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# Bankruptcy and Low Cost Carrier Expansion in the Airline Industry

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## ABSTRACT

This paper examines two separate but related questions about airline bankruptcies. First, we ask whether bankrupt airlines harm rivals, especially *efficient* rivals and the industry efficiency declines as a result, as often accused. Focusing on the 1,000 most travelled domestic routes in each quarter from 1998Q1 to 2008Q2, we do not find that the evidence supporting the bankrupt airlines' potential harm to efficient rivals. First of all, bankrupt legacy airlines reduce fare as well as capacity significantly in bankruptcy. During the same period, low-cost carrier (LCC) rivals rather increase fare marginally and expand capacity significantly. As bankrupt airlines' capacity reduction is filled by LCC rivals, the route total capacity shows only a modest decrease during bankruptcy and recovers after reemergence, rebutting the argument that outright liquidation will solve chronic overcapacity problem of the industry. As a result, the mix of capacity seems to change in favor of efficient firms as LCCs replace relatively high-cost bankrupt airlines' capacity. The findings are confirmed with the sample for 200 most popular airports during the same data periods. The pattern of the replacement of bankrupt airlines' capacity by LCCs raises another interesting question of what has limited efficient firms with lower cost from taking markets from relatively inefficient incumbents and what would spur their growth. The LCC expansion during rivals' bankruptcies may indicate the existence of entry barrier aside from product heterogeneities. Therefore, the substantial capacity reduction associated with bankruptcy can be a factor that lowers the entry barrier and spurs LCC expansion. We quantify how large the fraction of LCC growth spurred by rivals' bankruptcies. The fraction for the data time periods is estimated to be 13-19% and moreover most of the growth has occurred during legacy rivals' bankruptcies.

## 1 Introduction

Do loose bankruptcy laws allow inefficient airlines to survive and undermine their efficient rivals' profitability, harming the industry? This paper examines how bankruptcy filing airlines behave, how their rivals respond, and how the industry changes as a result in the periods surrounding bankruptcies.

Bankruptcies do not necessarily mean going out of business altogether. In the United States, firms can choose between two options, Chapter 11 or Chapter 7. Unlike the liquidation bankruptcy of Chapter 7, Chapter 11 permits bankrupt firms to keep operating as a going-concern while reorganizing themselves under protection from creditors in order to return to profitability. As Chapter 11 has been more of a rule than an exception in the airline industry, there have been critiques on this procedure's potential harms

to their rivals and the industry: Chapter 11 allows inefficient airlines to survive and harm even their healthier counterparts by lowering fares below what rivals charge and/or keeping capacity in the system that otherwise would have been eliminated. The following quote well-summarizes the worries over the potential harm of bankrupt airlines operating under Chapter 11.

What's wrong with Chapter 11? It may keep ailing businesses going, but it distorts the airline industry: Chapter 11 businesses end up with unfair competitive advantages over competitors, thanks to their ability to renegotiate contracts, cut costs and dump debts. Worse, the most basic problem in the industry is excess capacity – too many seats and too few customers, something Chapter 11 doesn't help: all too often it lets airlines restructure without cutting back capacity. This means the core problem is never resolved.

*Moneyweek, Dec 12, 2005*<sup>1</sup>

The arguments are not groundless in theory. To begin with, bankrupt airlines may renegotiate with workers and suppliers, under protection from creditors, to enjoy greater cost advantage over other airlines, which may lead to underpricing (even below their own normal cost level) that squeezes other airlines' profit margins and weakens their financial health similarly as predatory pricing. If this is the case, bankrupt airlines operating under protection can be harmful in the sense that it affects even healthier rivals negatively with unfair cost advantages.

In addition, the natures of competition in the airline industry can be inducive to overcapacity building. Fluctuating demand, for example, may lead to excess capacity when realized demand is low. The combination of huge fixed costs and small marginal costs may give airlines the incentive to increase supply up to unprofitable level. The incentive for building capacity may be enhanced since frequent flights and extensive networks can be valued by travelers. Moreover, capacity can be used as a strategic device to deter entry. If there are too many seats but too few passengers, outright liquidation of some airlines may help remaining rivals raise profit. In other words, Chapter 11 may keep costly excess capacity in the system that otherwise would have been eliminated. In this case, bankruptcy protection is harmful as compared to outright liquidation.

However, the arguments raise several questions. First, would bankrupt airlines be able to put price competitive pressure on rivals? Financially distressed firms' incentive to cut price has been theorized and examined empirically. For one, the heightened likelihood of bankruptcy and liquidation may lead to heavy discount of future profits. Theories of tacit collusion predict more incentive for price cut with lower discount factor. The fare cut could also be a desperate move to generate cash to avoid or postpone bankruptcy and liquidation. Cost advantages achieved in bankruptcy protection may enable the airlines to cut fare with little pain. Even though bankrupt airlines may adopt aggressive pricing, however, bankruptcy usually makes them a weaker competitor, for instance due to consumers' negative perception about bankruptcy or deteriorated value of the products. It is plausible that consumers discount bankrupt

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<sup>1</sup>"US airlines hit turbulence - again", By Simon Wilson, Moneyweek, Dec 12, 2005  
(<http://www.moneyweek.com/investment-advice/us-airlines-hit-turbulence—again.aspx>)

airlines for various reasons such as safety and convenience issues. So, the discounted fare by bankrupt airlines may not be so effective that pushes others to match the fare cut.

Second, liquidation will solve overcapacity problem, if any, on the condition that remaining airlines do not fill the slack after bankrupt airlines are gone. If there are structural reasons for the tendency to build overcapacity, the capacity reduction from liquidation will be only temporary at most. Also, the airplanes, terminals, and slots remain even after the owner airline disappears. Thus, other airlines may simply replace the liquidated airline's capacity and the total capacity level will then go back to the original level eventually. The recent stories of GM/Chrisler bankruptcies can be a guide in this respect as the auto industry is also often characterized by chronic overcapacity.

The two big automakers, GM and Chrisler filed for bankruptcy protection and have been slashing dealerships jobs, and unprofitable brands. The huge withdrawal of the two automakers from the market apparently presented new opportunities for their rivals to expand. The New York Times reports that "many smaller automakers are gaining a bigger share of the market, most notably Hyundai and Kia. 'They're seeing this as the perfect opportunity' to pick up market share in the United States."<sup>2</sup> The US News predicted that "the bankruptcy also gives several GM competitors a boost."<sup>3</sup> In sum, bankrupt carmakers are shrinking their operations as a measure to reduce expenses and raise overall profitability. At the same time, their efficient counterparts are reaping the benefits from the bankruptcies by expanding their market presence. This case suggests that (1) the capacity reduction by bankrupt firms will be filled by their rivals, (2) bankruptcies may open new growth opportunities for rivals firms, and (3) the beneficiaries are likely to be the newer, smaller, efficient firms whose expansion have been limited by incumbents. The efficient rivals' expansion upon incumbents' bankruptcies and downsizing may be even more prominent in the airline industry as the industry is characterized by fixed fundamental facilities. Motivated by the auto industry change in the periods surrounding big companies' bankruptcies, this study attempts to see how the total capacity and the composition of capacity between legacy and low-cost carriers change with airline bankruptcies.

This work investigates three empirical questions using event study approach. The first two questions are about the potential harm of Chapter 11 to the airlines competing against bankrupt airlines and the industry; (1) whether a bankrupt firm harm rivals and (2) whether the total capacity change over the course of bankruptcies. There are previous studies on the two questions although the works do not focus on the differences between bankrupt airlines and between rivals depending on which carrier group they belong to. Borenstein and Rose (1995) find that the fare cut by bankruptcy filing airlines seems to start prior to the actual filing but dissipates quickly during bankruptcy and their rivals do not change fare significantly during the same period. Recently Ciliberto and Schenone (2008) looked at the changes in fare and capacity during and after Chapter 11 bankruptcies. They find that bankrupt airlines' rivals do not cut fares to match bankrupt airlines' fare. They also report that bankrupt airlines reduce capacity but their rivals marginally reduce or even increase capacity. Another paper by Borenstein and Rose (2003) find no significant effect of bankruptcy on the total services at small and large airports and, even at medium

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<sup>2</sup>"Small Carmakers Benefit From Detroit's Woes", NY Times, June 22, 2009

<sup>3</sup>"Who Will Gain From the GM Bankruptcy?", US News, June 1, 2009

sized airports, the reduction is not large. Lastly, the surveys in the U.S. General Accounting Office (2005) report that, when dominant airlines reduce capacity for some reasons such as filing for bankruptcy or dropping hub airports, the reduced capacity is quickly filled by other airlines.

Our findings are largely consistent with the previous works but rather focused on LCCs competing with bankrupt legacy airlines. In sum, (1) bankrupt airlines cut capacity and the reduction continues even after reemergence from bankruptcy in the case of legacy airlines' bankruptcies, (2) LCCs replace the reduced capacity by bankrupt airlines, especially when legacy airline is gone bankrupt, (3) the replacement of bankrupt airlines' capacity by LCCs is more prominent on the routes where a bankrupt airline used to have a larger market share, (4) bankrupt airlines cut fares significantly starting even prior to the actual filing but LCCs do not match the bankrupt airline's fare cut and even increases the fare unlike other non-LCC rivals that tend to cut fare during the same period, (5) all airlines seem to keep lower fare in the post-bankruptcy periods after bankrupt airlines' reemergence than in the absence of bankruptcies, indicating the toughened competition after, not during, bankruptcies possibly due to the increased LCC presence, and lastly, (6) the total capacity shows modest decrease in terms of the number of available seats while the number of scheduled flights are mostly unaffected and even increasing in the post-bankrupt periods, implying the replacement of large airplane with smaller airplane.

