (189.88 dollars) and

[24] The second time that Markair filed for Chapter 11, Markair filed for Chapter 7 after two quarters under Chapter 11.

[25] The Origin and Destination Survey (DB1B) provides information on characteristics of the trip, such as whether the ticket is for round-trip travel or whether the ticket is for a direct flight. The dataset does not provide ticket characteristics (e.g. refundable or not), or characteristics of the buyer.

[26] Borenstein and Rose (1994) show that dispersion in the prices that an airline charges to different passengers in the same market is substantial and is consistent with discrimination based on customers' willingness to switch to

the median (137.68 dollars) is twice as large as the difference between the median and the 25th percentile of the fares (107.56 dollars), suggesting that there is much more dispersion at the top of the distribution than at the bottom. The variable P_{jrmt} denotes the fare charged by an airline.

4.3 Exogenous Variables

Average Cost per Seat Mile. The economic marginal cost, which would be the relevant cost information, is not observable.[27] Still, it is reasonable that the economic marginal cost of transporting one passenger is a function of the average cost to carry one passenger for one mile, a concept known in the airline industry as the average cost per seat mile. We construct the average cost per seat mile using the ratio of the quarterly operating expenses available from the Air Carrier Financial Reports (Form 41 Financial Data) over the quarterly total of the product of the number of seats transported and of the number of miles flown by the airline. Data on the total number of seats and miles flown is from the Air Carrier Statistics (Form 41 Traffic). The average cost per seat mile is denoted by $ASMCost_{jt}$. Its average is approximately 9 cents per seat mile, and can be as low as 4 cents and as high as 13 cents. Notice that this variable is not market specific.

In the structural analysis, we infer the economic marginal cost from the firms' pricing decisions under the assumption that airline firms play a non-cooperative *static* Nash-Bertrand game with differentiated products. This behavioral assumption is the same as in Bresnahan (1987), Berry, Levinsohn, and Pakes (1995), Nevo (2000 and 2001), Petrin (2002).[28]

Measures of Product Differentiation. We include a measure of the network of an airline at an airport and is motivated by the work of Berry (1990, 1992) and Ciliberto and Tamer (2006). $NetworkExtentOrigin_{jrmt}$ is equal to the percentage of all markets served out of an airport by airline j.[29]. The variable $NetworkExtentDest_{jrmt}$ is defined similarly. Airlines also differentiate

alternative airlines.

[27]Notice that the economic and accounting costs of flying one passenger are very different. The accounting cost of flying one passenger is the cost of issuing a ticket, processing the passenger through the gate, providing in-flight food and beverages, and insurance and other liability expenses. This cost is very small relative to the fixed costs faced by an airline to fly a plane on a route. However, this definition of accounting cost does not include the net profit on the passenger that the airline could have made on another route using the same plane, pilots and flight attendants (Elzinga and Mills [forthcoming]). In addition, it does not include the rental rate at which the airline could have leased the gate.

[28]Aguirregabiria and Ho [2006] consider a dynamic model of the airline industry. In their model, demand and supply in each period are independent across time. The entry decision is the only choice that that enters in their model in a dynamic fashion. The only, important, difference with our model is that we do not model the entry decision. Thus, market structure is assumed to be exogenous in our model, exactly as in Bresnahan [1987], Berry, Levinsohn, and Pakes (1995), Nevo [2000 and 2001], Petrin (2002).

[29]For example, in the second quarter of 2002, Northwest was serving 82.6 percent of the markets out of Minneapolis. The closest competitor of Northwest at Minneapolis was American, which was serving 43 percent of the markets. To the traveler interested in collecting frequent flyer miles, Northwest was clearly providing a more attractive service, *ceteris paribus*, than American at Minneapolis. It is difficult to assess the extent to which this measure of network service out of airports proxies the attractiveness of the airlines' frequent flyer programs, since it may also measure the extent to which an airline is the only provider out of an airport, or other services at the airport (food courts, the

their product in terms of the shortness of the flight between two airports. The variable $Direct_{jrmt}$ measures the percentage of tickets for direct service out of the total tickets sold by j.[30] When airlines provide connecting service, they must decide how many miles the passenger must travel in addition to the nonstop distance between two airports. $ExtraMiles_{jrmt}$ is equal to the ratio of the flown distance over the nonstop distance in miles between two airports.[31] Finally, airlines differ in the prices that they charge for one-way and round-trip tickets. The variable $RoundTrip_{jrmt}$ measures the percentage of roundtrip tickets.[32] Institutional characteristics of the airline industry ensure that these five variables are determined prior to the airlines' choice of prices. This is because prices can be changed at any time by an airline, while none of these variables can be changed in the same short period of time. Flight schedules, which involve crew scheduling and aircraft assignments, are developed a year prior to departure and updated every three months.[33] We will maintain that these five variables are exogenous in the demand and supply equations, and in the reduced form equation as well.

In some specifications, we also include other variables that explain variation in prices, such as the nonstop market distance and whether the destination airport is in either California, Florida, or Nevada (these are mostly tourist destinations). We also include the average temperatures at the origin and destination airports in February, May, July, and October.[34] Finally, we include the average precipitation at the origin in the same months, and the difference with the average precipitation at the destination airport.[35]

5 Econometric Model

First, we provide a reduced form price regression and then a structural model of supply and demand in the airline industry. Our model of supply and demand could be solved to yield a reduced form, but the resulting regression equation would have a complex non-linear form. Instead, we propose linear versions of the reduced form pricing equation. Consequently, the parameters in the reduced form equations are not related to the coefficients in the supply and demand model that we present below in an obvious way.

number of ticket counters, *etc*). See Lederman [forthcoming] for an analysis of the effect of FFPs on airlines' demand.

[30] If an airline provides both direct and connecting service, $Direct_{jrmt}$ is a fraction between 0 and 1.

[31] Thus, a direct flight will be associated with a value of $ExtraMiles_{jrmt}$ equal to 1, while connecting flights will be associated with values larger than 1. Clearly, the larger the number of extra miles that a passenger must travel between two airports, the less attractive is to travel on a connecting trip than on a nonstop trip.

[32] Most of the major airlines sell round-trip tickets at a considerable discount relative to buying two one-way tickets. Other airlines, such as Southwest, do not make such a difference.

[33] For more on this, see Ramdas and Williams [2007], and references therein.

[34] The data are from the site *weather.com*. They were collected in April 2005.

[35] Summary statistics for variables that are used in the analysis, for example the average temperature at the origin MSA, but are not shown in **Table 2** are available from the authors.

5.1 Reduced Form Analysis

First, we test the hypothesis that bankruptcy changes product market competition by studying the effect of a carrier's bankruptcy on the average price of tickets in the market where the carrier operates. Then, we study carrier specific responses to each of the bankruptcies in our sample.

5.1.1 Mean price effect, across markets and carriers

Using the notation introduced in Section (4.1), the first equation of interest is the following:

$$\ln P_{jrmt} = a_1 \cdot KisBkt_{mt} + b_1 \cdot KisIn_{mt} + \mathbf{X}_{jrmt}\mathbf{c}_1 + u_{1,jr} + u_{1,t} + u_{1,jrmt}. \tag{1}$$

The precise definition of the variables in the above equation is given in **Table 3**. Here, we present a brief discussion of what they measure. The coefficient a_1 of the variable $KisBkt_{mt}$ measures the effect that firm K's bankruptcy filing has on the prices of all firms in route r serving market m at time t. This is our main coefficient of interest for this specification. $KisIn_{mt}$ measures whether K's presence in a market affects the pricing behavior of all other carriers in that market, regardless of whether K is under Chapter 11 protection. $\mathbf{X}_{jmt}$ is a matrix of variables that are exogenous market or carrier specific, time varying determinants of prices. $u_{1,jr}$, $u_{1,t}$, and $u_{1,jrmt}$ are the error terms: $u_{1,jr}$ is a market-carrier effect; $u_{1,t}$ is a time effect; $u_{1,jrmt}$ are route-carrier-year-quarter idiosyncratic unobservables. We will use fixed and random effects to estimate the route-carrier, year-quarter effects, and report the differences in the estimation specifications.

Notice that in equation (1) only one firm, K, is under bankruptcy protection. This is just for simplicity of exposition. The full blown equation (1), incorporates as many terms $a_1 \cdot KisBkt_{mt} + b_1 \cdot KisIn_{mt}$ as bankrupt carriers there are.

5.1.2 Carrier-specific price response

The second reduced form specification investigates the effect of bankruptcy protection on the bankrupt carrier's own prices and on the competitors' prices in markets where the bankrupt carrier is actively competing:

$$\begin{aligned} \ln P_{jmt} \;=\; & a_2^{OWN} BktOwn_{jmt}^K + a_2^{LAR} BktLAR_{jmt}^K + a_2^{WN} BktWN_{jmt}^K + a_2^{LCC} BktLCC_{jmt}^K \\ & + b_2 \cdot KisIn_{mt} + \mathbf{X}_{jrmt}\mathbf{c}_2 + u_{2,jr} + u_{2,t} + u_{2,jrmt}.. \end{aligned} \tag{2}$$

The coefficient of $BktOwn_{jmt}^K$, a_2^{OWN}, captures the effect of K's bankruptcy filing on K's prices; a_2^{LAR} captures the effect on the prices of legacy carriers (American, Continental, Delta, Northwest, TWA, USAir, or United); a_2^{WN} captures the effect on the prices of Southwest; a_2^{LCC} captures the effect on the prices of low cost carriers. $KisIn_{mt}$and $\mathbf{X}_{jrmt}$ are as defined in Section 5.1.1, $u_{2,jr}$, $u_{2,t}$, $u_{2,jrmt}$ are the equivalent for this specification of the error terms in Section 5.1.1.

Again, for simplicity of exposition, only one carrier, K, is under bankruptcy protection, but the full blown equation we estimate incorporates as many terms $a_2^{OWN} BktOwn_{jmt}^K$, $a_2^{LAR} BktLAR_{jmt}^K$, $a_2^{WN} BktWN_{jmt}^K$, $a_3^{LCC} BktLCC_{jmt}^K$ and $b_3 \cdot KisIn_{mt}$ as bankrupt carriers there are.

5.2 Structural Analysis

5.2.1 Demand

Following Morrison and Winston (1989), Berry (1990), BCS, Aguirregabiria and Ho (2006), and Lederman (forthcoming), we model the demand for airline travel with a discrete choice model of demand. Consumers can choose among several carriers and airports to fly between two MSAs. Recall from Section (4.1) that a product here is a carrier-airport-to-airport combination.

Consumers can also decide not to fly. The decision not to fly is modeled as equivalent to choosing an outside option, $j = 0$. A crucial role of the outside good is to make sure that if the prices of all airlines increase, the aggregate demand drops. The shares of the outside good and of the inside goods are a function of the *potential* demand for unidirectional air travel. We model the potential demand for unidirectional air travel equal to the population of age 21 to 65 years old of the origin city.[36] This definition is consistent with those used by Berry, Levinsohn, and Pakes (1995), Nevo (2000,2001), and Petrin (2002). Notice that the inclusion of route-carrier specific effects addresses the possibility that markets and routes from the same city differ by some unobservable feature.

As before, let K denote a firm that files for bankruptcy protection at some point in time. We write the indirect utility that consumer i receives from purchasing airline product j in market m at time t as:

$$u_{ijrmt} = \mu p_{jrmt} + \mathbf{X}_{jrmt}^D \psi + \tilde{\epsilon}_{ijrmt},$$

and

$$u_{iKrmt} = \phi^K BktOwn_{Kmt}^K + \mu p_{Krmt} + \mathbf{X}_{Krmt}^D \psi + \tilde{\epsilon}_{iKrmt}.$$

Here, $\mathbf{X}_{jrmt}^D$ is the subset of $\mathbf{X}_{jrmt}$, first defined in Section (5.1), that determines the demand of airline travel. $BktOwn_{jmt}^K$ is defined as in Section (5.1.2), and ϕ^K measures the effect that K's filing for Chapter 11 has on the utility that consumers derive from flying on carrier K. The demand for travel on all airlines is affected when carrier K files for Chapter 11 because the choice of flying is made comparing all airlines.[37]

Next, we model the error term $\tilde{\epsilon}_{ijrmt}$ as follows:

$$\tilde{\epsilon}_{ijrmt} = \zeta_{igm} + \xi_{jr} + \xi_t + \xi_{jrmt} + \epsilon_{ijrmt}.$$

[36] The total size of the population is from the Regional Economic Accounts (Local Area Personal Income). The fraction of individuals that are of age 21 to 65 years old is from the Current Population Survey.