The relative efficiency of rivals that replaces bankrupt airlines' capacity matters as the change in capacity composition in favor of LCCs indicates the improved allocative efficiency in production in the periods surrounding bankruptcies. Moreover, LCC expansion during rivals' bankruptcy (especially when large network carriers are bankrupt) raises another interesting question about new comers' growth; what is the factor that limits efficient entrants' growth? In other words, what would be the factor that spurs the efficient firms' growth. This question is different from those studied in previous literatures on LCCs that focused on how incumbents respond to LCC entry. This study rather asks how LCCs would respond when incumbents contract in bankruptcy and thereby quantifies the resilience of incumbents and the factors stimulating LCC expansion.

It is often noted that market shares are sticky and market dominance is persistent. In the airline industry, LCC growth has been modest and rather limited considering the significant cost advantages over incumbent legacy airlines and the long history since deregulation in 1978. LCCs have grown mostly by creating and accommodating price-elastic demands that have not been served by incumbent airlines. Does this limited growth mean LCCs are inferior to legacy carriers, with cheap fare and comparable cheap services? The growth of LCCs during rivals' contraction suggest a different story. There might have been entry barriers that hinder efficient entrants from taking markets away from incumbents. The entry barriers can be fixed ground facilities, time slots, or consumer inertia from switching costs established by various loyalty programs. Patterns of past growth of LCCs can be useful in assessing the factors that spur or limit it. This leads us to the final question; how large is the fraction of LCC growth spurred from rivals' bankruptcies? The magnitude of the estimates will be informative of how high the entry barriers are.

We provide quantitative estimates of the direct growth effect from rivals' bankruptcy. Based on the event study results, the fraction of LCC capacity growth occurred during bankrupt rivals' capacity

cutback will be estimated. For the entire sample of bankruptcies, we estimate the fraction of LCC growth from rivals' bankruptcies as 13-19% of the LCC growth 1998Q1 through 2008Q2 (i.e. data periods). In particular, legacy airlines' bankruptcies explain about 16~17% of the growth and other (non-legacy) airlines' bankruptcies explain about -2~3% of the growth. As our most conservative estimate, i.e. lower bound estimate is about 13% of the growth, the effect explains a significant portion of the growth.

In sum, we are interested in what airline bankruptcies mean to bankrupt airlines' competitors. The paper is composed of two parts that investigate separate but related questions. The first part investigates how bankruptcy affects market competition and the second part quantifies the fraction of LCC growth spurred by rivals' bankruptcies. In particular, we attempt to see whether a bankrupt airline under protection harms rivals. Our empirical results do not support the accusation that bankrupt airlines harm rivals by toughening competition and contributing to overcapacity. The results show that bankrupt airlines' fare cut does not push more efficient LCC rivals to match their fare cut and even outright liquidation will not solve overcapacity problem, if any, as bankrupt airlines' reduced operations are filled by rivals. Especially, LCCs tend to expand as bankrupt airlines cut back on capacity. Thus, if bankrupt airlines are liquidated immediately, then the increased market presence of LCCs may put much even stronger downward pricing pressure as weaker competitors will be replaced by stronger competitors with lower cost structure.

Overall, the answer to the question if bankruptcy protection harms the industry would be yes and no. The answer is "no" in the sense that bankrupt protection does not worsen the situation by hurting healthy competitors or keeping redundant capacities. On the other hand, it can be "yes" on the cost side in the sense that efficient airlines could have expanded even more extensively and the industry could have been better without bankrupt airlines. Thus, the answer would depend on the capability of bankrupt airlines to cut costs down to the level comparable to efficient rivals, LCCs.

The second part is about firm growth. The results from the first part indicate that LCCs expand while rivals are bankrupt and shrinking. The results are consistent with the existence of entry barriers. That is, lower cost structure is not all it takes for entrants to take markets away from incumbents. It can be the case that airlines tend to hold onto their capacities and try to even increase them as long as they are not facing an immediate danger of survival. Bankruptcies are the events that can shake up persistent market shares. Bankrupt airlines are forced to cut back on capacity and their smaller presence may provide room for others to expand. The rivals, especially LCCs seem to be active in taking advantage of the immediate growth opportunities. We quantify the fraction of LCC growth explained by rivals' bankruptcies and the estimated fraction is not negligible.

The remainder of this paper proceeds in the following steps. Section 2 introduces backgrounds. Section 3 outlines a conceptual framework with identification strategy and potential biases. Section 4 describes data sources and sample construction. Section 5 presents econometric specifications and Section 6 discusses estimation results. Section 7 quantifies the fraction of the LCC growth from rivals' bankruptcies. Finally, Section 8 concludes.

## 2 Background

This section introduces backgrounds and motivations of the paper. In particular, we will discuss what to expect and what the results would mean. Airline bankruptcy and what it means for competitors of bankrupt airlines are of the main interest in this paper. Our first question is whether bankrupt airlines hurt rivals, especially efficient ones with low cost structure, and the industry efficiency and profitability deteriorate as a result. We begin with the potential harms of bankrupt airlines to rivals and the industry as a whole then discuss whether those harms are likely to be realized and outright liquidation would have prevented them from happening. As presented in the later sections, empirical results are not consistent with the accusation of potential harms that bankrupt airlines may have on rivals and the industry. In fact, the reduced presence of bankrupt airlines seem to open the windows of opportunity to rivals, providing immediate growth opportunities, which leads to our next question: who replaces bankrupt airlines and how large the fraction of the replacing airlines' growth can be attributed to rivals' bankruptcies?

In order to expect and understand bankrupt airlines' behavior and their rivals' responses, we need to see the incentives they have. First of all, why would bankrupt airlines trigger a price war? For one, financially distressed firms may discount future profits more heavily as liquidation gets more likely. Theories of tacit collusion predict that lower discount factor leads to more incentive to defect and initiate a price war. Also, when firm's survival is at risk, the firm may engage in a price war in order to secure survival at the expense of profit maximization. Hendel (1996) built a model in which financially distressed firms use aggressive pricing as a source of internal financing to raise liquidity. The tendency to trigger a fare war under financial distress in the airline industry is reported by Busse (2002). Cost advantages from bankruptcy protection may enhance this incentive even more. Bankrupt airlines may be able to achieve significant cost reduction, which enables them to cut fare even below their normal cost level. As prices are strategic complements, the fare cut initiated by bankruptcy filing airlines may put pressure on rivals to follow suit. In this case, even low-cost competitors may find it hard to match the fare cut without hurting their own financial health too much. Thus, downward pricing pressures may take a huge toll on bankrupt airlines' rivals.

There is also an argument that bankrupt airlines should have been liquidated to resolve the industry's chronic overcapacity problem. It would be useful to discuss the reasons why overcapacity problem may exist in the airline industry in order to expect whether outright liquidation of bankrupt airlines will solve the problem. If there are structural reasons for overcapacity, the problem will not be solved even after some airlines disappear because others will enter or expand to fill the slack. Morrison and Winston (1995) pointed out cyclical demand and forecast error as a main source for overcapacity. Since airlines have to plan capacity ahead of time when demand is actually realized, the difference between expected and realized demand will contribute to overcapacity. Aside from forecast errors, airlines have economic reasons for overcapacity. To begin with, the combination of huge fixed cost and insignificant marginal cost leads airlines to supply seats as long as the fare covers variable costs, even up to the unprofitable, excessive level. Since network size and flight frequencies are qualities that may affect consumers' willingness to pay, economies of scale and scope give airlines additional reason to expand. Moreover, airlines may have

strategic reasons for excess capacity such as deterring entry or preempting the resources, such as airport terminals, gates, and time slots, that are fixed at least in short-term.

However, the potential harm of bankrupt airlines to rivals may not be as effective as often accused to be and the situation may not have been much different with outright liquidation. First of all, bankrupt airlines are weaker competitors. Whether bankrupt airlines' fare cut, if any, will lead to tougher competition is uncertain. Consumers would discount bankrupt airlines for safety issue, inconvenience, less valuable frequent flyer program, or other reasons. Thus, bankrupt airlines' rivals may not need to struggle to match the fare cut. On the other hand, healthy rivals may even initiate aggressive pricing so as to eliminate the weakened bankrupt airlines that cannot afford to cut fare against them. Therefore, we need to see whether and when bankrupt airlines and rivals engage in significant fare cut and whether fares go up after bankrupt airlines exit the market.

Second of all, the incentives to expand do not disappear with liquidated airlines because the sources of overcapacity are not the existence of some financially distressed airlines. The nature of competition in the airline industry is easy to lead to overcapacity. Thus, if consumers are willing to substitute bankrupt airlines' tickets for other airlines, then the elimination of bankrupt airlines' capacity will not be permanent. That is, when some airlines are gone, other airlines that can afford to expand will come and pick up the slack. If overcapacity is prevalent, it would not be costly for the rival airlines to expand. In this case, outright liquidation may reduce the total capacity in short-term but the capacity level will bounce back eventually as the reduced capacity by bankrupt airlines is absorbed by healthier competitors. Besides, bankrupt airlines, though not liquidated, may simply not afford to maintain the normal level of services and reduce operations as a measure to cut total expenses. Therefore, we need to see whether bankrupt airlines reduce capacity and whether rivals fill the gap as bankrupt airlines shrink operations. The empirical results in later sections support that airlines start to cut back on capacity as they are near bankruptcy, either by withdrawing services from route/airport altogether or by reducing seat supply (with smaller airplanes or less frequent flights). In addition, we find that total route capacity does not seem to change meaningfully.

Our findings on capacity have two implications, one on the allocative cost efficiency and the other on LCC growth. First, if total capacity level remains unaffected but rivals replace bankrupt airlines' capacity, then the composition of capacity will change. In this case, who would replace the capacity is an important question. If replacing airlines are relatively more efficient than bankrupt airlines, then allocative efficiency of production will improve as market shares change in favor of more efficient firms. The replacement pattern would depend on substitutability with bankrupt airlines' products and the rivals' ability to add capacity at low costs. Under the competition with differentiated products, the closest competitors will benefit most from bankrupt airlines' contract. If competition is more about price, then the most efficient competitors with low cost structure are more likely to benefit. Our empirical results show that LCC expansion is prominent while bankruptcy filing airlines are shrinking, especially when the bankrupt airline is a legacy carrier. This result suggests that the answer to the question of whether or not outright liquidation would have improved industry efficiency depends on bankrupt airlines' capability to



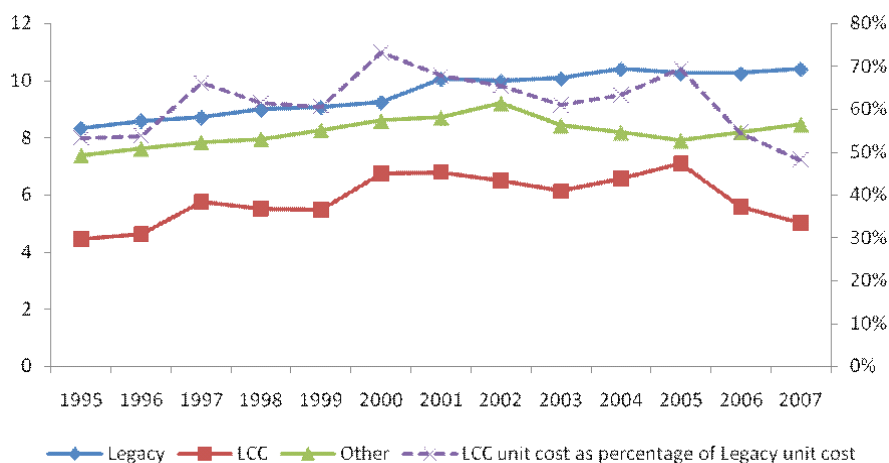


Figure 1: CASM (cost per available seat mile) Excluding Fuel Costs (in cents) (Source: Author’s calculation based on the Airline Data Project (ADP) established by the MIT Global Airline Industry Program)

cut cost level comparable to the rivals that would have absorbed and replaced bankrupt airlines’ capacity if liquidated.

Second, LCCs can be substitutes for bankrupt airlines and moreover they are willing to and can afford to expand, which raises our next question; what has been holding LCCs back from expanding more quickly? In other words, what would be the factor that spurs efficient airlines’ growth? Figure 1 shows the unit cost (excluding fuel cost<sup>4</sup>) differential between carrier groups. LCC’s unit cost level is about 50-70% of that of legacy airlines. If fuel cost is included, the cost differential will be even bigger.

Even with the significant cost advantages over legacy airlines, LCC expansion has been slower than expected given the long history of airline industry deregulation (1978). In general, market shares are sticky and market dominance is quite persistent. In the earlier period of deregulation, LCC expansion has focused on niche markets/demands that have not been served and secondary airports. That is, LCC growth has been mostly done in a limited range. In the airline industry, we can think of two reasons why LCCs have not expanded that quickly, in other words, why LCC expansion has been limited. The reasons can be either product differentiation or entry barriers. If travellers regard legacy carriers’ services as superior to LCCs’ somehow (.e.g preference for extensive network, more frequent flights, or other extra services), then LCCs would not have been able to take large markets away from legacy carriers. Switching costs from the Frequent Flyer Program (FFP) can act as an artificial entry barrier. Moreover, the resources essential for airline operations such as airport terminals, gates, and time slots are fixed at least in short term. So, it is hard to get the access to the facility if incumbents are not giving up their shares locked in long-term contracts.

The findings that LCCs replace bankrupt legacy airlines’ capacity may indicate that the obstacle for the

<sup>4</sup>CASM excluding fuel costs between carrier groups have been compared as fuel cost may be affected more by external shock than by endogenous managerial or operational efficiency, which also shows a significant cost difference between carrier groups.

growth is more likely to be the existence of entry barrier. Lower cost alone does not guarantee for entrants to take markets from less efficient incumbents. Discrete capacity cutback by incumbents motivated by bankruptcy or near-bankruptcy financial distress may present immediate growth opportunities for those efficient airlines. That is, when a bankrupt airline shrinks their operations, LCCs will be able to pick up the slack either because LCCs are now facing competition without switching cost due to the decreased value of FFP of the bankrupt airline or because there are physical resources/facilities that are given up by the bankrupt airline and become available to others. The fraction of LCC growth spurred by rivals' bankruptcies will be quantified in Section 7. The magnitude of the fraction will inform us about how high the entry barrier would have been.

### 3 Identification

This section outlines a conceptual framework of the paper and raises several identification issues. First of all, we are interested in evaluating the effect of bankruptcies on airlines. In particular, the change in fare and capacity set by bankruptcy filing airlines in the periods surrounding bankruptcies and the effect of the exposure of airlines to rivals' bankruptcies on their fare and capacity during the same period will be of the main interest in this paper. The central questions are, first, how bankrupt airlines change fare and capacity, second, how bankrupt airlines' rivals change fare and capacity in response, and lastly, how the total route capacity level changes (or does not change) as a result. The first two questions are intended to answer whether bankrupt airlines are harming rivals, as often accused, and the last question is to see whether overcapacity problem, if any, would be resolved with outright liquidation instead of bankruptcy protection, as often claimed.

To describe a conceptual framework, we begin with the definition of potential outcomes with and without bankruptcy. In fare and capacity analysis for bankrupt airlines and their rivals, an individual is a carrier-route-time combination labelled with  $irt$  and the outcome of interest is fare or capacity ( $Y_{irt}$ ). Airlines can be involved in bankruptcy in two ways: either they file for bankruptcy themselves or they are competing against bankrupt airlines. There are two potential outcomes depending on whether an airline is bankrupt or not (bankrupt-carrier indicator:  $D_{it} = 1$  if a carrier  $i$  is bankrupt at time  $t$  and 0 otherwise). Also, there are two potential outcomes depending on whether an airline is a rival to bankrupt airlines or not (bankruptcy indicator:  $W_{rt} = 1$  if bankrupt airlines are serving route  $r$  at time  $t$  and 0 otherwise). Basically, we want to compare the conditional expectation of potential outcomes (fare and capacity) with and without bankruptcy. To be more specific, we are interested in identifying

$$\begin{aligned} \tau_{Bankrupt}(x) &\equiv E \left[ \log \left( \frac{Y_{irt}(D_{it} = 1)}{Y_{irt}(D_{it} = 0)} \right) \mid X_{irt} = x \right] \\ &= E[\log(Y_{irt}(D_{it} = 1)) - \log(Y_{irt}(D_{it} = 0)) \mid X_{irt} = x] \end{aligned}$$

for bankrupt airlines and

$$\begin{aligned}\tau_{Rival}(x, b) &\equiv E \left[ \log \left( \frac{Y_{irt}(W_{rt} = 1)}{Y_{irt}(W_{rt} = 0)} \right) \mid X_{irt} = x, Bshr_{rt} = b \right] \\ &= E[\log(Y_{irt}(W_{rt} = 1)) - \log(Y_{irt}(W_{rt} = 0)) \mid X_{irt} = x, Bshr_{rt} = b]\end{aligned}$$

for the rivals competing against the bankrupt airlines where  $Y_{irt}$  is fare or capacity set by a carrier  $i$  on a route  $r$  at time  $t$ ,  $X_{irt}$  is a set of other factors that affect the outcomes, fare or capacity, and  $Bshr_{rt}$  is the market presence of bankrupt airlines on a route  $r$  at time  $t$ , that is, how dominant the bankrupt airlines are on the route at that time. As for the effect on rivals' fare and capacity,  $Bshr_{rt}$  is considered to allow the effect to vary depending on the degree of exposure to bankruptcies. For instance, when an airline used to be dominant on a route, its bankruptcy may have more effects on rivals competing on the route. Notice that it is included only when the bankruptcy indicator is triggered on because it is not applicable where no airline is filing for bankruptcy.