[37] Formally, consumer i flies on the bankrupt firm K instead of airline j if: $u_{iKmt} \geq u_{ijmt} \Leftrightarrow -\phi^K BktOwn_{Kmt}^K + \mu \left(p_{Krmt} - p_{jrmt}\right) + \left(\mathbf{X}_{Krmt}^D - \mathbf{X}_{jrmt}^D\right) \psi + \tilde{\epsilon}_{iKrmt} - \tilde{\epsilon}_{ijrmt} \geq 0$.

Here, ϵ_{ijrmt} is an identically and independently distributed extreme value. ζ_{igm} is an unobserved variable common to all products in group g and has a distribution that depends on λ with $0 \leq \lambda < 1$.[38] The distribution of ζ_{igm} is the unique distribution with the property that, if ϵ_{ijrmt} is an extreme value random variable, then $\zeta_{igm} + (1-\lambda)\,\epsilon_{ijrmt}$ is also an extreme value random variable (see Berry (1994)). We consider the case where there are two nests in each market: flying and not flying. Then, the λ parameter governs consumers' substitution patterns between flying and the outside option (not traveling, driving, ...). Higher values of λ imply that the consumer views products in different nests as poor substitutes.

ξ_{jr} is a route-carrier specific unobservable; ξ_t is a year-quarter specific unobservable. We control for these unobservables using fixed effects, exactly as in the reduced form regression. Finally, ξ_{jrmt} is a route-carrier-year-quarter unobservable. Firms and consumers observe this error and firms take it into account when they set their prices. Hence, prices are correlated with the errors and we need to introduce exclusion restrictions. We discuss the instruments in Section (6).

We aggregate across consumers to get the following expression for the demand and then rearrange to write:

$$\ln(s_{jrmt}) - \ln(s_{0mt}) = \phi^K BktOwn^K_{jmt} + \mu p_{jrmt} + \mathbf{X}^D_{jrmt}\psi + \lambda \ln(s_{jrmt|g}) + \xi_{jr} + \xi_t + \xi_{jrmt}, \quad (5)$$

where all the parameters of the consumers' utility function now enter the equation linearly (Berry (1994)). Here, s_{jrmt} and s_{Krmt} represent product $j's$ and $K's$ market shares, s_{0mt}, the share of the outside good, $s_{jrmt|g}$ the group share of product j. We have normalized the value of the outside option to: $u_{0mt} = \zeta_{0mt} + (1-\lambda)\epsilon_{i0mt}$. Equation (5) provides the first set of equations that enter our system of demand and pricing equations.

5.2.2 Pricing Equation

The pricing equation is derived from the first order condition of the carrier's profit maximization problem for all its products sold in market m at time t. Following Nevo (2000), and omitting the bankruptcy terms for sake of brevity, these carrier's first order conditions for profit maximization can be derived as follows. First write the profit function of an airline j in market m as (fixed costs and market size are omitted for simplicity):

$$\pi_{jmt} = \sum_{l \in F_{jmt}} (\underset{1\times1}{p_{jlmt}} - \underset{1\times1}{mc_{jlmt}}) \underset{1\times1}{s_{jlmt}} \left(\underset{C_{mt}\times1}{\mathbf{p}_{mt}}, \underset{C_{mt}\times K}{\mathbf{X}_{mt}}, \underset{C_{mt}\times1}{\boldsymbol{\xi}_{mt}} \right)$$

where F_{jmt} is the sets of routes served by firm j in market m at time t. Recall that C_{mt} is the set of all possible choices for the consumers. Then, $F_{jmt} \subseteq C_{mt}$. Further, p_{jlmt}, mc_{jlmt}, and s_{jlmt} are

[38] In the empirical implementation we do not restrict λ to be included between 0 and 1. We do estimate it to be between those two values.

firm j's fare, marginal cost and market share in route l, market m at time t, respectively.

The first order conditions for the price of a ticket on route r served by product firm j satisfies $s_{jrmt} + \sum_{l \in F_{jmt}} (p_{jlmt} - mc_{jlmt}) \frac{\partial s_{jlmt}}{\partial p_{jrmt}} = 0$. Using vector notation this simplifies to,

$$\underset{C_{mt}\times 1}{\mathbf{s}_{mt}} + \underset{C_{mt}\times C_{mt}}{\boldsymbol{\Omega}^{mt}} (\underset{C_{mt}\times 1}{\mathbf{p}_{mt}} - \underset{C_{mt}\times 1}{\mathbf{mc}_{mt}}) = \mathbf{0} \tag{6}$$

where the matrix $\boldsymbol{\Omega}^{mt}$ is the matrix of cross and own price elasticities after we replace those entries which correspond to routes served by different carriers with zeros. Thus, an entry in the matrix $\boldsymbol{\Omega}^{mt}$ is defined as,

$$\Omega^{mt}_{jl} = \begin{cases} -\frac{\partial s_{jlmt}}{\partial p_{jrmt}} & if \exists j: \ \{r, l\} \subset F_{jmt} \\ 0 & otherwise. \end{cases}$$

Because we estimate the demand for airline travel, we can estimate the matrix $\boldsymbol{\Omega}^{mt}$. We can invert the matrix, $\boldsymbol{\Omega}^{mt}$, to solve for the equilibrium price vector, $\mathbf{p}_{mt}$, in equation (6) to yield the pricing equation we will estimate,

$$\mathbf{p}_{mt} = (\boldsymbol{\Omega}^{mt})^{-1} \mathbf{s}_{mt} + \mathbf{mc}_{mt}. \tag{7}$$

The marginal cost of each product r served by firm j as follows:

$$mc_{jrmt} = \theta ASMCost_{jt} + \kappa w_{jrmt}.$$

where $ASMCost_{jt}$ is the accounting average cost per seat mile that we defined in Section (4.3) and w_{jrmt} are observed factors impacting the pricing decisions of airlines, and include controls such as $NetworkExtentOrigin$ and $NetworkExtentDest$.[39] Note that w_{jrmt} does not include time invariant route-carrier characteristics, since we include route-carrier fixed effects

Now, given the vectors $\boldsymbol{\Omega}^{mt}$ and $\mathbf{mc}_{mt}$, and including the bankruptcy terms, the pricing function we estimate is,

$$\begin{aligned} \mathbf{p}_{mt} \ = \ & \alpha^{OWN} \mathbf{BktOwn}^K_{mt} + \alpha^{LAR} \mathbf{BktLAR}^K_{mt} + \alpha^{WN} \mathbf{BktWN}^K_{mt} + \alpha^{LCC} \mathbf{BktLCC}^K_{mt} \\ & + \beta \cdot \mathbf{KIsIN}_{mt} + (\boldsymbol{\Omega}^{mt})^{-1} \mathbf{s}_{mt} + \mathbf{mc}_{mt} + \tilde{\boldsymbol{\omega}}_{mt}. \end{aligned} \tag{8}$$

Here, α^{OWN}, α^{LAR}, α^{WN}, and α^{LCC} are parameters measuring the supply side changes in pricing behavior that are not explained by changes in the markup of a firm ($(\boldsymbol{\Omega}^{mt})^{-1}\mathbf{s}_{mt}$), or in its marginal cost ($\mathbf{mc}_{mt}$), for large national carriers, Southwest Airlines, and low cost carriers, respectively. $\tilde{\boldsymbol{\omega}}_{mt}$ is the vector of unobservables that determine the pricing decisions of the firm. A cell in $\tilde{\boldsymbol{\omega}}_{mt}$ is

[39] The variables $NetworkExtentOrigin_{jmt}$ and $NetworkExtentDest_{jmt}$ enter into the first order condition as part of w_{jmt}. The larger the network, the more likely the presence of economies of densities at an airport (Brueckner and Spiller (1994)). However, as Borenstein (1989) clearly pointed out, firms might use the extent of their network at an airport to leverage the consumers' loyalty and charge higher prices. As above, the parameters associated with these two variables capture the *net* effect of these two opposite forces.

modeled as, $\tilde{\omega}_{jrmt} = \omega_{jr} + \omega_t + \omega_{jrmt}$,where ω_{jr} are route carrier specific unobservables and ω_t are year-quarter specific unobservables. We control for these two unobservables with the corresponding fixed effects. The unobservable ω_{jrmt} is route-carrier-year-quarter specific.

5.3 Estimation

Following Berry (1994) and Berry, Levinsohn, and Pakes (1995), we estimate the parameters of our model using GMM. Estimating the two equations simultaneously allows us to take into account the cross-equation restrictions present in our model. The non-linear parameters in our model include the price coefficient in the consumer's utility function, ϕ and the term governing substitution patterns, λ.[40] The assumption of a nested logit model of demand implies that the disturbance terms in both the supply and demand equations, $\omega_{jrmt}(\Theta)$ and $\xi_{jrmt}(\Theta)$ respectively, have an analytical solution as a function of the parameters and data as demonstrated above.[41]

6 Identification

There are four identification concerns that need to be addressed.

First, a firm's bankruptcy filing is a consequence of the firm's financial distress. And in turn, the firm's financial distress might impact the firm's pricing behavior. Thus, the firm's bankruptcy filing could potentially be a product of the firm's pricing strategy while in financial distress. As the firm's financial condition becomes increasingly dire, the firm might drop its prices to generate cash (Hendel (1996)). Competitors might match the price drop, which in turn, worsen the distressed firm's financial condition. As a result, the distressed firm might file for bankruptcy protection sooner than it would have, had it not lowered prices in an attempt to generate cash. Such behavior by the distressed firm and its competitors might dim the estimated effect that bankruptcy has on prices, since prices would be changing *before* the actual bankruptcy filing. We propose a simple solution to address this concern: We drop market-carrier-year-quarter observations that are from

[40] The small number of non-linear parameters allows one to get an excellent set of starting values for the GMM routine by first estimating demand and then the supply equation.

[41] The moment conditions we will use in estimation are constructed by interacting these unobservables with sets of exogenous instruments (discussed in detail in the next section) as

$$G(\Theta) = \begin{bmatrix} (\frac{1}{n}) \sum z'_{1jrmt}\xi_{jrmt}(\Theta) \\ (\frac{1}{n}) \sum z'_{2jrmt}\omega_{jrmt}(\Theta) \end{bmatrix}$$

These moment conditions are then used to construct an objective function to be minimized, implying that our final estimator takes the form $\widehat{\Theta} = \arg\min_{\Theta} G^*(\Theta)' G^*(\Theta)$,

where $G^*(\Theta) = A(\Theta)G(\Theta)$, and $A(\Theta)'A(\Theta) = W(\Theta)$, the weighting matrix used in estimation. The weighting matrix used in estimation is a consistent estimate of the inverse of the variance-covariance matrix of the moment conditions. The asymptotic distribution of our estimator is then $\sqrt{n}(\widehat{\Theta} - \Theta_0) \xrightarrow{d} (\Gamma'\Gamma)^{-1}\Gamma' V \Gamma(\Gamma'\Gamma)^{-1}$ where $\Gamma = E\left[\frac{\partial G^*(\Theta_0)}{\partial \Theta_0'}\right]$ *and* $V = E\left[G^*(\Theta_0)G^*(\Theta_0)'\right]$The standard errors reported use consistent estimates of both Γ and V. A consistent estimate of Γ is computed using numerical derivatives where necessary.

two quarters before a to-be-bankrupt firm's filing date and that are from markets where the to-be-bankrupt firm was present.[42] For example, since United filed for bankruptcy protection at the end of 2002, we drop from our dataset all the markets where United was present in the third and fourth quarter of 2002. We repeat this for all the bankruptcies in our sample. By dropping the quarters that immediately preceded the filing we can tease apart the pre-bankruptcy period, when the distressed firm might have taken desperate actions to avoid the bankruptcy filing, and the pre-bankruptcy period, during which bankruptcy was most likely unforeseeable.

Second, the presence of a carrier in a market might have some effect on the pricing behavior of other carriers in that market, regardless of the carrier's bankruptcy status. Thus, it is important to differentiate the effect on prices of a bankruptcy filing from the effect that just the presence of a firm in the market might have. To deal with this, we include the categorical variable $KisIN_{mt}$, which switches on when firm K is in market m at time t. This variable, however, is likely a function of the same unobservables that affect the pricing decisions.[43] We use market-carrier fixed effects to control for the unobservables just described.

Third, prices and shares are endogenous in the demand equation. Following Bresnahan (1987) and Berry, Levinsohn, and Pakes (1995), we look at the first order conditions for price to gain intuition regarding appropriate instruments. Under the assumption maintained in the literature, that the location of products in characteristic space precedes the pricing decision, Bresnahan (1987) and Berry, Levinsohn, and Pakes (1995) suggest that the closeness of competitors' products, measured in characteristic space, is an important and exogenous determinant of pricing behavior.[44] Examining the first order conditions for price, it is then clear that the $NetworkExtentOrigin_{krmt}$, and $NetworkExtentDest_{krmt}$ of all the firms $k \neq j$, present at the origin and destination are appropriate instruments for prices in the demand equation. Further examination of the first order conditions reveals a number of variables excluded from the demand system that also determine the pricing behavior of firms and consequently within group shares. These excluded variables include the vector of cost shifters, w_{jrmt} summarized in **Table 2**.

Finally, we include year-quarter fixed effects to control for demand changes spurring from seasonal, as well as exogenous, shocks (e.g. September $11, 2001$) and for supply shocks (e.g. increases in the cost of fuel).

[42] See footnote 2 in BR for another discussion on the endogeneity of bankruptcy filings. BR do not address the endogeneity of the filings in their analysis. The choice of two quarters is motivated by Table 5 in BR, which presents the change in prices 0-90 and 90-180 days before the filing.

[43] For instance, a carrier flying on a certain time schedule might benefit business travel in some markets but not necessarily in others, thus affecting the price behavior of that carrier in those markets. It could also be the case that a carrier in a given market uses more modern planes than other carriers in that same market; this unobservable plane quality characteristic in a specific market can potentially affect the price that each carrier in that market can demand for its service.

[44] See our discussion in Section (4.3) for more on this.

7 Reduced Form Results

7.1 Mean price effect across markets and carries

Table 4 presents the coefficient estimates for the reduced form equation (1) in Section 5.1.1. Bankruptcies are grouped according to some shared characteristic (for example, TWA's third filing and US Airways second filing share the feature that their bankruptcy ended when the distressed carrier merged with a financially sound carrier). In this specification, the coefficient on $KisBkt_{mt}$ measure the average price response, across carriers and markets, to the bankruptcy of carrier K flying in market m in year-quarter t.

Column 1 describes the baseline regression estimate. We first report the results for the group of bankruptcies for which of our sample period covers their pre- bankruptcy years, as well as the bankruptcy and post-bankruptcy years: United Airlines, US Airways (first filing), and ATA. The estimate on $UAisBkt_{mt}$ shows that in response to United Airline's bankruptcy, median prices dropped on average 2.5 percent. Similar results apply to the bankruptcy of ATA, which lead to an average price drop of 1.3 percent. The result for US Airways's first filing is slightly larger, with a mean price drop of about 3.3 percent. The second group of bankruptcies share the feature that their bankruptcy ended when the distressed carrier merged with a financially sound carrier: TWA merged with American Airlines on April 9, 2001, barely over 4 months after its Chapter 11 bankruptcy; and US Airways merged with America West on September 27, 2005, almost a year after its Chapter 11 filing. The average price reactions in response to these bankruptcies are larger in magnitude. The third set of results concerns not-first-time filers. In response to US Airways's second bankruptcy filing, the median price dropped by 8.7 percent and in response to TWA's third filing the median price dropped 4.9 percent. If repeated filings reveal a more dire financial condition, the larger price response could reflect the carrier's frantic attempt to collect cash and avoid liquidation, while competitors are more aggressively trying to push these carriers into liquidation.

During our sample period, two carriers, National Airlines and Markair, filed for Chapter 11 and subsequently converted their filing into a Chapter 7 filing. Under this filing, the bankrupt firm must sell its assets and liquidate. While these carriers operated under Chapter 11 protection, the price response to their Chapter 11 filing is not significant. One explanation for this result is that both the bankrupt carrier, as well as its competitors, knew that filing under Chapter 11 protection was a hopeless attempt by the bankrupt carrier to remain in business; thus the bankrupt carrier did not pursue a more aggressive pricing behavior, and the competitors were not compelled to follow suit, or to price more aggressively in an attempt to drive the distressed carrier to liquidate its assets.

Our sample periods begins with some carriers already operating under Chapter 11 bankruptcy protection. These carriers are Continental, America West, and TWA and Markair during their first filing. Thus, our estimates capture the average price reaction as these carriers prepare to emerge from bankruptcy protection. The estimates show that as Continental prepares to emerge from bankruptcy, average prices, across carriers in markets where Continental operates, drop by 7.9 percent. As America West's bankruptcy ends, average prices increase by 3 percent. There is no significant price reaction as Markair and TWA prepare to emerge. Two carriers filed for Chapter 11 protection towards the end of our sample period, Northwest and Delta Airlines. Thus for these carriers our estimates capture the early price reaction to Delta and Northwest's bankruptcy. In response to Delta and Northwest's filing, prices increase by 3.9 and 1.2 percent respectively. As will be shown below, this result is not robust to different specifications of equation (1).

The last bankruptcy we consider is a special case. It is TWA's second bankruptcy filing, which was a pre-packaged bankruptcy. This means that prior to filing for Court protection, TWA had a reorganization plan already approved by its creditors. Consequently, at the time of filing, the carrier and its competitor's were aware of TWA's business reorganization plan, and thus the filing in itself did not add to the carrier's strategic interactions. The coefficient estimate is economically insignificant.

Column 2 of **Table 4** reports the estimated coefficients when the pre-bankruptcy window (two quarters before a to-be-bankrupt firm's filing date) is excluded from our sample. Controlling for the endogeneity of the bankruptcy filing, the estimated price reaction to each filing is at least as large in magnitude as the estimated price reaction when ignoring the potential endogeneity issue. In the remaining of our analysis, we will keep dropping two quarters before a to-be-bankrupt firm's filing date.

Columns 3 and **4** of **Table 4** use the 25^{th} and 75^{th} percentile price as dependent variables. This illustrates how bankruptcy affects prices differently across the price distribution. The 75^{th} percentile price reaction to United's bankruptcy is almost twice as large as the reaction of the 25^{th} percentile price: While the latter drops 1.7 percent, the former drops 3 percent. The reaction to US Airway's first filing is more than twice as high for the 75^{th} percentile price than the 25^{th} percentile price: The latter drops 3 percent while the former drops 8.1 percent. The difference is not so stark for other carriers, but qualitatively the same results hold following the bankruptcies of US Airways second filing, TWA's third filing, National Airlines, and Markair. Thus, the largest price drop following a carrier's bankruptcy filing occurs at the top of the price distribution.[45]

Column 5 shows that the effect of bankruptcy on prices is overestimated if year-quarter effects are ignored. In particular, the effect of the bankruptcies of United, US Airways, National, TWA's third filing, and America West are at least twice as large when time effects are ignored. Thus,

[45] The BTS does not accurately report whether a fare corresponds to a first, business, or economy class ticket; so while we think that the larger price drop occurs for the first and business class tickets, we cannot confirm this in the data.

Column 5 confirms that specific controls for unobservable year-quarter effects are needed to obtain unbiased estimates for $KisBkt_{rmt}$ in equation (1).

7.2 Carrier-specific price response

The estimates reported in **Table 4** show the average price reaction to a carrier's bankruptcy filing without disentangling the own bankrupt carrier effect from the effect of competitors. In **Table 5** we tease apart a carrier response to its own bankruptcy, from the response of its competitors. These estimates correspond to the reduced form specification (2).

We identify whether the price reaction of the bankrupt carrier, and of competitors such as Southwest, large national carriers (such as American Airlines, Continental, and United), and low cost carriers (such as Jet Blue and Frontier) differ in significant ways. **Table 5** reports the results of this specification, corresponding to equation (2). The dependent variable in this estimation is the median price paid for a ticket in market m at time t. **Column 1** reports the bankrupt carrier's own price effect. **Column 2** reports the price reaction of Southwest to the various bankruptcies in our sample period. **Column 3** presents the results for large national carriers and **Column 4** shows results for the LCCs.

The results in **Columns 1**, **2**, and **3** reveal that Southwest's response to most bankruptcies is opposite to that of the bankrupt carrier, and to that of large national carriers. For instance, in response to United's bankruptcy, United lowered prices by 5.1 percent, and large national carriers lowered prices by 3.7 percent; yet Southwest increased prices by 13.6 percent. We obtain similar results for Southwest's response to US Airway's first, TWA's third, and National Airlines bankruptcies: US Airways dropped prices by 7.6 percent, large national carriers lowered prices by 5.5 percent, but Southwest increased prices by 12.1 percent; TWA dropped prices by 7.8 percent during its third filing and its competitors dropped prices by 5.9 percent, yet Southwest increased prices by 10 percent. As for National Airline's bankruptcy, National did not modify prices significantly, but the large carriers dropped prices by 4.5 percent; again Southwest's response was opposite that of large carriers: Southwest increased prices by 15.3 percent. In the case of America West's, and TWA's second filing, Southwest decreased prices by 23.1 percent and 14.3 percent respectively, even though large carriers increased prices by 3.8 and 4.4 percent respectively. Only in response to US Airway's second filing, and to Continental's filing does Southwest respond in the same direction as the bankrupt carrier and the large national carriers, though Southwest's reaction is larger in magnitude: For instance, in response to Continental's filing, Continental lowered prices by 13.1 percent, large carriers lowered prices by 5.5 percent, but Southwest lowered prices by 30.8 percent. We cannot identify a pattern in Southwest's atypical behavior, in the sense that Southwest's reaction is not consistent within bankruptcies that share some common characteristic (such as bankruptcies that culminated in liquidation, bankruptcies for which our sample covers the beginning of the bankruptcy years or the end of the bankruptcy years).

Results reported in **Column 4** reveal that low cost carriers either do not significantly react to a carrier's bankruptcy filing, or react lowering prices. The bankruptcies to which low cost carriers react are ATA, Continental, US Airway's second filing, and TWA's third filing, with an average price drop range from 5.6 percent in response to US Airways's bankruptcy, to 9.9 percent, in response to Continental's bankruptcy. Note that the low cost carrier's response is not limited to, and does not include all, the bankruptcies of other low cost carriers (such as National and Markair). We do not find any specific pattern as to the type of bankruptcies low cost carriers react to.

8 Structural Form Results

The results from the reduced form estimation indicate that, following a carrier's bankruptcy filing, ticket prices change. But that analysis could not explain whether the price changes are supply or demand driven. The purpose of this structural estimation is precisely to tease apart whether the price reaction to a bankruptcy filing is supply, demand, or supply *and* demand driven.

8.1 Demand Estimation

We estimate the demand function (5) using different assumptions on the error structure; different assumptions on the choices that consumers have when they travel; and different ticket prices (median, 25^{th}, and 75^{th} price). Coefficient estimates are reported in **Table 6.**

Column 1 presents the main specification, where the demand is estimated jointly with the pricing equation (8). This specification uses the median ticket price, and includes year-quarter fixed effects and route-carrier fixed effects. We find that filing for Chapter 11 *decreases* the demand of the bankrupt firm, with the only exception of the bankruptcy of America West and National Airlines. These coefficients reveal a small economic impact on the demand of *all* airlines. We return to this in Section (8.3).

To check the robustness of our estimates, we explore three possible explanations for why bankruptcy might have a small effect on demand.

First, it is possible that the price distribution is skewed to the right in such a way that using the median price in equation (8) does not allow us to capture the true effect of bankruptcy on demand. To address this possibility, **Columns 2** and **3** of **Table 5** consider the effect of the bankruptcy filings on the demand when we use the 25^{th} and 75^{th} percentile price, respectively. Using these different points in the price distribution does not yield larger demand effects of bankruptcy. Further, comparing **Columns 1** through **3** of **Table 6,** reveals that the effect of bankruptcy on demand is *not* systematically different along the price distribution.