As the log difference is approximately the same as the percentage change,  $\tau_{Bankrupt}$  is interpreted as the percentage change in  $Y$  from own bankruptcy and  $\tau_{Rival}$  is regarded as the percentage change in  $Y$  from rivals' bankruptcies. The rationale for choosing relative change over absolute change is that we think the percentage change is a more appropriate measure of the difference in fare or capacity with and without bankruptcy because the fare or capacity level will be different on different routes and the airlines are expected to change the fare and capacity proportionally to the usual level on a route rather than by the same amount on every route.<sup>5</sup>

We assume the unconfoundedness, i.e.

$$\begin{aligned}D_{it} &\perp\!\!\!\perp Y_{irt}(D_{it} = 1), Y_{irt}(D_{it} = 0) \mid X_{irt} \\ W_{rt} &\perp\!\!\!\perp Y_{irt}(W_{rt} = 1), Y_{irt}(W_{rt} = 0) \mid X_{irt}, Bshr_{rt}\end{aligned}$$

that enables the identification of  $\tau_{Bankrupt}$  and  $\tau_{Rival}$ . The assumption means that, given the observed characteristics  $X_{irt}$  and  $Bshr_{rt}$ , there are no confounding factors that are associated with both  $Y$  (fare and capacity) and the bankrupt-carrier and bankruptcy indicators,  $D_{it}$  and  $W_{rt}$ . We will come back to the unconfoundedness assumption later in this section to discuss the validity. Under the assumption, we can rewrite the equations as the difference between conditional expectations:

$$\begin{aligned}\tau_{Bankrupt}(x) &= E[\log(Y_{irt}) \mid D_{it} = 1, X_{irt} = x] - E[\log(Y_{irt}) \mid D_{it} = 0, X_{irt} = x] \\ \tau_{Rival}(x, b) &= E[\log(Y_{irt}) \mid W_{rt} = 1, X_{irt} = x, Bshr_{rt} = b] - E[\log(Y_{irt}) \mid W_{rt} = 0, X_{irt} = x, Bshr_{rt} = b]\end{aligned}$$

To model fare and capacity, we assume that (1) the percentage changes in fare and capacity set by bankrupt airlines are homogenous on all routes where those airlines are serving, (2) the percentage changes

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<sup>5</sup>Though not reported here, the same analysis has been done to estimate absolute change instead of relative change and the results are not different qualitatively.

in fare and capacity set by bankrupt airlines' rivals are proportional to the degree of bankrupt airlines' market presence/dominance on a route, and so (3) the log-transformed outcome  $\log(Y_{irt})$  can be expressed as a linear function as follows:

$$\log(Y_{irt}) = \alpha_0 + \alpha_1 D_{it} + \alpha_2 W_{irt} Bshr_{rt} + X_{irt} \beta_0 + D_{it} X_{irt} \beta_1 + W_{irt} Bshr_{rt} X_{irt} \beta_2 + \varepsilon_{irt}$$

where  $\{\alpha_0, \alpha_1, \alpha_2, \beta_0, \beta_1, \beta_2\}$  is a set of parameters to be estimated and  $\varepsilon_{irt}$  is a random error with mean zero. Then, the estimands of interest are

$$\begin{aligned} \tau_{Bankrupt}(x) &= \alpha_1 + x\beta_1 \\ \tau_{Rival}(x, b) &= \alpha_2 + xb\beta_2 \end{aligned}$$

which can be estimated consistently by regressing  $\log(Y_{irt})$  on 1,  $D_{it}$ ,  $W_{irt} Bshr_{rt}$ ,  $X_{irt}$ ,  $D_{it} X_{irt}$  and  $W_{irt} Bshr_{rt} X_{irt}$ .

Likewise, we want to identify

$$\begin{aligned} \tau_{Route}(z, b) &\equiv E \left[ \log \left( \frac{Y_{rt}(W_{rt} = 1)}{Y_{rt}(W_{rt} = 0)} \right) \mid Z_{rt} = z, Bshr_{rt} = b \right] \\ &= E[\log(Y_{rt}(W_{rt} = 1)) - \log(Y_{rt}(W_{rt} = 0)) \mid Z_{rt} = z, Bshr_{rt} = b] \end{aligned}$$

as for the total route capacity where  $Y_{rt}$  is the total route capacity on route  $r$  at time  $t$ ,  $Z_{rt}$  is the route characteristics that may be associated with bankruptcy of a carrier serving on route  $r$ , and  $W_{rt}$  and  $Bshr_{rt}$  are the same as defined as before. We will call the routes where bankruptcy filing airlines are serving as "bankrupt" routes. We are interested in how the total route capacity changes (or does not change) over the course of bankruptcies of serving carriers. Similarly with carrier-level fare and capacity, we assume that the percentage change in total route capacity on "bankrupt" routes is proportional to the degree of bankrupt airlines' presence on the route and model the log-transformed value of total route capacity as a linear equation accordingly:

$$\log(Y_{rt}) = \gamma_0 + \gamma_1 W_{irt} Bshr_{rt} + Z_{rt} \delta_0 + W_{irt} Bshr_{rt} Z_{rt} \delta_1 + \varepsilon_{rt}$$

where  $\{\gamma_0, \gamma_1, \delta_0, \delta_1\}$  is a set of parameters to be estimated and  $\varepsilon_{rt}$  is a random error with mean zero. Combined with unconfoundedness assumption  $(W_{rt} \perp\!\!\!\perp Y_{rt}(W_{irt} = 1), Y_{rt}(W_{irt} = 0)) \mid Z_{rt}, Bshr_{rt})$ , the model enables us to identify the change in total route capacity with and without bankruptcy, i.e.

$$\tau_{Route}(z, b) = \gamma_1 + zb\delta_1$$

by regressing  $\log(Y_{rt})$  on 1,  $W_{irt} Bshr_{rt}$ ,  $Z_{rt}$ , and  $W_{irt} Bshr_{rt} Z_{rt}$ .

So far, we did not divide bankrupt airlines and rivals depending on which carrier group they belong for a simpler presentation of identification problem. In empirical analysis, we will separate the bankruptcy

filings depending on whether a bankrupt airline is a legacy carriers or not. We will then divide bankrupt airlines' rivals depending on whether the rival is a LCC or not. Moreover, we allow for the bankruptcy effects to vary over the course of bankruptcy by estimating the changes in each event period (starting from pre-bankruptcy periods near bankruptcy to post-bankruptcy periods after reemergence, if applicable, from bankruptcy) separately. This division of does not change the implication of the identification problems and models stated above. The specific variable constructions are detailed in section 5.1. and the empirical specifications are presented in section 5.2.

The basic empirical approach is the event study. Basically, we will compare fare or capacity for bankruptcy-affected airlines and routes (bankrupt airlines, their rivals, and "bankrupt" routes) to the normal counterparts unaffected by bankruptcy. The normal counterparts mean the counterfactuals absent bankruptcy events. The key to the identification is unbiased estimation of the counterfactuals in absence of bankruptcies. We will discuss what we can do with available data to this end.

Ideally, we want to know how much capacity or fare would be with and without bankruptcies for an identical unit, that is, the same airline on the same route at the same time period (or the same route at the same time period as for total capacity). In that case, we can simply compare the average of two outcomes (fare or capacity) with and without bankruptcy. That is, the difference between the averages with and without bankruptcy will be a consistent estimator of bankruptcy effect. Unfortunately, we can observe only what has been realized and we do not have data on potential outcomes that have not been realized. That is, we either observe fare/capacity of an airline  $i$  on a route  $r$  at time  $t$  with bankruptcy or that without bankruptcy. This is where unconfoundedness assumption plays a part. That is, this is less of a problem if bankruptcy is randomly assigned given  $X_{irt}$  or  $Z_{rt}$ , that is, the bankrupt-carrier indicator and the bankruptcy indicator are exogenous given  $X_{irt}$  or  $Z_{rt}$ , respectively, since then we are able to achieve consistent estimates by taking a difference between the averages of log-transformed value of fare/capacity for the two groups with and without bankruptcy. The validity of this assumption will depend on how effectively we can control for potential endogeneities of becoming a bankrupt airline or bankrupt airlines' rival.

First of all, the panel structure of our data set has a strength that enables us to control for time-constant individual heterogeneities. We will take advantage of this feature by employing a fixed effect model. Time-invariant individual heterogeneities will account for a large portion of endogeneities in bankruptcy-related indicators.

Aside from individual fixed effects, for the confounding factors that may affect fares and be correlated with bankruptcies, we include the presence of LCCs and network size of a carrier. As we will see later, bankruptcy of a carrier serving a route may attract LCCs to enter and the entry of LCC has been reported to affect fare level negatively. Also, bankrupt airlines often shrink network size and it may have negative impact on fare level as they cannot command premium for extensive networks. Other factors such as the portion of direct flights, round trips, and code-sharing are also considered for more precise estimation. On the other hand, we add the presence of LCC that may confound capacity change from LCC entry with bankruptcy effect as the entry of LCC are often linked to increasing capacity as fares are lowered.

Now, sufficient number of observations unaffected by bankruptcy will allow us to estimate the counterfactual patterns of fare/capacity set by airlines. The sources for estimating the counterfactuals are from two data; the data from the periods unaffected by bankruptcy (prior to bankruptcy) and the data from routes where no airline is bankrupt. That is, for bankrupt airlines, we will compare fare and capacity set by the physically identical carriers at different times (one before and the other after affected by bankruptcy). For their rivals, the comparison will be done for identical carriers both over-time and cross-sectionally (between the routes where a rival is bankrupt and those where no airline is bankrupt). We have at least five quarters ahead of bankruptcy filing and, for most of bankruptcy cases, we have more than two years ahead of bankruptcy filings. Among the quarterly 1000 largest routes used in the analysis, at least some routes are not affected by bankruptcy (which is true for the quarterly 200 popular airports used for supplementary analysis).