Second, we might be understating the size of market, and/or the demand for the outside good. To address this possibility we eliminate from the model for demand the outside good.[46] This requires that we redefine what a market is. Instead of defining a market as all the population of age 21 to 65 years old in the origin city, we consider the extreme case where the market size is equal to the total number of travelers in a market in a year-quarter. Under this assumption, the demand function we estimate is,

$$\begin{aligned} \ln(s_{jrmt}) - \ln(s_{lrmt}) &= \phi^K \left(BktOwn^K_{jmt} - BktOwn^K_{lmt} \right) + \mu \left(p_{jrmt} - p_{lrmt} \right) \\ &\quad + \left(\mathbf{X}^D_{jrmt} - \mathbf{X}^D_{lrmt} \right) \psi + \left(\xi_{jr} - \xi_{lr} \right) + \left(\xi_{jrmt} - \xi_{lrmt} \right). \end{aligned}$$

where j and l are two airlines in a market. In each market-year-quarter we choose a "base" airline, l, to which we compare all the other airlines.[47] The estimates are reported in **Column 4**. As is well known, this specification forces consumers to choose among the inside goods and demand only depends on *differences* in prices; thus a general increase in prices will not decrease aggregate output (Berry (1994)). Consequently, the coefficient on prices, μ, is underestimated ($\mu = -0.815$ in **Column 1** and drops to $\mu = -0.771$ in **Column 4**) and the demand is estimated to be less elastic than it actually is. For our purpose, underestimating the elasticity is not a serious concern since our main objective is to estimate the effect of bankruptcy, ϕ^K. These are largely similar in **Columns 1** and **4**, suggesting that the definition of the market is not driving our results.[48]

The estimates of the control variables reported in **Table 6** are all intuitive. The coefficient on price suggests that the demand for airline travel is more elastic at the bottom end of the distribution (the coefficient is equal to -1.457 in Column 2), than at the median (-0.815), and at the top of the distribution (-0.459). Second, an estimate of λ significantly different from zero implies that there is correlation in the unobservable portion of consumers' utility for products in the same group. In the context of our model of demand with only two nests, $g \in \{airtravel\ or\ outside\ option\}$, consumers do not view other forms of travel, or the option of not traveling, as a good substitute for air travel and vice-versa.[49]

[46] We also considered other definition of market size. For example, we used information from the data from the Omnibus Household Survey, August 2003, which reports that about one out of every three adult US residents flew at least once on a commercial airline during the 12 months prior to the survey, to define a smaller market size. However, the results were almost identical.

[47] Clearly, monopoly markets had to be dropped from the analysis. In addition, in each market-year-quarter, we had to drop observations from the base airline l.

[48] In fact, 86.1 percentage of the 5.5 percentage change consisted of demand shifting to the outside good (driving a car or not traveling). The remaining 0.76 percent ($0.76 = (1 - 0.861) * 5.5\%$) change in United's demand corresponds to consumers substituting United with United's competitors.

[49] Discussion on the estimation results for the other control variables is omitted for sake of brevity. It is available from the authors.

8.2 Estimation of the Pricing Equation

Table 7 presents the estimation results of equation (8). The dependent variable is the median fare divided by 100. **Table 7** reports the results of one specification and uses different columns to present the effect that each of the bankruptcy filings has on relevant competitors.[50]

Column 1 reports the bankrupt firm's price reaction to its bankruptcy, after we control for changes in the bankrupt carrier's marginal cost and demand-driven markup. The results are consistent throughout all carriers, but America West and the recent filings, Delta and Northwest. Excluding the latter, all other carrier's respond to their bankruptcy significantly lowering prices. For instance, United Airlines responded to its bankruptcy filing lowering prices by $8.17. We compute that for United the $8.17 price drop is equivalent to a 5.79 percentage price drop.[51] This effect is close to the 5.1 percent price drop reported in the reduced form results in **Table 6**. The closeness of the reduced form results and the pricing equation estimates is not unique to United's bankruptcy. For instance, for US Airway's first filing, the price equation estimates report that the bankrupt carrier lowered its price by $7.24. When we translate this to an average price change we find a 5.4 percentage price change, which is near the 7.2 percentage change reported in the reduced form results in **Table 6**.

Column 2 through **4** report the price reactions for Southwest, other large national carriers, and low cost carriers respectively. **Column 2** shows that Southwest's behavior is again at odds with that of other carriers. The parameter estimate for Southwest's response to the bankruptcies of United, US Air first filing, TWA's third filing, National Airlines, Delta, and Northwest is consistently positive and significant. This means that Southwest raises its prices beyond what would be explained by changes in its marginal cost and by demand driven changes to its markup. For example, Southwest increased its price by $21.21 in response to United's Chapter 11 filing, and $17.55 in response to US Airway's first filing. **Column 3** shows that the price reaction of large national carriers is consistent with the own bankrupt carrier's response. **Column 4** shows similar results for the low costs carrier's price response.

8.3 Demand versus Supply Explanation

We now determine whether the price changes uncovered by the reduced form analysis are mainly demand or supply driven. To do this, we prepared **Table 8**.

[50] Note that because in the reduced forms the dependent variable was the log (fare), the coefficient of the bankruptices could be itnerepreted as percentrage changes. Here, however, the coefficients are price changes, not percentage changes. Therefore, to compare the results in **Table 6** with those in **Table7** we first need to divide the coefficient estimates by the average price of an airline in each route and then take the average across all routes.

[51] To compare this result with the drop in price reported in the reduced form estimation in **Table 6**, we must convert this nominal price change into its percentage equivalent. We do this by first computing the mean price charged by a carrier in a market. Then, we take the ratio of the estimated coefficients over this mean price. Then, we take the mean of the ratios across all markets where the carrier is present.

Table 8 compares the observed price *during the bankruptcy year-quarters* with the price that would have prevailed had the carrier not filed for bankruptcy, and with the price that would have prevailed if the bankruptcy filing only affected the carrier's supply side.

To compute the price that would prevail if bankruptcy only affected supply, we follow these three steps. First, we choose the market-year-quarter observations when the carried under consideration is bankrupt. Next, for the selected time window, we calculate the average price, across markets, for each carrier. Third, we set to zero the relevant bankruptcy dummies in the demand equation and leave the bankruptcy dummies in the supply equation equal to 1. Using this data construct, we recompute the equilibrium price.

To compute the price that would have prevailed if the carrier did not file for bankruptcy, we follow a similar strategy. We identify the time window when the carrier under consideration is operating in bankruptcy and set, for this time frame, the bankruptcy dummies in the demand *and* in the price equation to zero. We then recompute the equilibrium price using this data construct.

The results show that for the bankrupt carrier, the observed prices during bankruptcy are lower than those that would have prevailed had the carrier not filed for bankruptcy. For instance, had United not filed for bankruptcy, United's average price across markets during its bankruptcy years would have been \$132.04, and the observed average price for United during this sample window is \$123.90. Similar results hold for US Airway's first and second bankruptcies. Had US Airways not filed for Court protection the first (second) time, US Airways average price across markets during its bankruptcy years would have been \$111.94, (\$116.10); the observed average price during this time frame is \$104.76, (\$103.91).

When we replicate this analysis for the competitors of the bankrupt carrier we find results consistent with our previous findings. During the period when United operated under bankruptcy, American Airlines' prices where on average across markets, \$121.64. Had united not filed for bankruptcy, American Airline's prices would have been \$126.36. Qualitatively similar results hold for US Airways first and second filing, and for ATA's filing. And also consistent with our previous finding, Southwest's behavior is mixed. Southwest's prices during United's bankruptcy are \$120.58, but would have been \$132.04 has United not filed for bankruptcy. So Southwest increased its prices in response to United's filing. But, in response to US Airway's second filing and to ATA's filing Southwest dropped prices. In particular, during US Airways' second filing, Southwest average price is \$96.67, and would had been \$101.78 had US Airways not filed.

Now, the question is whether this price change is supply or demand driven. Comparing the price we would observe if bankruptcy only affected the supply side with the price we actually observe, we find that these two prices are close to each other, consistently for all carriers. To illustrate this, consider United's bankruptcy filing. United's average price during its bankruptcy is \$123.90, had bankruptcy only affected United's supply, then United's prices would have been \$124.03. Southwest's prices where \$120.58 during these bankruptcy years, and had this bankruptcy only affected Southwest's price equation, Southwest's price would have been \$120.55. Finally, American Airline's prices where \$121.64 but had bankruptcy only affected American's price equation, its price would have been \$121.61.

9 Do Consumers Benefit from Chapter 11?

There is a large body of work that studies the advantages of giving bankrupt firms the possibility to reorganize their activity under Chapter 11 of the US Bankruptcy Code instead of asking them to liquidate their assets. Bris, Welch, and Zhu (2006) provide a recent survey on this. The main findings are that Chapter 7 is *not better* than Chapter 11, and warns about oversimplified estimates of bankruptcy costs.

To the best of our knowledge, no research has been done on the extent to which consumers benefit from the existence of Chapter 11. This is the purpose of this Section. In particular, we ask whether consumers would have been better off if Chapter 11 had not been available to firms and if the firms had to liquidate their assets and shutdown.

This counter-factual exercise consists of computing the equilibrium prices, market shares, and change in consumer welfare that would have prevailed if the bankrupt firm had to liquidate its assets. To do this, we focus on the bankruptcies of United, USAir, and ATA. We further restrict our anaylsis to *year-quarters observations after the bankrupt firm emerged from Chapter 11.* We exclude the bankrupt airline from this restricted sample and use the demand and pricing parameter estimates reported in Sections (8.1) and (8.2) to recompute the the equilibrium prices, shares, and consumer welfare.

For each of these bankruptcies, we calculate the average change in prices and market shares for all firms and, separately, for Southwest.

The top panel of **Column 1** of **Table 9** reports that, if United had been liquidated instead of allowed to operate under Chapter 11 protection, average prices would have been 0.9 percent higher and market shares 0.5 percent lower. The findings for Southwest are analogous. Overall, consumers would lose if United could not file for Chapter 11 protection, but the change in welfare would have been quite marginal, as we measure it to be, on average, equal to $-3,409$ dollars in a quarter in a market. Clearly, the change in consumer welfare would have been negative because on average the prices increased. Thus, in the case of United's bankruptcy, the carrier's ability to operate under Chapter 11 protection affected consumer welfare only marginally. **Columns 2** and **3** of **Table 9** study how the possibility that USAir had to file under Chapter 11 affected prices, market shares, and consumer welfare. The results are basically analogous to those for United in

Column 1. the case of ATA's bankruptcy is reported in **Column 4**. We observe that prices would have been higher and market shares lower if ATA had to liquidate its assets and shutdown. Most importantly, consumer welfare would have been significantly lower if ATA had liquidated.

The results reported in **Table 9** reveal that consumer welfare would drop significantly and in a consistent fashion if Chapter 11 were unavailable only in the case of ATA's bankruptcy. In the other three bankruptcies considered, consumer welfare, prices, and shares would be essentially unchanged if a to-be-bankrupt firm had to liquidate its assets instead of being given the possibility to reorganize itself.

We interpret this result as evidence that Chapter 11 plays a crucial role in protecting consumers only when the to-be-bankrupt firm is a low cost carrier, such as ATA. The loss of a low-cost carrier drives up the equilibrium prices charged by all firms in a market, and results in a lower consumer welfare.

Now, let's return to the Introduction. There, we wrote that in the long run we would expect entry in the markets from which the bankrupt firm exited. It turns out that our main conclusion that Chapter 11 did not benefit consumers in the United and USAir bankruptcies is actually *reinforced* by the short-run nature of our exercise. To see why, notice that if new firms were to enter into markets, we would expect prices to drop and consumer welfare to increase. But we see that prices would have been largely unchanged even in the event of no new entries. If anything, allowing for new entry would possibly lead to conclude that Chapter 11 was not beneficial even in the ATA bankruptcy filing.

10 Conclusions

This paper empirically examines whether a firm's bankruptcy filing affects product market competition, using evidence from the US airline industry. Detailed institutional analysis reveals that a bankruptcy filing spawns real shocks to the supply and demand of the bankrupt firm and its competitors. Thus, we first investigate whether a firm's bankruptcy filing affects product market prices, and second, we disentangle whether the price effect is demand or supply driven.

We find that, in response to a carrier's bankruptcy filing, prices significantly drop in the markets where the bankrupt carrier is an active competitor. To identify whether these price changes are supply or demand driven, we present a structural model of the airline industry, where we estimate a model of the demand for air travel and a model of airline pricing behavior. Our estimates show that most of the price change is driven by the carrier's pricing behavior. In fact, we do not find any evidence that consumers substitute away from the bankrupt carrier to its competitors, instead, we find that consumers shift to the "no flying" option. Though our structural analysis allows us to identify that most of the price reaction to a carrier's bankruptcy filing is generated by the firm's shift in pricing equation, we are not able to identify what exactly in their pricing behavior changes. This is, our estimates of the price function includes categorical variables for each bankruptcy, and we observe that when these variables switch on, the firm's price strategy changes. What is driving the changes picked up by these categorical variables is best left for future research.

Finally, we present a counter-factual experiment, studying how prices and consumer welfare would have changed if firms had to liquidate their assets and exit the industry. We show that consumers do not benefit significantly from the availability of Chapter 11 to United or USAir (during its first bankruptcy); but that consumers benefit substantially from ATA's possibility to reorganize under Chapter 11. This counterfactual analysis is focused on consumer welfare, and thus leaves aside other consequences inherent to ignoring Chapter 11. For example, our analysis does not consider losses that passengers would face if reorganization was not an option and passengers where to loose frequent flyer miles; nor does it consider loses that cities and workers would face if a carrier in bankruptcy had to liquidate forcing widespread layoffs.

We started off wondering whether there is a real linkeage between a firm's bankruptcy filing, and the product market competitive interaction of firms in the industry. Our analysis shows that indeed, a firm's bankruptcy filing spurs real shochs in the industry that ultimately affect competition in the bankrupt firm's product market. We find that during bankruptcy, both the bankrupt firm and its competitor to lower prices. We also find that the main channel through which a firm's bankruptcy impacts prices is the pricing behavior of firms in the bankrupt firm's market. Bankruptcy thus appears to have negligible consequences on consumer's demand for air travel.

11 Appendix

11.1 A Simple Model

Each one of the two firms faces the profit function $\pi_j(p_j, p_{-j}) \equiv [p_j - c_j] D_j(p_j, p_{-j})$, where $-j$ is the subscript associated with the competing firm. p_j is the price set by firm j and p_{-j} is the price set by its competitor.[52] $D_j(p_j, p_{-j})$ indicates the quantity of the good that firm j must sell when it sets the price p_j and its competitor sets the price p_{-j}. c_j denotes the constant marginal cost of the firm j. At an interior Bertrand-Nash equilibrium, the first order condition for firm j is given as $\frac{\partial \pi_j(p_j^*, p_{-j})}{\partial p_{j,}} = D_j\left(p_j^*, p_{-j}\right) + \left[p_j^* - c_j\right] \frac{\partial D_j(p_j^*, p_{-j})}{\partial p_j} = 0$.

We assume the following: $\frac{\partial D_j(p_j^*, p_{-j})}{\partial p_j} < 0$, $\frac{\partial^2 D_j(p_j^*, p_{-j})}{\partial p_j^2} < 0$, and $\frac{\partial D_j(p_j^*, p_{-j})}{\partial p_{-j}} > 0$. We can then use the implicit function theorem to find the slope of the reaction function,

$$\frac{dR_j(p_{-j})}{dp_{-j}} = -\left[\frac{\partial D_j\left(p_j^*, p_{-j}\right)}{\partial p_{-j}} + \left[p_j^* - c_j\right] \frac{\partial^2 D_j\left(p_j^*, p_{-j}\right)}{\partial p_j \partial p_{-j}}\right] \left[2\frac{\partial D_j\left(p_j^*, p_{-j}\right)}{\partial p_j} + \left[p_j^* - c_j\right] \frac{\partial^2 D_j\left(p_j^*, p_{-j}\right)}{\partial p_j^2}\right]^{-1}.$$

[52] Fixed costs are omitted since we do not estimate them.

The denominator is negative, and thus the sign of $\frac{dR_j(p_{-j})}{dp_{-j}}$ depends on $\frac{\partial D_j\left(p_j^*,p_{-j}\right)}{\partial p_{-j}}+\left[p_j^*-c_j\right]\frac{\partial^2 D_j\left(p_j^*,p_{-j}\right)}{\partial p_j \partial p_{-j}}$. Because $\frac{dD_j\left(p_j^*,p_{-j}\right)}{dp_{-j}}>0$, whether $\frac{dR_j(p_{-j})}{dp_{-j}}$ is negative depends on the sign of $\frac{\partial^2 D_j\left(p_j^*,p_{-j}\right)}{\partial p_j \partial p_{-j}}$. In particular, if $\frac{\partial^2 D_j\left(p_j^*,p_{-j}\right)}{\partial p_j \partial p_{-j}}\geq 0$, p_j^* increases in p_{-j} and we then say that products j and $-j$ are strategic complements (Bulow, Geanakoplos, Klemperer (1985]). This is the case, for example, with the usual textbook linear demands. It is also the case with the logit demand functions that we use below. In the paper, we have maintained that $\frac{\partial^2 D_j\left(p_j^*,p_{-j}\right)}{\partial p_j \partial p_{-j}}\geq 0$, thus j and $-j$ are strategic complements.

The first order condition implicitly defines a reaction function $p_j^*=R_j\left(p_{-j}\right)$. We can apply the Implicit Function Theorem to find $\frac{dp_j^*}{dc_j}=\frac{\partial D_j\left(p_j^*,p_{-j}\right)}{\partial p_j}\left[2\frac{\partial D_j\left(p_j^*,p_{-j}\right)}{\partial p_j}+\left[p_j^*-c_j\right]\frac{\partial^2 D_j\left(p_j^*,p_{-j}\right)}{\partial p_j^2}\right]^{-1}$. Under the assumptions on the demand, $\frac{dp_j^*}{dc_j}>0$.

11.2 Data Construction

Fare and passenger information are from the Origin and Destination Survey (DB1B), which is a 10 percent sample of airline tickets from reporting carriers. The data from the DB1B are merged with data from the T-100 Domestic Segment Dataset by the operating carrier. The T-100 Domestic Segment Dataset contains domestic market data by air carriers, origin and destination airports for passengers enplaned. The T-100 is not a sample: it reports all flights occurred in the United States in a given month of the year. Data are from every quarter from the first quarter in 1993 to the third quarter in 2005. A market is defined as a unidirectional trip from one airport to another airport, with or without connections. The unit of observation is a market-carrier-year-quarter data point.

We drop: tickets that are neither one-way nor round-trip travel, such as open-jaw trip tickets; tickets involving a US-nonreporting carrier flying within North America and foreign carrier flying between two US points; tickets that are part of international travel; tickets including travel on more than one airline on a directional trip (known as interline tickets); tickets involving non-contiguous domestic travel (Hawaii, Alaska, and Territories); tickets with fares less than 20 dollars or larger than 9999 dollars; and tickets whose fares were in the bottom and top 5 percentile percentile in their year; tickets with more than 6 coupons. We then merge this dataset with the T-100 Domestic Segment (U.S. Carriers) and drop tickets for flights that have less than 12 departures over a quarter in one direction (this means less than 1 departure every week in one direction).

Following Borenstein (1989), the mean, median, 25th percentile, and 75 percentile fares are from the distribution of fares weighted by the number of passengers paying each fare, not from a distribution that gives equal weight to each fare listed by the airline.

One important issue is how to treat regional airlines that operate through code-sharing agreements with national airlines. As long as the regional airline sells tickets independently, we treat it separately from the national airline.[53] The D1B1 dataset provides information on the "operating" and "ticketing" carrier, which might differ in the case of code share agreements. In their institutional analysis of airline alliances, Bamberger, Carlton, and Neumann (2003) discuss how code-share agreements allow a carrier to independently set price and sell service between cities that it otherwise would not be able to serve. Code share agreements can involve different financial agreements between the operating carrier and its alliance partner. In some alliances ("free sale" agreement), the operating carrier determines seat availability and the ticketing carrier sets prices for its service. In other alliances ("blocked space" agreement), the ticketing carrier buys a block of seats on each code-share flight from the operating carrier. Since fares are set by the ticketing carrier in both cases, we use the ticketing carrier to assign a ticket to a specific airline. Notice that this approach addresses the issue of how to treat regional carriers that operate for major airlines.

Another issue is that there are airlines that transport very few passengers in a quarter. In particular, consider an airline using a small plane that has 20 seats to serve a regional market. One flight per week over a quarter tells us that the airline will transport 240 passengers at full capacity. A 10 percent sample should give the airline reporting 24 passengers in the dataset. If an airline reports less than 20 passengers in a quarter, we assume that the airline does not have an active presence in this market. Berry (1992) drops airlines which report less than 90 passengers in a quarter. We relax this condition to account for the progressive adoption of smaller regional jets by the US airlines.

Finally, we code a round-trip ticket as one directional trip ticket, which costs half the full round-trip ticket fare. This avoids overcounting the lower fares associated with round-trip tickets relative to the higher fares associated with purchasing two one-way tickets. In this way, it is possible to make the comparisons between one-way and round-trip fares meaningful, by comparing what two passengers would pay for traveling the same distance. Each passenger is only counted once when constructing the market and airport market shares.

References

[1] Aguirregabiria Victor, and Ho, Chu Yo, "A Dynamic Oligopoly Game of the US Airline Industry: Estimation and Policy Experiments," University of Toronto, Working Paper, 2006.

[53] The D1B1 dataset provides information on the "operating" and "ticketing" carrier, which might differ in the case of code share agreements. In their institutional analysis of airline alliances, Bamberger, Carlton, and Neumann [forthcoming] discuss how code-share agreements allow a carrier to independently set price and sell service between cities that it otherwise would not be able to serve. Code share agreements can involve different financial agreements between the operating carrier and its alliance partner. In some alliances ("free sale" agreement), the operating carrier determines seat availability and the ticketing carrier sets prices for its service. In other alliances ("blocked space" agreement), the ticketing carrier buys a block of seats on each code-share flight from the operating carrier. Since fares are set by the ticketing carrier in both cases, we use the ticketing carrier to assign a ticket to a specific airline. Notice that this approach addresses the issue of how to treat regional carriers that operate for major airlines.

[2] Berry, Steven, "Airport presence as product differentiation," American Economic Review, 1990, 80, 394-399.

[3] Bamberger Gustavo E., Carlton, Dennis W., and Neumann, Lynette R., "An Empirical Investigation of the Competitive Effects of Domestic Airline Alliances, " Journal of Law and Economics, (forthcoming).

[4] Berry, Steven., "Airport Presence as Product Differentiation," American Economic Review, May, 1990, 80, 394-399.

[5] Berry, Steven, "Estimation of a Model of Entry in the Airline Industry," Econometrica 1992, 60, 889-917.

[6] Berry, Steven, "Estimating Discrete-Choice Models of Product Differentiation," The RAND Journal of Economics, 1994, 25, 242-262.

[7] Berry, Steven; Levinsohn, James; Pakes, Ariel. "Automobile Prices in Market Equilibrium" Econometrica, July 1995, 841

[8] Berry, Steven; Carnal, Michael; Spiller, Pablo "Airline Hubs: Costs, Markups, and the Implications of Costumer Heterogeneity," in Advances in Airline Economics, Competition Policy and Antritrust, Volume 1, Edited By Darin Lee, Elsevier, 2006.

[9] Borenstein, Severin, "Hubs and High Fares: Dominance and Market Power in the U.S. Airline Industry," Rand Journal of Economics, Autumn 1989, 20: 344-365

[10] Borenstein, Severin and Zimmerman, Martin B,. "Market Incentives for Safe Commercial Airline Operation," American Economic Review, December 1988, 78, 913-35.

[11] Borenstein, Severin "The Dominant-Firm Advantage in Multiproduct Industries: Evidence from the U.S. Airlines," Quarterly Journal of Economics, November 1991, 106, 1237-1266.

[12] Borenstein Severin, and Rose, Nancy, "Competition and Price Dispersion in the U.S. Airline Industry," Journal of Political Economy, August 1994, 653-683.

[13] Borenstein Severin, and Rose, Nancy, "Bankruptcy and pricing behavior in the US airline markets," American Economic Review Papers and Proceedings, May 1995, 85, 397-402

[14] Brander, James, and Lewis, Tracey, "Oligopoly and Financial Structure: The Limited Liability Effect," American Economic Review, December 1986, 76, 956-970.

[15] Bresnahan, Timothy, "Competition and Collusion in the American Automobile Industry: The 1955 Price War," Journal of Industrial Economics, June 1987, 35, 457-482.

[16] Bris, Arturo, Welch, Ivo, and Zhu, Ning, "The Costs of Bankruptcy", The Journal of Finance, 2006, 61, 1253-1303.