Besides, we look at the events where a bankrupt airlines exit from a market and see how the exit affects rivals. The empirical results and anecdotal evidences suggest that bankrupt airlines shrink operations by either reducing capacity in a market or withdrawing services from a market altogether. The exit event will give us the opportunity to expect what would have happened if a bankrupt airline is liquidated instead of under Chapter 11 protection. The exit events, by no means, is a random experiment on liquidation effect on rivals because a bankrupt airline made a decision to withdraw from the market or creditors found the airline unprofitable to keep operating. However, it will inform us what actually happened when a bankrupt airline is gone, supplementing the evidence from the comparison between actual and counterfactual behaviors of airlines affected by bankruptcies.

There are four remaining issues that may lead to potential biases in estimating counterfactuals absent bankruptcies. We will discuss them and best available options to lessen the potential biases one by one. First, as bankruptcy filing airlines will begin to experience financial distress at some point prior to actual bankruptcy filing, this may alter the airlines' behavior even prior to the actual bankruptcy filing. Kennedy (2000) examined the operating performance of bankruptcy filing firms and their rivals and found that the majority of declines in performances of bankrupt firms and their competitors occur in the periods close to the filing or in the early stage of bankruptcy. So, treating pre-bankruptcy periods as normal times may bias the estimates of bankruptcy effects downwards. In this case, separate estimation of pre-bankruptcy periods will solve the problem. Thus, we begin to track bankrupt airlines three quarters prior to the actual filing.

Effects in post-bankruptcy periods will also be treated separately to see whether bankruptcies have temporary or permanent effects on airlines and the industry. The significance and size of estimates on fare/capacity change in post-bankruptcy periods will show us whether the effect, if any, is persistent. Bankrupt airlines may just go back to the original strategies before they suffer from financial distress. On the other hand, bankrupt airlines may continue to keep their strategies in bankruptcy even after they reemerge. It is also a possibility that the airlines become an even stronger threat to rivals once they exit bankruptcy and with lower debt and cost level, engage in aggressive strategies to win the market share lost in bankruptcy. If bankrupt airlines' behavior can change in post-bankruptcy periods, not considering those possibilities will bias the estimates on bankruptcy effects.

Second, it is noteworthy that bankruptcies often coincide with deteriorated demand conditions. The trend in demand, if exists, matters as it may complicate the problem due to the fact that total route capacity will decline with diminishing popularity of travelling the route and the decreasing demand may push some airlines to file for bankruptcy. The change in demand condition may result in a false causal relationship between bankruptcy and total capacity level. How to deal with the endogeneity, however, depends on our view of whether the endogeneity is local or not. Ciliberto and Schenone (2008) argued that, since airlines serving the routes with diminishing demands may be more likely to file for bankruptcy, the downward demand trend can complicate the estimated fare/capacity change upon bankruptcy to be biased in negative direction. As a measure to lessen the bias, they include origin and destination specific linear time trends in their econometric models (on fare, number of available seats, or load factor). If there is the positive relationship between bankruptcy and diminishing time trend of demand, removing linear time trend will be appropriate. However, removing origin and destination specific linear time trend could be problematic for several reasons.

To begin with, the demand shocks or trends pushing airlines to file for bankruptcy will be rather economy-wide than market-specific. That is, airlines, especially big ones, will not be forced to file for bankruptcy just because demand is decreasing on some routes that they serve. Also, bankrupt airlines do not choose to be bankrupt on some unprofitable routes where demand is in downward trend. Thus, it can be misleading to conclude that bankrupt routes are more likely to have been suffering from diminishing demands. Besides, if the decline in demand is severe and expected to continue on some routes, then airlines will adjust their route structure in the manner they move out of declining routes and enter into more flourishing routes. That is, airlines will not stay in declining routes to file for bankruptcy.

Moreover, an important question when it comes to including time trends is whether there actually are specific linear time trends on bankrupt routes in the first place. If we look at some routes where a dominant carrier is bankrupt, it is hard to say that demand is declining on those routes as compared to other routes. If there is no specific demand time trends before any of the airlines serving the route files for bankruptcy and we include a linear time trend variable to control for the non-existing "trend", then the estimated "trend" will be picking up all the bankruptcy-related effects and we will have biased estimates for them. For example, if fare or capacity cut start prior to bankruptcy filing and continues over the bankruptcy proceedings, then the linear time trend variable will pick up this negative effect of bankruptcy on fare or capacity level and the estimated bankrupt effect will be biased upward. The bias from including "non-existing" linear time trends has been explored by Wolfers (2006) on the effect of unilateral divorce laws on divorce rates. In this study, instead of including market-specific linear time trends, time-specific dummy variables will be used to take account of economic shocks common to airlines and routes and the effect from local economy conditions will be controlled by personal income or employment conditions for origin and destination.

Third, another source of potential bias comes from the possible pre-existing trend of LCC growth. Since the deregulation, LCCs have grown slowly but steadily. In this case, the LCC expansion surrounding bankruptcies may be a mere ratification of the pre-existing trend that would have continued even without bankruptcies. In fact, the increasing presence of LCCs may have even pushed other airlines further into

bankruptcy. If the pre-existing trend is not controlled for, it will lead to overestimation of bankruptcy effects on LCC expansion. In order to disentangle pre-existing growth trend from bankruptcy effect, it would be ideal to know the individual airline's growth plan and how it has been changed over rivals' bankruptcies. Without knowledge of them, however, the best assumption would be that the pre-existing trend would have continued, were it not for rivals' bankruptcies. Including pre- and post-bankruptcy periods will control, at least partially, for the trend that may exist on a route affected by bankruptcy. In their research on the impact of workers' job losses on earnings, Jacobson, LaLonde, and Sullivan (1992) added a set of worker-specific linear time trends to take account of individual-specific rates of earnings growth. With sufficient observations for the time being before affected by bankruptcy, we can estimate pre-existing growth trend of each carrier, if any, properly. If we include carrier-specific linear time trends, the estimates of bankruptcy effect on rivals not-in-bankruptcy will capture the rivals' capacity growth (or decline) as compared to the periods prior to the time bankruptcy takes an effect as well as other routes unaffected by bankruptcy.

However, caution is needed here, as in the case of inclusion of market-specific time trends. Without such pre-existing trend, the inclusion of individual-carrier-specific time trends may pick up all the bankruptcy effects, leading to underestimation of them. So, we report the estimates both with and without the time trends. In addition, including LCC-specific linear time trends or individual-carrier-specific linear time trends will lessen the bias from potential pre-existing growth trends, if any.

Four, there can be a selection bias, too. LCCs' choice with limited resources upon rivals' bankruptcy may bias the estimation. It may take some time for airlines to increase airplanes and employees when they see the opportunity to expand. In this case, the airlines will instead reallocate the limited resources to more promising routes/airports in the short term. For example, if the airlines find bankrupt routes/airports profitable, then they will transfer their capacity from other routes to the bankrupt routes, leading to overestimation of capacity expansion of non-bankrupt airlines during rivals' bankruptcy. The reverse can be true if bankruptcy hurts rivals. Here, the self-selection issue arises not because LCCs are not identical on bankrupt and non-bankrupt routes but because the identical airline can redistribute the constrained capacity between bankrupt and non-bankrupt routes. That is, the source of bias is the dependency between routes.

However, the bias will become negligible in the long term. After all, the short-term fixed capacity of an airline will become flexible in the long term. So, the estimated bankruptcy effects in the later period of bankruptcy will become less vulnerable to the potential bias as an airline adjusts its total capacity level. Besides, we conduct airport-level analysis as well as route-level analysis as they are complementary. Airport-level analysis will be relatively free from the bias because the transfer of capacity between airports will be less active than that between routes.

## 4 Data

There are two main data sets used in the analysis; the Airline Origin and Destination Survey Data Bank 1B (DB1B) and the Air Carrier Statistics database (T-100 data bank). Both are available from the



Bureau of Transportation Statistics of the U.S. Department of Transportation.<sup>6</sup> First, the Airline Origin and Destination Survey DB1B is a 10% sample of airline tickets from reporting carriers collected by the Office of Airline Information of the Bureau of Transportation Statistics. The data set includes origin, destination and other itinerary details such as ticket price, number of passengers transported, ticketing (i.e. marketing) carrier, operating carrier, distance of the itinerary, number of stops (number of coupons used in a itinerary), whether the ticket is a round trip, etc., on a quarterly basis.<sup>7</sup>

Second, we restrict our attention to U.S. domestic passenger airlines<sup>8</sup> and domestic markets so use T-100 Domestic Market (U.S. Carriers) and T-100 Domestic Segment (U.S. Carriers) data from the Air Carrier Statistics database. The "market" data includes a monthly air carrier passenger traffic information by enplanement for operating carrier, origin, destination combination each time period. The "market" data records the passengers that enplane and deplane between two specific points, regardless of the number of stops between the two points. This market definition is comparable to the origin and destination pair in DB1B. On the other hand, the "segment" data contains the number of seats available, the number of scheduled departures and departures performed, by operating carrier, origin, and destination. Unlike in the "market" data, the "segment" is composed of a pair of points served or scheduled by a single stage.<sup>9</sup>

A route is defined as a pair of origin and destination (on an airport basis) and each route is regarded as a market. A route is treated in a direction-manner in the sense that, if origin and destination airports are switched, it is considered to be a different route. Direction matters because demand conditions can be different even between the same two end points, depending on which way passengers are heading.<sup>10</sup> Using the T-1000 Domestic Market database, we pick the 1000 largest routes in each quarter from 1998Q1 to 2008Q2, based on passenger enplanements. The 1000 routes represent a significant portion of airline market demands. For instance, in 2007, the number of passengers who travelled the 1000 largest routes is about 60% of the total demand. In addition, we pick the 200 most popular airports (in terms of the number of passengers flying out of the airport) in the same way. The 200 airports covers over 99% of the total number of originating passengers.