[17] Brueckner Jan K., and Spiller, Pablo, "Economies of Traffic Density in the Deregulated Airline Industry," Journal of Law and Economics, October 1994, 37, 379-415.

[18] Bulow, Jeremy; Geanakoplos, John; Klemperer, Paul, "Multimarket Oligopoly: Strategic Substitutes and Complements," The Journal of Political Economy, 1985, 93, 488-511.

[19] Busse, Meghan, "Firms Financial Condition and Airline Price Wars," Rand Journal of Economics, Summer 2002, 33, 298-318.

[20] Campello, Murillo, "Debt Financing: Does it Boost or Hurt Performance in Product Markets?" Journal of Financial Economics, 2006, 83, 135-172.

[21] Chevalier, Judith, "Do LBO Supermarkets charge more? An empirical analysis of the effects of LBO on supermarket pricing,," Journal of Finance, 1995a, 50, 1095-1112.

[22] Chevalier, Judith, "Capital Structure and Product-Market Competition: Empirical Evidence from the Supermarket Industry," American Economic Review, 1995b, 85, 415-435.

[23] Chevalier, Judith, and Scharfstein, David, "Capital-Market Imperfections and Countercyclical Markups: Theory and Evidence," The American Economic Review, September 1996, 86, 703-725.

[24] Chevalier, Judith, and Scharfstein, David, "Liquidity Constraints and the Cyclical Behavior of Markups," American Economic Review, May 1995, 85, 390-396.

[25] Ciliberto, Federico and Williams, Jonathan, "Limited Access to Airport Facilities and Market Power in the Airline Industry," 2007, Working Paper, University of Virginia.

[26] Ciliberto, Federico, and Tamer, Elie, "Market Structure and Multiple Equilibria in Airline Markets," 2005, Working Paper, University of Virginia and Northwestern University.

[27] Elzinga, Kenneth, and Mills, David, "Predatory Pricing in the Airline Industry: Spirit Airlines vs. Northwest Airlines (2005)," in The Antitrust Revolution, 5th Edition, edited by J. Kwoka and L. White, Forthcoming.

[28] Dasgupta, Sudipto, and Titman, Sheridan, "Pricing Strategy and Financial Policy," Review of Financial Studies, Winter 1998, 11, 705-737.

[29] Hendel, Igal, "Competition Under Financial Distress, "The Journal of Industrial Economics," September 1996, 44, 309-324.

[30] Khanna, Naveen, and Tice, Sheri, "Pricing, exit, and location decisions of firms: Evidence on the role of debt and operating efficiency," Journal of Financial Economics, 2005, 75, 397-427

[31] Kovenock, Dan, and Gordon, Phillip, "Capital Structure and Product Market Rivalry: How do we reconcile Theory and Evidence?," American Economic Review, 1995, 85, 403-408.

[32] Kovenock, Dan, and Gordon, Phillip, "Capital Structure and Product Market Behaviour: An Examination of Plant Exit and Investment Decisions," Review of Financial Studies, Autumn 1997, 10, 767-803.

[33] Lederman, Mara, "Do Enhancements to Loyalty Programs Affect Demand? The Impact of International Frequent Flyer Partnerships on Domestic Airline Demand," RAND Journal of Economics, forthcoming.

[34] Morrison, Steven A., and Winston, Clifford, "Enhancing the Performance of the Deregulated Air Transportation System," Brookings Papers on Economic Activity, Microeconomics, 1989, 61-123.

[35] Nevo, Aviv, "Mergers with Differentiated Products: The Case of the Ready to Eat Cereal Industry" The Rand Journal of Economics, Autumn, 2000, 31, 395-421.

[36] Nevo, Aviv, "Measuring Market Power in the Ready to Eat Cereal Industry", Econometrica, March 2001, 69, 307-342.

[37] Opler, Tim, and Titman, Sheridan, "Financial Distress and Corporate Performance," Papers and Proceedings Journal of Finance, July 1994, 49, 1015-1040.

[38] Petrin, Amil, "Quantifying the Benefits of New Products: The Case of the Minivan" Journal of Political Economy, 2002, 110, 705-729

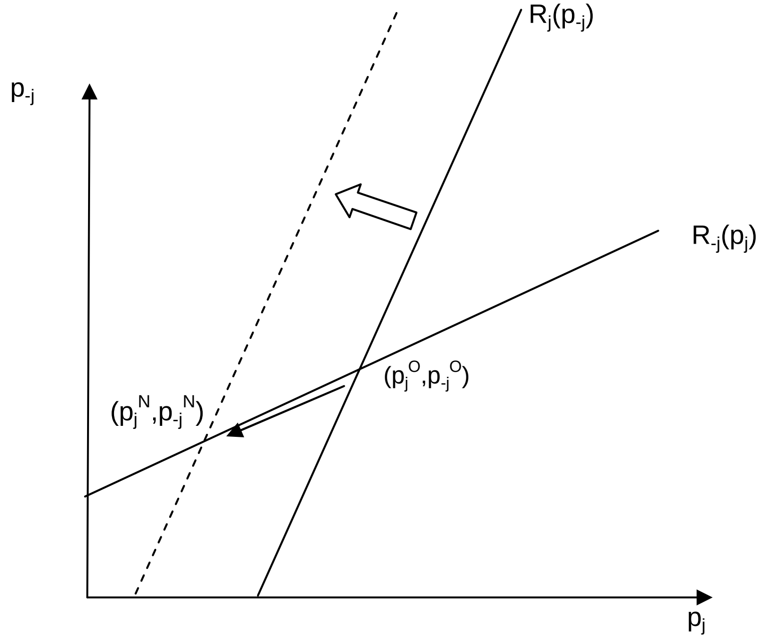
[39] Phillips, Gordon, "Increased Debt and Industry Product Markets: An Empirical Analysis," Journal of Financial Economics, 1995, 37, 189-238.

[40] Ramdas, Kamalini; Williams, Jonathan, "Putting Queuing Theory Fundamentals to Work: An Investigation into the Causes of Airline Flight Delays" University of Virginia, Working Paper, January 2007

[41] Showalter, Dean, "Oligopoly and financial structure: Comment," American Economic Review, 85, 647-653.

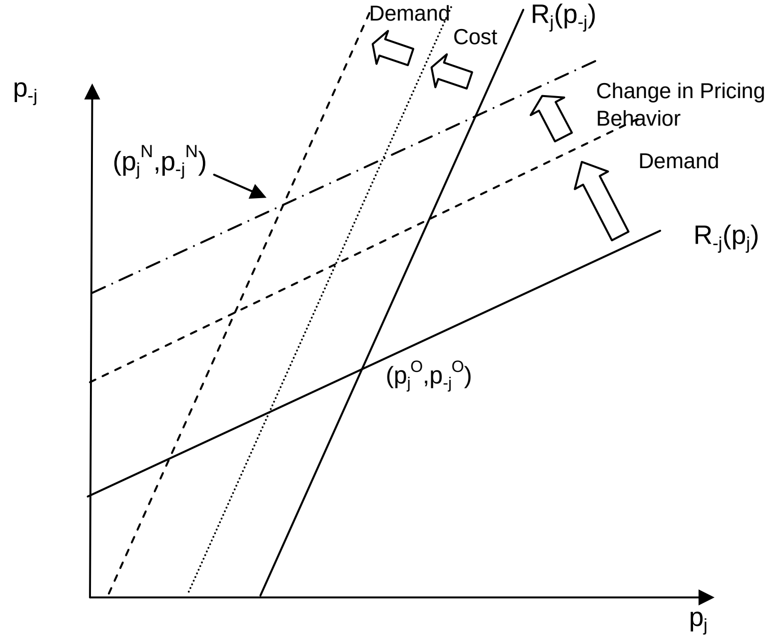
Figure 1: Comparative Statics of the Effect of a Bankruptcy Filing

Figure 1a: *j*'s Supply Side Shock



A shock to *j*'s cost function would only shift the reaction function of firm *j*. As a result, *both* firms would charge lower prices in the new equilibrium.

Figure 1b: *j*'s Supply and Demand Sides Shocks



A shock to the cost and demand functions of *j* would, and/or a shock to *-j*'s pricing equation would shift the reaction functions of both firms. Firm *j*'s reaction function would contract and move to the left, while firm *-j*'s reaction function w*ould* expand, also moving to the left. As a result, the price charged by firm *i* would be lower at the new equilibrium. The price charged by firm *-i* *could* be higher.

Table 1: Stylized facts

Bankruptcies in the Airline Industry between 1993 and 2005. Airline Bankruptcies are identified from the Air and Transportation Association (ATA), and cross checked with the Bankruptcy Research Database from Professor Lynn LoPucki. The remaining information is obtained from news searches in Lexis-Nexus and Factiva.

(1) Code	(2) Airline Name	(3) File 11	(4) File 7	(5) Voluntary	(6) Filing Nu.	(7) Date Filed	(8) Date Emerged	(9) Convert 11 to 7	(10) Convert 11 to 7	(11) Grounded	(12) Days
WV	Air South, Inc.	1	0	1	1	8/28/1997	0	1	9/16/1997	8/28/1997	18
AQ	Aloha Airlines, Inc.	1	0	1	1	12/30/2004	0	0	0	0	
HP	America West Airlines, Inc.	1	0	1	1	6/27/1991	8/25/1994	0	0	0	1138
TZ	Ata Airlines d/b/a Ata.	1	0	1	1	10/26/2004	0	0	0	0	
HQ	Business Express	1	0	0	1	1/22/1996	4/17/1997	0	0	0	445
CO	Continental Air Lines, Inc.	1	0	1	2	12/3/1990	4/27/1993	0	0	0	864
DL	Delta Airlines	1	0	1	1	9/14/2005	0	0	0	0	
W9	Eastwind Airlines, Inc.	0	1	0	1	9/30/1999	0	0	0	9/8/1999	
QD	Grand Airways, Inc.	1	0	1	2	11/28/1995	0	1	1/4/1996	1/4/1996	36
HA	Hawaiian Airlines, Inc.	1	0	1	1	9/21/1993	9/12/1994	0	0	0	351
HA	Hawaiian Airlines, Inc.	1	0	1	2	3/21/2003	6/2/2005	0	0	0	791
FLYi	Independence Air	1	0	1	1	11/7/2005	0	0	0	0	
KP	Kiwi International	1	0	1	1	9/30/1996	0	1	7/17/1997	10/15/1996	287
KP	Kiwi International	1	0	1	2	3/23/1999	0	1	8/27/1999	3/24/1999	154
BF	Markair, Inc.	1	0	1	1	6/8/1992	5/4/1994	0	0	0	686
BF	Markair, Inc.	1	0	1	2	4/14/1995	0	1	12/4/1995	10/25/1995	230
JI	Midway Airlines, Inc.	1	0	1	2	8/14/2001	0	1	10/30/2003	9/11/2001	796
N7	National Airlines	1	0	1	1	12/6/2000	0	1	11/6/2002	11/6/2002	690
NW	Northwest Airlines	1	0	1	1	9/14/2005	0	0	0	0	
PN	Pan American Airways Corp.	1	0	1	2	2/26/1998	6/28/1998	0	0	2/26/1998	122
P9	Pro Air, Inc.	1	0	1	1	9/19/2000	0	1	10/5/2001	9/19/2000	376
SY	Sun Country Airlines	0	1	0	1	1/8/2002	4/15/2002	7 to 11: 3/13/2002	4/15/2002	12/7/2001	97
FF	Tower Air, Inc.	1	0	1	1	2/29/2000	0	1	12/7/2000	5/1/2000	
TW	Trans World Airways, Llc	1	0	1	1	1/30/1992	11/3/1993	0	0	0	633
TW	Trans World Airways, Llc	1	0	1	2	6/30/1995	8/24/1995	0	0	0	54
TW	Trans World Airways, Llc	1	0	1	3	1/10/2001	0	0	4/9/2001	0	89
UA	United Airlines	1	0	1	1	12/9/2002	2/2/2006	0	0	0	
US	USAir	1	0	1	1	8/11/2002	3/31/2003	0	0	0	230
US	USAir	1	0	1	2	9/12/2004	9/27/2005	0	0	0	375
NJ	Vanguard Airlines, Inc.	1	0	1	1	7/30/2002	0	1	12/19/2003	7/30/2002	499
W7	Western Pacific Airlines	1	0	1	1	10/5/1997	0	1	2/4/1998	2/4/1998	119

Table 2: Summary Statistics for the Market Competition Variables

Fare and passenger data are from the Origin and Destination Survey (DB1B). The DB1B Survey is a 10 percent sample of airline tickets collected by the Office of Airline Information of the Bureau of Transportation Statistics. These are quarterly data from the first quarter in 1993 to the second quarter in 2005. Any carrier that is independently owned is included in the dataset, as long as the carrier independently sold a ticket. Following Berry [1990], we define the variable *Carrier Market Presence* as the average of the percentage of markets served by an airline at the market's endpoints. *Competitors Market Presence* is the average market presence of the competitors of the carrier in a market. *Direct* is equal to 1 if a carrier provides direct service in a market. *Roundtrip* measures the percentage of passengers who flew a round-trip travel with a given carrier in a given market. *Extra Miles* is given by the ratio of the miles flown on average between two cities and the non stop market distance.

	Mean	S.D.
Fare ($1993)	170.224	48.538
25^{th} percentile fare	107.562	33.593
Median fare	137.690	49.618
75^{th} percentile fare	189.882	75.258
Network extent origin	0.428	0.207
Network extent destination	0.421	0.216
Direct	0.264	0.396
Roundtrip	0.810	0.175
Nonstop	0.238	0.400
Extra miles	1.109	0.142
Average cost per seat mile (ACSM)	0.091	0.018
Observations	52394	

Table 3: Definition of the Variables used in the reduced form and structural estimation.

There are 52,394 market-carrier-year-quarter specific observations. Markets are indexed by m=1,...,M and year-quarter combinations by t=1,...T. Airport-to-airport routes are denoted by r =1,..., R_{mt}. j = 1,..., J_{mt} denotes an airline. A single product is a combination $jrmt$, and indicates that airline j (American) flies route r (Chicago O'Hare to Fort Lauderdale Airport) in the market m (Chicago-Miami) at time t (quarter 2 of 2002). Number and identity of carriers changes by market, route, and time. In any market m and time t, the consumer can choose among C_{mt} choices, which is related to the number of airlines in a market J_{mt} and the number of airports in the two cities.

Variable	Variable Definition
$BktOwn_{jmt}^{K}$	$BktOwn_{jmt}^{K} = \begin{cases} 1 & \text{if } K \text{ is under bankruptcy protection at time } t \text{ and serves market } m\text{; and observation } jmt \text{ is for one of the (other) national firms: American, Continental, Delta, Northwest, TWA, USAir, or United} \\ 0 & \text{otherwise} \end{cases}$
$BktLAR_{jmt}^{K}$	$BktLAR_{jmt}^{K} = \begin{cases} 1 & \text{if } K \text{ is under bankruptcy protection at time } t \text{ and serves market } m\text{; and observation } jmt \text{ is for one of the (other) national firms: American, Continental, Delta, Northwest, TWA, USAir, or United} \\ 0 & \text{otherwise} \end{cases}$
$BktWN_{jmt}^{K}$	$BktWN_{jmt}^{K} = \begin{cases} 1 & \text{if } K \text{ is under bankruptcy protection at time } t \text{ and serves market } m\text{; and observation } jmt \text{ is for Southwest Airlines} \\ 0 & \text{otherwise} \end{cases}$
$BktLCC_{jmt}^{K}$	$BktLCC_{jmt}^{K} = \begin{cases} 1 & \text{if } K \text{ is under bankruptcy protection at time } t \text{ and serves market } m\text{; and observation } jmt \text{ is for none of the carriers for which } BktOwn_{jmt}^{K}, BktLAR_{jmt}^{K}, BktLCC_{jmt}^{K} \text{ is } 1 \\ 0 & \text{otherwise} \end{cases}$
$KisIn_{mt}$	$KisIn_{mt} = \begin{cases} 1 & \text{if bankrupt firm } K \text{ is an active competitor in market } m \text{ at time } t\text{, and observation } jrmt \text{ is not for } K \\ 0 & \text{if obs. } jrmt \text{ is for } K \text{ serving route } r\text{, in market } m\text{, at time } t\text{; or } K \text{ is not serving market } m\text{, at time } t \end{cases}$
X_{jmt}	Matrix of variables that are exogenous market or carrier specific, time varying determinants of prices
$ASMCost_{jt}$	Average cost per seat mile: The ratio of the quarterly operating expenses over the quarterly total of the product of the number of seats transported and of the number of miles flown by the airline.
$NetworkExtentOrigin_{jrmt}$	The percentage of all markets served out of an airport by airline j
$NetworkExtentDest_{jrmt}$	The percentage of all markets served into an airport by airline j
$RoundTrip_{jrmt}$	The percentage of roundtrip tickets
$Direct_{jrmt}$	Percentage of tickets for direct service out of the total tickets sold by j
$ExtraMiles_{jrmt}$	Ratio of the flown distance over the nonstop distance in miles between two airports
$u_{S,jr}$	Market-carrier effect in specification S of the reduced form
$u_{S,t}$	Time effect in specification S of the reduced form
$u_{S,jrmt}$	Route-carrier-year-quarter idiosyncratic unobservables in specification S of the reduced form

Table 4 : Average Price Effect

The dependent variable is the natural logarithm of the median price charged by carrier j in market m at time t in columns 1-2, and 5-6. The dependent variable in Column 3 is the natural logarithm of the 25th percentile price, and in Column 4 it is the natural logarithm of the 75th percentile price. Columns 2-5 exclude the two quarters prior a carrier's bankruptcy filing.

	Median Price	Median Price	Log25	Log75	Median Price
United Airlines	-0.025***	-0.018***	-0.017***	-0.030***	-0.074***
(Emerged)	(0.005)	(0.006)	(0.005)	(0.006)	(0.004)
US Airways 1st filing	-0.033***	-0.040***	-0.030***	-0.081***	-0.105***
(Emerged)	(0.008)	(0.011)	(0.009)	(0.012)	(0.008)
ATA	-0.013	-0.028**	-0.026**	-0.024*	-0.008
(Emerged)	(0.010)	(0.012)	(0.010)	(0.014)	(0.013)
US Airways 2nd filing	-0.087***	-0.112***	-0.086***	-0.119***	-0.133***
(Merged with HP)	(0.007)	(0.010)	(0.008)	(0.011)	(0.009)
TWA 3rd filing	-0.049***	-0.049***	-0.030***	-0.036**	-0.031***
(Merged with AA)	(0.013)	(0.014)	(0.011)	(0.016)	(0.011)
Markair 2nd filing	0.023	-0.130**	-0.127**	0.021	0.075
(Liquidated)	(0.049)	(0.063)	(0.053)	(0.072)	(0.068)
National Airlines	-0.017	-0.031	-0.046***	-0.058**	-0.110***
(Liquidated)	(0.016)	(0.020)	(0.017)	(0.023)	(0.021)
TWA 2nd filing	0.013	0.011	0.034***	0.012	0.108***
(Pre-Packaged)	(0.014)	(0.014)	(0.012)	(0.016)	(0.012)
Continental Airlines	-0.079***	-0.080***	-0.061***	-0.005	0.207***
(Emerged)	(0.016)	(0.016)	(0.013)	(0.018)	(0.013)
TWA	-0.013	-0.012	0.001	-0.005	0.070***
(Emerged)	(0.010)	(0.010)	(0.008)	(0.011)	(0.009)
Markair 1st filing	-0.040	-0.057*	-0.037	-0.076**	0.079**
(Emerged)	(0.027)	(0.030)	(0.025)	(0.035)	(0.032)
America West	0.030***	0.035***	0.068***	0.004	0.189***
(Emerged)	(0.007)	(0.007)	(0.006)	(0.008)	(0.007)
Delta Airlines	0.039***	0.044***	-0.010	0.065***	-0.062***
(Under)	(0.008)	(0.009)	(0.007)	(0.010)	(0.006)
Northwest Airlines	0.012*	0.010	-0.002	0.018**	-0.011
(Under)	(0.007)	(0.007)	(0.006)	(0.009)	(0.007)
Market-Carrier FE	Yes	Yes	Yes	Yes	No
Year Quarter FE	Yes	Yes	Yes	Yes	No
Market-Carrier RE	No	No	No	No	Yes
Year Quarter Re	No	No	No	No	Yes
Exclude 2 Qtrs. before filing	No	Yes	Yes	Yes	Yes
Observations	52394	45367	45367	45367	45367
Number of markets	2092	2066	2066	2066	2066
R^2 Within	0.335	0.322	0.393	0.241	0.192
R^2 Overall	0.186	0.174	0.168	0.135	0.107

Standard errors in parentheses.* significant at 10%; ** significant at 5%; *** significant at 1%.

Each specification further includes a categorical variable to indicate whether the flight is direct, and one to indicate whether it is a roundtrip. Other included variables are: the log of the average cost per seat mile (the ratio of the quarterly operating expenses over the quarterly total of the product of the number of seats transported and of the number of miles flown by the airline), the number of extra miles flown (the ratio of the flown distance over the nonstop distance in miles between two airports, for a direct flight it is 1, while for connecting flights it is larger than 1); a measure of the carrier's network at origin and at destination, equal to the percentage of all markets served by the carrier from the origin and destination airport respectively; and a constant term

Table 5: Carrier Specific Effect

We report one specification and *use different columns to present the effect that each of the bankruptcy filings has on relevant competitors.* For example, the *-0.051* entry in the first column means that United dropped its prices by *5.1* percent while it was under bankruptcy protection. The entry *0.136* in the second column means that Southwest increased its prices by *13.6* percent while United was under Chapter 11 protection. The dependent variable is the natural logarithm of the median price charged by carrier j in market m at time t in all columns.

	Own	Southwest	Large national	Low Cost Carriers
United Airlines	-0.051***	0.136***	-0.037***	0.005
(Emerged)	(0.009)	(0.012)	(0.006)	(0.009)
US Airways 1st filing	-0.076***	0.121***	-0.055***	0.023
(Emerged)	(0.017)	(0.029)	(0.012)	(0.023)
ATA	-0.074*	-0.042	-0.020	-0.058*
(Emerged)	(0.041)	(0.050)	(0.014)	(0.030)
US Airways 2nd filing	-0.116***	-0.140***	-0.112***	-0.056***
(Merged with HP)	(0.018)	(0.029)	(0.012)	(0.021)
TWA 3rd filing	-0.078***	0.100***	-0.054***	-0.067**
(Merged with AA)	(0.025)	(0.037)	(0.015)	(0.029)
Markair 2nd filing	-0.163		-0.105	-0.214
(Liquidated)	(0.169)		(0.073)	(0.148)
National Airlines	0.014	0.153*	-0.045**	-0.022
(Liquidated)	(0.089)	(0.082)	(0.022)	(0.034)
TWA 2nd filing	-0.059**	-0.143***	0.044***	-0.039
(Pre-Packaged)	(0.026)	(0.054)	(0.016)	(0.041)
Continental Airlines	-0.131***	-0.308***	-0.055***	-0.099**
(Emerged)	(0.028)	(0.071)	(0.018)	(0.044)
TWA	-0.028	-0.056	-0.011	-0.033
(Emerged)	(0.019)	(0.051)	(0.011)	(0.034)
Markair 1st filing	-0.007	0.000	-0.062*	-0.079
(Emerged)	(0.083)	(0.000)	(0.034)	(0.055)
America West	0.086***	-0.231***	0.038***	-0.014
(Emerged)	(0.016)	(0.033)	(0.008)	(0.032)
Delta Airlines	0.033***	0.099***	0.040***	0.027
(Under)	(0.012)	(0.017)	(0.010)	(0.016)
Northwest Airlines	0.018	0.070***	-0.003	0.022
(Under)	(0.013)	(0.022)	(0.009)	(0.018)
Market-carrier fixed effect			Yes	
Year-quarter fixed effect			Yes	
Observations			45367	
Number of markets			2066	
R^2			0.330	
R^2 Within			0.330	
R^2 Overall			0.173	

Standard errors in parentheses* significant at 10%; ** significant at 5%; *** significant at 1%

Each specification includes a categorical variable to indicate whether the flight is direct, and one to indicate whether it is a roundtrip. Other included variables are: the log of the average cost per seat mile (the ratio of the quarterly operating expenses over the quarterly total of the product of the number of seats transported and of the number of miles flown by the airline), the number of extra miles flown (the ratio of the flown distance over the nonstop distance in miles between two airports, for a direct flight it is 1, while for connecting flights it is larger than 1); a measure of the carrier's network at origin and at destination, equal to the percentage of all markets served by the carrier from the origin and destination airport respectively; and a constant term. All columns include market-carrier, and year-quarter fixed effects. All columns exclude the two quarters prior a carrier's bankruptcy filing.