We mainly rely on the "route sample" that includes the quarterly 1,000 most travelled routes for forty two quarters from 1998Q1 through 2008Q2. The "airport sample" which covers the 200 most popular airports will be also used to confirm and supplement the findings from the main sample. The route sample will inform us about the change in market competition. The airport sample, on the other hand, will better-represent the fixed physical facilities that should be allocated between airlines. The route sample include fare, capacity, market share, and so on, while the airport sample include only capacity data.

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<sup>6</sup><http://www.transtats.bts.gov/>

<sup>7</sup>The data is recorded when a ticket is used, not when it is purchased, so the timing of the change in an airline's competitive behavior and the market outcome may not be exact. However, if most people buy tickets within one or two months ahead of an actual flight date, this may not be a big problem.

<sup>8</sup>Airlines used in the study are the scheduled passenger airlines. Thus charter, freight and taxi airlines etc. are excluded.

<sup>9</sup>For example, if Southwest operates only connecting flights from San Francisco airport (SFO) to Chicago Midway airport (MDW), the flights will be recorded in DB1B and the "market" data but not in the "segment" data.

<sup>10</sup>For example, when Superbowl is held in Tampa, Florida, demands for tickets going to and coming from Tampa would be different.

Capacity is mostly measured by the number of available seats but the scheduled departures will also be analyzed as another capacity measure.

As for the local economic conditions, we include employment, personal income, and population. Supplemental data on local economic conditions comes from the Regional Economic Accounts at the Bureau of Economic Analysis.<sup>11</sup> However, the data set is rather limited. First, the data set covers only Metropolitan Statistical Areas (MSA) on a yearly basis so it does not include Puerto Rico, Virgin Islands, and numerous cities in Hawaii or Alaska, which are in the main sample. In the main sample, the portion of data which both of the two end points of a route is MSA is about 96%. In addition, the most recent observation available is for 2007. So we report the estimation results both with and without local economic condition variables.

Table 1. Airline List by Carrier Group

Carrier group	Carrier Name	Code	Status *
	American Airlines	AA	
	Continental Airlines	CO	
Legacy	Delta Airlines	DL	Emerged from bankruptcy
	Northwest Airlines	NW	Emerged from bankruptcy
	United Airlines	UA	Emerged from bankruptcy
	US Airways	US	Emerged from bankruptcy twice
	Alaska Airlines	AS	
	Trans World Airlines	TW	Bankrupt then merged by American
	Southwest Airlines	WN	
Low Cost	ATA Airlines	TZ	Emerged but liquidated later
	JetBlue Airways	B6	
	AirTran Airways	FL	
	Frontier Airlines	F9	Under Ch 11
	Spirit Airlines	NK	
	American West Airlines	HP	Merged by US
Others	Midway Airlines	JI	Liquidated
	Midwest	YX	
	Hawaiian Airlines	HA	Emerged from bankruptcy

\* Status change from 1998 to 2008

The observation unit in DB1B is itinerary level. We aggregate the data to carrier level using the

<sup>11</sup><http://www.bea.gov/regional/reis/default.cfm?selTable=CA1-3&section=2>

number of passengers as a weight. So, we have one observation for a (ticket) carrier<sup>12</sup> on a route (or in an airport) in a give time (pair of year and quarter) in the final data set. In the route (airport) -level analysis, itinerary level observations are aggregated to route (airport) -level so that we have one observation for a route in a give time. Again, observations are weighted with number of passengers. Besides, we drop tickets if a carrier has less than 1% passengers on a route (or 1% capacity in an airport) in a given time or fares less than 20 dollars. All market fares used in analysis are inflation adjusted in 2000 dollars.<sup>13</sup> Table 1 is the list of main airlines in the final data set by carrier group. Those eighteen carriers account for about 98% of the sample.<sup>14</sup>

Table 2. Airline Bankruptcy Filings

Carrier Name	Date of Filing	Ch.	Date of Emergence	Date of Service Cessation
Kiwi International (KP)	Mar 23, 1999	11		Dec 8, 1999
Eastwind Airlines (W9)	Sep 30, 1999	7		
Tower Air (FF)	Feb 29, 2000	11		Dec 7, 2000
Pro Air (P9)	Sep 19, 2000	11		Sep 19, 2000
National Airlines (N7)	Dec 6, 2000	11		Nov 6, 2002
Midway Airlines (JI)	Aug 14, 2001	11		Oct 30, 2003
Trans World Airlines (TW)*	Jan 10, 2001	11		Dec 1, 2001
Sun Country Airlines (SY)**	Jan 8, 2002	7	April 15, 2002	
Vanguard Airlines (NJ)	July 30, 2002	11		Dec 19, 2004
United Airlines (UA)	Dec 9, 2002	11	Feb 2, 2006	
US Airways (US) 1st	Aug 11, 2002	11	Mar 31, 2003	
Hawaiian Airlines (HA)	Mar 21, 2003	11	June 2, 2005	
ATA Airlines (TZ) 1st	Oct 26, 2004	11	Feb 28, 2006	
US Airways (US) 2nd	Sep 12, 2004	11	Sep 27, 2005	
Aloha Airlines (AQ) 1st	Dec 30, 2004	11	Feb 17, 2006	
Delta Airlines (DL)	Sep 14, 2005	11	April 25, 2007	
Northwest Airlines (NW)	Sep 14, 2005	11	May 18, 2007	
Independence Air (DH)	Nov 7, 2005	11		Jan 5, 2006
Aloha Airlines (AQ) 2nd	Mar 31, 2008	7		
ATA Airlines (TZ) 2nd	April 3, 2008	11		April 3, 2008
Frontier Airlines (F9)	April 10, 2008	11		

\* Trans World is merged by American,

\*\* Sun Country's bankruptcy procedure was converted from Ch.7 to Ch.11

<sup>12</sup>A ticket carrier and an operating carrier can be different for the same itinerary. We choose a ticket carrier over an operating carrier because a ticket carrier sets a price even though other carrier may actually operate the service.

<sup>13</sup>Consumer Price Index - All Urban Consumers is available from <http://data.bls.gov/cgi-bin/surveymos>.

<sup>14</sup>For the LCC list, refer to Darin Lee's webpage (<http://www.darinlee.net/data/lccshare.html>).

To identify bankruptcy events, we rely on Lynn M. LoPucki's Bankruptcy Research Database (BRD)<sup>15</sup> and "U.S. Airline Bankruptcies & Service Cessations" listed on Air Transportation Association (ATA) website.<sup>16</sup> The BRD contains Chapter 11 filings of public companies with assets over \$100 million that are required to file a form 10-K with SEC. The list of bankruptcy filings on ATA web page includes both Chapters 7 and 11, regardless of the size of a bankrupt airline. However, it says the list is "loose, unofficial". So, when the dates of bankruptcy filing, reemergence, or service cessation do not match between the two sources, we searched for news articles on a specific bankruptcy event on the web and picked the more accurate one. From these sources, we construct the history of airline bankruptcies that we are interested in. Table 2 shows all bankruptcy events that we will cover in the analysis. There are twenty one bankruptcy filings in the sample. Among them, bankruptcy filing airlines emerged in ten cases,<sup>17</sup> went out of business after bankruptcy protection in nine cases, and ceased services right away in two cases. It is noteworthy that only one legacy airline out of six cases has been liquidated.<sup>18</sup>

## 5 Empirical Model

### 5.1 Variable Construction

In the empirical analysis, we will see how bankrupt airlines behave for the number of quarters before, during, and after bankruptcy, how their rivals respond, and how the total capacity level changes as a result. Thus, the bankruptcy-related variables are constructed in the manner that we can capture how a bankrupt firm's and its competitors' behaviors change over time in the periods surrounding bankruptcy. Table 3 shows how the bankruptcy-related variables are constructed.

The event dates of interest include a series of quarters from three quarters prior to bankruptcy filing to post-bankruptcy periods (if a bankrupt airline reemerged) or liquidation date (if a bankrupt airline ends up being liquidated). The quarters before and after a bankrupt airline exits from a market during bankruptcy procedures will also be considered to see whether outright liquidation will help rivals improve profitability by softening competition and removing excess capacity. To our knowledge, the exit of bankrupt airlines from markets have not been covered in previous studies on airline bankruptcies. If a bankrupt airline disappeared from the route that it served at some point in a year prior to bankruptcy filing and then does not show up in the data for at least for four consecutive quarters after they first disappeared, we regard the event as a bankrupt airline's exit from the route. If liquidation of bankrupt airlines would benefit rivals by preventing bankrupt airlines from cutting fare below others' fare level and eliminating excess capacity, then we will be able to find the sign of improvement in rivals' profitability and reduction in total capacity.

We divide bankruptcy filings into two groups based on which carrier group the filing airline belongs to. If a bankrupt airline is a legacy carrier, we call it as "legacy bankruptcy". In other cases, the bankruptcy

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<sup>15</sup>[http://www.webbrd.com/bankruptcy\\_research.asp](http://www.webbrd.com/bankruptcy_research.asp)

<sup>16</sup><http://www.airlines.org/economics/specialtopics/USAirlineBankruptcies.htm>

<sup>17</sup>Frontier Airlines filed for bankruptcy in the second quarter of 2008 and are still under bankruptcy protection. The case is regarded as an emergence case in the analysis. However, treating this case as liquidation does not change the results.

<sup>18</sup>Trans World Airlines filed for bankruptcy protection for three times and ended up being liquidated at the final attempt.

is called as "other bankruptcy". The same set of variables will be constructed for two groups, respectively. The study is more interested in legacy bankruptcies than others since, first, it informs us of the impact of large incumbent airlines' bankruptcies on their rivals and, second, the bankruptcy will affect a large number of routes so we have many observations to get more reliable estimates on bankruptcy effects as compared to other bankruptcies that involve smaller carriers so the affected markets and competitors are rather limited.

Table 3. Variable List: Bankruptcy-Related Variables

	Event period ( $k$ )	Carrier		Route
		Bankrupt airline	Rivals	"Bankrupt" route
Pre- bankruptcy	$[T_{B-3}]$			
	$[T_{B-2}]$	$D[k]_{it}^m$	$W[k]_{irt}^m * Bshr[B]_{rt}^m$	$W[k]_{rt}^m * Bshr[B]_{rt}^m$
	$[T_{B-1}]$			
During bankruptcy	$[T_B]$			
	$[T_{B+1}]$ $[T_{B+2} \sim T_{RE}]$	$D[k]_{it}^m$	$W[k]_{irt}^m * Bshr[B]_{rt}^m$	$W[k]_{rt}^m * Bshr[B]_{rt}^m$
Post- bankruptcy	$[T_{RE+1}]$			
	$[T_{RE+2}]$	$D[k]_{it}^m$	$W[k]_{irt}^m * Bshr[B]_{rt}^m$	$W[k]_{rt}^m * Bshr[B]_{rt}^m$
	$[T_{RE+3} \sim]$			
Pre-exit	$[T_{EX-2}]$		$W[k]_{irt}^m * Bshr[E]_{rt}^m$	$W[k]_{rt}^m * Bshr[E]_{rt}^m$
	$[T_{EX-1}]$			
After-exit	$[T_{EX}]$			$W[k]_{rt}^m * Bshr[E]_{rt}^m$
	$[T_{EX+1}]$	(No Observations)	$W[k]_{irt}^m * Bshr[E]_{rt}^m$	
	$[T_{EX+2} \sim]$			

Superscript  $m$  = Legacy if legacy bankruptcies, Oth if others.  
 $T_B$ : Quarter of bankruptcy filing,  $T_{RE}$ : Last quarter in bankruptcy  
 $T_{EX}$ : Quarter of a bankrupt airline's exit from a route

The "bankrupt" routes and the "rivals" to bankrupt carriers can be defined in two ways depending on whether a bankrupt airline has direct flights on a route or not. A bankrupt airline can be present on a route either by operating its own direct flights or by providing connected flights or marketing tickets with other airlines through code-sharing. Our definition is based on whether a bankrupt airline is selling tickets on a route. This definition emphasizes more on consumer perception than fixed resources/facilities. So, we allow the possibility that connected flights are good substitutes for direct flights. In addition, the definition based on whether to provide direct flights can involve measurement error in identifying bankruptcy effect since connected flights can be a large portion of services especially for network carriers.

Basically, we regard a route as a "bankrupt" route if a bankrupt airline's market share is not less than 1%. The competitors selling a ticket on the "bankrupt" route are considered as "rivals" to bankrupt carriers. Since we consider market share of a bankrupt airline as will be explained later, the potential bankruptcy effect will depend on the presence of the bankrupt airline. The robustness checks using the

other definition, though not reported here, are not qualitatively different from the results presented in this paper. This is because an airline is very likely to be providing direct services on a route where its market share is significant. Besides, in the supplemental analysis with the airport sample (Section 6.3), bankruptcy-affected routes and rivals only when a bankrupt airline is operating at the airport. That is, for airport analysis, an airport will be considered as "bankrupt" only when a bankrupt airline is physically present.

In particular, we first construct bankruptcy-related dummy variables as an interaction between carrier identity (based on whether bankrupt or not and whether legacy carrier or not) and the indicator of time intervals (pre-, during, post-bankruptcy periods, or pre- and post-exit periods). To begin with, bankruptcy indicators are a series of dummy variables for a bankruptcy filing carrier in each event quarter  $k$  from three quarters prior to the filing through the carrier's last quarter in the sample, as listed in the column labelled "Bankrupt airlines" in Table 3, i.e.  $k \in \{T_B - 3, T_B - 2, T_B - 1, T_B, T_B + 1, T_B + 2, T_{RE}, T_{RE} + 1, T_{RE} + 2, T_{RE} + 3, T_{EX} - 2, T_{EX} - 1, T_{EX}, T_{EX} + 1, T_{EX} + 2\}$  where  $T_B$  is the quarter of bankruptcy filing,  $T_{RE}$  is the last quarter in bankruptcy before reemergence from bankruptcy if applicable, and  $T_{EX}$  is the quarter of bankrupt airlines' exit from a route.  $D[k]_{it}^{lg}$  is a bankrupt-carrier indicator that takes one if  $t = k$  where  $t$  is calendar quarter while  $k$  is event quarter. So,  $D[T_B]_{it}^{lg}$ , for example, has one if an airline  $i$  is a legacy carrier and it files for bankruptcy in the current quarter  $t$ .  $D[T_{RE} + 1]_{it}^{oth}$  is triggered on if an airline  $i$  is not a legacy carrier and it reemerged from bankruptcy last quarter.

The bankruptcy indicators ( $W[k]_{irt}$ ) are the counterparts of bankrupt-carrier indicators for each event quarter  $k$ .  $W[k]_{irt}$  takes one if an airline  $i$  is competing with bankrupt airlines on route  $r$  at  $t = k$ , that is, if there are bankrupt airlines serving route  $r$  at  $t = k$ . We then multiply the bankruptcy indicators for the leads and lags of bankruptcy filing dates with the average market share of bankrupt airlines for the previous one year from four quarters prior to the bankrupt filing ( $\equiv Bshr[B]_{rt} = \sum_{t=T_B-7}^{T_B-4} Market\ share_{rt}$  where  $T_B$  is the quarter of bankruptcy filing and  $Market\ share_{rt}$  is the market share of bankrupt airlines on route  $r$  at time  $t$ ). Similarly, the bankruptcy indicators before and after a bankrupt airline's exit is multiplied with the average market share of the bankrupt airline for the one year prior to four quarters before the bankrupt airline exits the market ( $\equiv B\_shr[E]_{rt} = \sum_{t=T_{EX}-7}^{T_{EX}-4} Market\ share_{rt}$  where  $T_{EX}$  is the quarter of bankrupt airline's exit from route  $r$  and  $Market\ share_{rt}$  is the same as before).

We interacted bankruptcy indicators with the market share of a bankrupt airline to take account of the possibility that bankrupt airlines' rivals' responses are different depending on the market presence of the bankrupt airline as each market can be exposed to different levels of bankruptcy effects. For instance, even though a bankrupt airline changes capacity at the same rate in all markets, the impact of the behavior to competing airlines may be larger in the market where the bankrupt airline used to be dominant. Here, the market shares from the periods before affected by bankruptcy are chosen to avoid endogeneity issues and measure the bankruptcy airlines' presence in the market when unaffected by bankruptcy. We take a one-year average since it is a more reliable measure than one-time market share which is vulnerable to time-specific shock. The rivals will then be divided into two groups based on whether the airline is LCC or not.

The last column of Table 3 is route-level bankruptcy-related variables. Route-level analysis is intended to see the capacity change in total on bankruptcy-affected routes, as a result of financial distress, bankruptcy, reemergence, or bankrupt airlines' exit from the market. The comparison group is the routes where no carrier is bankrupt. Bankruptcy indicators,  $W[k]_{rt}$  is again interacted with the average market share of bankrupt airlines serving the route for a year from three quarters prior to bankruptcy filing. Table 4 is the list of other variables used in the empirical analyses.