Table 6: Demand Estimation

In the first four columns, we estimate the regression,

$$\ln(s_{jrmt}) - \ln(s_{Omt}) = \phi^K BktOwn^K_{jmt} + \mu p_{jrmt} + X^D_{jrmt}\psi + \lambda \ln(s_{jrmt|g}) + \xi_{jr} + \xi_t + \xi_{jrmt} ,$$

where s_{jrmt} represents product *j*'s market share, s_{Omt}, the share of the outside good, and $s_{jrmt|g}$ the group share of product *j*. The variables $BktOwn_{jrmt}$ is as defined before ($BktOwn_{jrmt} = 1$ if i) firm K is under bankruptcy protection at time t; ii) firm K serves route r in market m; iii) the observation jrmt is for firm K. Otherwise, $BktOwn_{jmt} = 0$). In Column 5 we estimate the demand equation in a model where there is no outside good,

$$\ln(s_{jrmt}) - \ln(s_{lrmt}) = \phi^K\left(BktOwn^K_{jmt} - BktOwn^K_{lmt}\right) + \mu\left(p_{jrmt} - p_{lrmt}\right) + \left(X^D_{jrmt} - X^D_{lrmt}\right)\psi + \left(\xi_{jr} - \xi_{lr}\right) + \xi_{jrmt} - \xi_{lrmt}$$

	Median Price	25th Pctile Price	75th Pctile Price	Median Price
United Airlines (Emerged)	-0.049***	-0.083***	-0.025	-0.112***
	(0.015)	(0.016)	(0.014)*	(0.018)
US Airways 1st filing (Emerged)	-0.027	-0.024	-0.036	0.014
	(0.037)	(0.033)	(0.031)	(0.034)
ATA (Emerged)	-0.185**	-0.296***	-0.097	-0.369
	(0.090)	(0.078)	(0.071)	(0.112)
US Airways 2nd filing (Merged)	-0.181***	-0.160***	-0.169***	-0.123***
	(0.041)	(0.034)	(0.031)	(0.034)
TWA 3rd filing (Merged)	0.015	0.020	-0.052	-0.072
	(0.046)	(0.049)	(0.045)	(0.069)
Markair 2nd filing (Liquidated)	-0.128	-0.134	0.029	-0.294
	(0.160)	(0.335)	(0.307)	(0.474)
National Airlines (Liquidated)	0.364**	0.254	0.334**	0.437*
	(0.151)	(0.177)	(0.162)	(0.249)
TWA 2nd filing (Pre-Packaged)	-0.094*	-0.068	0.013	0.051
	(0.049)	(0.051)	(0.047)	(0.069)
Continental (Emerged)	-0.090*	-0.126**	0.065	0.046
	(0.053)	(0.055)	(0.049)	(0.078)
TWA 1st (Emerged)	0.026	-0.001	0.056	0.293***
	(0.044)	(0.038)	(0.034)	(0.053)
Markair 1st (Emerged)	-0.101	-0.078	-0.128	-0.149
	(0.186)	(0.165)	(0.151)	(0.245)
America West (Emerged)	0.146***	0.222***	0.068***	0.119***
	(0.027)	(0.029)	(0.026)	(0.043)
Delta (Under)	-0.045**	-0.085***	-0.020	-0.103***
	(0.019)	(0.019)	(0.017)	(0.026)
Northwest (Under)	-0.032	-0.057 **	-0.002	-0.004
	(0.026)	(0.024)	(0.022)	(0.036)
P_{jmt} (μ)	-0.815***	-1.457***	-0.459 ***	-0.771***
	(0.031)	(0.064)	(0.019)	(0.031)
$\ln(s_{jmt\|g})$ (λ)	0.159***	0.246***	0.191***	
	(0.024)	(0.028)	(0.025)	
Observations	45367	45367	45367	33369
Route-Carrier FE	Yes	Yes	Yes	Yes
Carrier FE	No	No	No	No
Fitness	GMM: 0.048	R^2 Within: 0.331	R^2 Within: 0.439	R^2 Within: 0.3103

Notes: Standard errors in parentheses* significant at 10%; ** significant at 5%; *** significant at 1%
Each specification includes a categorical variable to indicate whether the flight is direct, and one to indicate whether it is a roundtrip. Other included variables are: the log of the average cost per seat mile (the ratio of the quarterly operating expenses over the quarterly total of the product of the number of seats transported and of the number of miles flown by the airline), the number of extra miles flown (the ratio of the flown distance over the nonstop distance in miles between two airports, for a direct flight it is 1, while for connecting flights it is larger than 1); a measure of the carrier's network at origin and at destination, equal to the percentage of all markets served by the carrier from the origin and destination airport respectively; and a constant term.

Table 7: Air carrier pricing behavior

We estimate the regression,

$$\mathbf{p}_{mt} = \alpha^{LAR}\mathbf{BktLAR}^{K}_{mt} + \alpha^{WN}\mathbf{BktWN}^{K}_{mt} + \alpha^{LCC}\mathbf{BktLCC}^{K}_{mt} + \beta\mathbf{KisIn}_{mt} + \left(\Omega^{mt}\right)^{-1}\mathbf{s}_{mt} + \mathbf{mc}_{mt} + \boldsymbol{\omega}_{mt}$$

where α^{LAR}, α^{WN}, α^{LCC} are parameters measuring the supply side changes in pricing behavior that are not explained by changes in the markup of a firm, or in its marginal cost for large national carriers, Southwest Airlines, and low cost carriers, respectively; $\boldsymbol{\Omega}^{mt}$ is a matrix obtained by taking the matrix of cross and own price elasticities and replacing zeros for those entries which correspond to routes served by different carriers; $\mathbf{mc}_{mt}$ is the vector of estimated marginal cost for each carrier; $\mathbf{s}_{mt}$ is a vector of carrier's market shares in markets m at time t, and ω_{mt} is the vector of unobservables determine the pricing decisions of the firm. A cell in ω_{mt} is modeled as, $\omega_{jrmt} = \upsilon_{jr} + \upsilon_{t} + \upsilon_{jrmt}$ The dependent variable is the median price divided by 100. *We report one specification* and *use different columns to present the effect that each of the bankruptcy filings has on relevant competitors.*

	Own	Southwest	Large carriers	Low cost carriers
United Airlines (Emerged)	-0.0817***	0.2121***	-0.0484***	-0.0122
	(0.0124)	(0.0162)	(0.0079)	(0.0119)
US Airways 1st filing (Emerged)	-0.0724***	0.1755***	-0.0542***	0.0551***
	(0.0248)	(0.0320)	(0.0160)	(0.0246)
ATA (Emerged)	-0.0223	-0.0288	-0.0247	-0.0663*
	(0.0328)	(0.0451)	(0.0171)	(0.0357)
US Airways 2nd filing (Merged)	-0.1171***	-0.1438***	-0.1201***	-0.0586***
	(0.0257)	(0.0258)	(0.0142)	(0.0225)
TWA 3rd filing (Merged)	-0.1043***	0.1500***	-0.0853	-0.0993***
	(0.0397)	(0.0544)	(0.0232)	(0.0432)
Markair 2nd filing (Liquidated)	-0.1518***		-0.0965	-0.1962
	(0.0588)		(0.2086)	(0.2084)
National Airlines (Liquidated)	-0.0222	0.1865***	-0.1067***	-0.1033
	(0.0941)	(0.0700)	(0.0359)	(0.0702)
TWA 2nd filing (Pre-Packaged)	-0.1005***	-0.2396***	0.0844***	-0.0816
	(0.0350)	(0.0534)	(0.0262)	(0.0614)
Continental (Emerged)	-0.2636***	-0.5745***	-0.0789*	-0.2045***
	(0.0418)	(0.0770)	(0.0435)	(0.0667)
TWA 1st (Emerged)	-0.0756***	-0.1034***	-0.0133	-0.0351
	(0.0293)	(0.0685)	(0.0208)	(0.0363)
Markair 1st (Emerged)	-0.0740		-0.0806	-0.0609
	(0.0643)		(0.0600)	(0.0922)
America West (Emerged)	0.1143***	-0.4385***	0.0654***	-0.1024***
	(0.0239)	(0.0390)	(0.0138)	(0.0325)
Delta (Under)	0.0445***	0.1404	0.0691***	0.0685***
	(0.0165)	(0.0191)	(0.0133)	(0.0183)
Northwest (Under)	0.0213	0.1052***	-0.0171	0.0064
	(0.0178)	(0.0237)	(0.0119)	(0.0209)
Observations	45367			
Route-Carrier FE	Yes			
Carrier FE	No			
Fitness	GMM: 0.048			

Standard errors in parentheses; *** significant at 1%; ** significant at 5%;* significant at 10%

Table 8: The Economic Magnitude of the Bankruptcy Effects on Demand and Supply

The prices reported here are calculated as follow. First we choose the market-year-quarter observations where the carried under consideration is bankrupt. For example, when considering United's bankruptcy, (columns 2 -4) we select the 4th quarter of 2002 through the first quarter of 2005. The observed price when the carrier is bankrupt is the mean price across in these quarters, across markets. To determine the prices we would observe if bankruptcy *only affected supply side*, we set the relevant bankruptcy dummies in the demand equation we estimate equal to zero, while leaving the bankruptcy dummies in the supply equation we estimate equal to 1; and recomputed the equilibrium price. The price reported in the second row of prices is precisely this new equilibrium price. To determine the prices we would observe had the carrier *not* filed form Chapter 11 protection, we set the relevant bankruptcy dummies in the demand and in the price equation we estimate equal to zero and recomputed the equilibrium price. The price reported in the third row of prices is precisely this new equilibrium price.

	1	2	3	4	5	6	7	8	9	10	11	12
Bankruptcy of :	United Bankruptcy			US Airways 1st Bankruptcy			US Airway's 2nd Bankruptcy			ATA Bankruptcy		
Effect on prices of:	United	Southwest	American Airlines	US Airways	Southwest	American Airlines	US Airways	Southwest	American Airlines	ATA	Southwest	American Airlines
Observed Prices When Firms are Bankrupt	123.90	120.58	121.64	104.76	118.68	111.92	103.91	96.67	104.31	104.97	110.49	103.45
Prices we would observe if bankruptcy *only affected supply side*	124.03	120.55	121.61	104.84	118.66	111.90	104.42	96.51	104.21	105.19	110.46	103.42
Prices we would observe if Firm were *not* in bankruptcy	132.04	100.00	126.36	111.94	101.72	117.20	116.10	110.78	116.18	107.42	113.33	105.89

Table 9: How Prices, Consumer Welfare, Profits Would Have Been Without the Bankrupt Firm

This table presents a counter-factual exercise which consists of computing the equilibrium prices, market shares, and then the change in consumer welfare that we would have observed if the bankrupt firm had to liquidate its assets. Using the parameter estimates from the demand function reported in Table 6, and the price function reported in Table 7, we recomputed equilibrium prices, market shares, and consumer welfare excluding the bankrupt airline from the sample. We focus on the United, the USAir, and ATA bankruptcies, and for each of them, we report the average change in prices and market shares for all firms and, separately, for Southwest only. We find that consumer welfare would only drop significantly and in a consistent fashion if Chapter 11 were unavailable in the case of the ATA bankruptcy. In the other three bankruptcies, consumer welfare, prices, and shares would be essentially unchanged if a to-be-bankrupt firm had to liquidate its assets instead of being given the possibility to reorganize itself.

	The Period After the Bankrupt Firm Exited the Bankruptcy			
	United Bankruptcy	US Airways 1st Bankruptcy	US Airway's 2nd Bankruptcy	ATA Bankruptcy
Percent change prices	0.9 (977)	1.1 (1200)	1.1 (2105)	6.7(141)
Percent change prices by Southwest	0.9 (110)	1.2 (61)	1.2 (227)	7.1 (15)
Percent change market shares	-0.5 (977)	-1.1 (1200)	-1.1 (2105)	-6.7 (141)
Percent change market shares of Southwest	-0.5 (110)	-1.1 (61)	-1.1 (227)	-6.7 (15)
Dollar amount change CV	-3409 (818)	-2334 (1020)	-2029 (1795)	-40203 (132)

In parentheses the number of observations used.