Table 4. Variable List: Other Variables

	Variable	Unit	Description
Price	$Avg\_fare_{irt}$	2000\$	Average fare of a carrier $i$ on route $r$ at time $t$
Capacity	$N\_seats_{irt}$	1,000	# available seats by a carrier $i$ on route $r$ at $t$
	$N\_seats\_all_{rt}$	1,000	# available seats on route $r$ at $t$
Share	$Mkt\_share_{irt}$	1	Share of a carrier $i$ on route $r$ at $t$ in terms of passenger enplanement
	$Seat\_share_{irt}$	1	Share of a carrier $i$ on route $r$ at $t$ in terms of available seats
Route	$LCCin_{rt}$		1 if LCC serves route $r$ at time $t$ , 0 otherwise
Characteristics	$SWin_{rt}$		1 if Southwest serves route $r$ at $t$ , 0 otherwise
Local	$Inc\_origin_{rt}$	2000\$	Personal income in a origin city of route $r$ at $t$
Economic	$Inc\_dest_{rt}$	2000\$	Personal income in a destination city of route $r$ at $t$
Conditions	$Pop\_origin_{rt}$	1,000	Population in a origin city of route $r$ at $t$
	$Pop\_dest_{rt}$	1,000	Population in a destination city of route $r$ at $t$
	$Emp\_origin_{rt}$	1,000	Total employment in a origin city of route $r$ at $t$
	$Emp\_dest_{rt}$	1,000	Total employment in a destination city of route $r$ at $t$
Carrier	$Network_{it}$	1/1000	# routes a carrier $i$ is serving at $t$
Characteristics	$Net\_origin_{irt}$	1/1000	# destinations carrier $i$ is flying out of the origin airport of route $r$ at $t$
	$Net\_dest_{irt}$	1/1000	# origins carrier $i$ is flying into the destination airport of route $r$ at $t$
	$Direct_{irt}$	1	Fraction of direct flights tickets of a carrier $i$ on route $r$ at $t$
	$Round_{irt}$	1	Fraction of round trip tickets of a carrier $i$ on route $r$ at $t$
	$Codeshr_{irt}$	1	Fraction of tickets of a carrier $i$ on route $r$ at time $t$ operated by a different carrier

## 5.2 Empirical Model

We begin with fare and capacity as dependent variables as price and quantity are the main strategic tools that firms use to compete. We then see the change in market share and revenue of bankrupt airlines and their rivals in the periods surrounding bankruptcies. In particular, we will use the following econometric specification:

$$\begin{aligned}
\log(Y_{irt}) &= \sum_{k \in K1} D[k]_{it}^{lg} \alpha_k + \sum_{k \in K1} D[k]_{it}^{oth} \beta_k \\
&+ \sum_{k \in K1 \cup K2} W[k]_{irt}^{lg} * Bshr[k]_{rt}^{lg} * (1 - D\_lcc_i) \gamma_k^{nlcc} \\
&+ \sum_{k \in K1 \cup K2} W[k]_{irt}^{lg} * Bshr[k]_{rt}^{lg} * D\_lcc_i \gamma_k^{lcc} \\
&+ \sum_{k \in K1 \cup K2} W[k]_{irt}^{oth} * Bshr[k]_{rt}^{oth} * (1 - D\_lcc_i) \lambda_k^{nlcc} \\
&+ \sum_{k \in K1 \cup K2} W[k]_{irt}^{oth} * Bshr[k]_{rt}^{oth} * D\_lcc_i \lambda_k^{lcc} \\
&+ X_{irt} \cdot \sigma_1 + D\_time_t \cdot \phi_1 + \sum_{c \in C} D\_c_i * Trend_t \theta_c + u_{irt}
\end{aligned}$$

where an observation unit is a carrier  $i$  on a route  $r$  at time  $t$  ( $= 1998Q1, 1998Q2, \dots, 2008Q2$ ),  $\log(Y_{irt})$  is a dependent variable after log-transformation of variables of interest,  $\log(Avg\_fare_{irt})$ ,  $\log(N\_seats_{irt})$ ,  $K1$  and  $K2$  are the set of lead and lag quarters of bankruptcies and bankrupt airlines' exit, respectively ( $K1 = \{T_B - 3, T_B - 2, T_B - 1, T_B, T_B + 1, T_B + 2, T_{RE}, T_{RE} + 1, T_{RE} + 2, T_{RE} + 3\}$ ,  $K2 = \{T_{EX} - 2, T_{EX} - 1, T_{EX}, T_{EX} + 1, T_{EX} + 2\}$ ), bankruptcy-related variables are as defined in the previous section with  $B\_shr[k] = B\_shr[B]$  if  $k \in K1$  and  $B\_shr[E]$  if  $k \in K2$ ,  $D\_lcc$  is an indicator of LCC,  $X_{irt}$  is a set of a constant, local economic conditions e.g. log-transformed value of personal income, population, and total employment in origin and destination cities, and other control variables such as  $LCCin$ ,  $SWin$ ,  $Network$ ,  $Net\_origin$ ,  $Net\_dest$ ,  $direct$ ,  $Round$  and  $Codeshr$  if a dependent variable is  $\log(Avg\_fare)$  and  $LCCin$  and  $SWin$  if a dependent variable is  $\log(N\_seats)$ ,<sup>19</sup>  $D\_time_t$  is a set of time-specific dummies for year-quarter pair and quarter dummies for Florida route,<sup>20</sup>  $D\_c$  is an indicator of a carrier  $c$  ( $\in C =$  set of all carriers),  $Trend$  is a linear time trend, and  $u_{irt}$  is the combination of time-invariant route-carrier fixed effect ( $\delta_{ir}$ ) and random shock to a carrier-route pair at time  $t$  ( $\delta_{irt}$ ), i.e.  $u_{irt} = \delta_{ir} + \delta_{irt}$ .

The strength of data set is the panel structure that enables us to control for time-constant individual heterogeneities. We will exploit this by employing a fixed effect model with a carrier-route pair as a panel ID. The fixed effect model is chosen to allow an individual effect to be correlated with other explanatory variables including bankruptcy-related variables. We assume that the effect of a specific carrier-route pair on fare/capacity level has a time-invariant component ( $\delta_{ir}$ ) and random shock component ( $\delta_{irt}$ ). While the time-invariant component is captured by carrier-route dummies, the random component varies over time and thus are treated as usual normal error terms (i.e.  $\delta_{irt} \sim N(0, \sigma^2)$ ).<sup>21</sup>

In the basic econometric specification, the panel ID is a carrier-route pair. Airline market, however,

<sup>19</sup>See Table 4 for the description of variables. Some control variables, such as network variables, fraction of direct flights and round trips, seems to be related to a fare premium or discount but not to quantity level. So, those variables are dropped in quantity equations.

<sup>20</sup>As for the quarter dummies for Florida route, see the paragraph on panel ID below.

<sup>21</sup>We report Eicker-White Robust Standard Errors clustered in a panel ID to account for potential heterogeneity.



is often characterized by seasonality (e.g. demand conditions in the first quarter differ from those in the third quarter), a carrier-route-quarter combination may be another appropriate candidate for the panel ID. There is a trade-off between these two choices of the panel ID. If we choose carrier-route-quarter combination, we can control for seasonal adjustment. However, we will have much shorter data periods<sup>22</sup> that we can use to estimate "but for" fare/capacity level, which may lead to a biased estimation of counterfactual patterns. On the other hand, though choosing carrier-route pair has disadvantage that we do not control for quarterly adjustment by a carrier on a route, it allows us to have much longer data periods<sup>23</sup> that we can depend on to estimate counterfactual fare/capacity level but for bankruptcy events.

This study chooses A carrier-route pair as a panel ID over a carrier-route-quarter combination. We instead include quarter dummies if origin or destination airports are in Florida in addition to time specific dummy variables (from 1998Q2 to 2008Q2: base.= 1998Q1). The time-specific dummy variables are intended to control for aggregate demand/supply shocks common to all routes and carriers or common quarterly movement in fare or capacity. Quarter dummy variables for the route originated from or destined to Florida region are included because quarterly pattern is similar for most of routes (demand highest in the third quarter and lowest in the first quarter) but the pattern is reversed in Florida region (demand lowest in the third quarter and highest in the first quarter). As we will see later in this section, the estimated coefficients for time specific dummies and Florida quarter dummies show the expected pattern.<sup>24</sup>

The key variables are bankruptcy-related variables. The estimates of coefficients on bankruptcy indicators, that is, a series of dummy variables for bankruptcy filing carriers ( $D[k]$ ) captures the average impact of financial distress on the airlines. On the other hand, the estimated coefficients on interaction between rivals' bankruptcy and the bankrupt airlines' market share ( $W[k]*Bshr$ ) show the effect of bankruptcy on rivals which are allowed to vary with different level of exposure to the bankruptcy. Bankrupt airlines' rivals fall into one of the two groups, either LCCs or. non-LCCs. The difference (or similarity) in the behavior of the two groups will help us understand how airlines have been competing (or not).

Since the dependent variable is of log-transformed value, the estimated coefficients are interpreted as a semi-elasticity, i.e. % change in  $Y$ , e.g. fare or capacity, in response to a unit change of RHS variable. In this model, after accounting for carrier-route individual (fixed) effects, the estimates for bankruptcy-related variables are interpreted as the change in dependent variable of the same airline on the same route when affected by bankruptcy.

All other empirical analyses are a modification of the basic empirical model. For instance, the empirical model for route-level analysis is as follows:

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<sup>22</sup>Then the panel data becomes yearly data set for each carrier-route-quarter combination. So, we have eleven years of observation at most.

<sup>23</sup>The panel data is a quarterly data set for carrier-route pair. So, we have forty two quarters of observation at most.

<sup>24</sup>The estimation results do not change qualitatively even if we do not include quarterly dummies for Florida region. Choosing carrier-route-quarter combination changes the estimation results a bit in the sense that the fare change is larger before filing for bankruptcy than during bankruptcy procedures. Other than that, the estimation results are similar.

$$\ln(Y_{rt}) = \sum_{k \in K1 \cup K2} W[k]_{rt}^{lg} * Bshr[k]_{rt}^{lg} \rho_k^{lg} + \sum_{k \in K1 \cup K2} W[k]_{rt}^{oth} * Bshr[k]_{rt}^{oth} \rho_k^{oth} + Z_{rt} \cdot \sigma_2 + D\_time_t \cdot \phi_2 + u_{rt}$$

where an observation unit is a route  $r$  at time  $t$  ( $= 1998Q1, 1998Q2, \dots, 2008Q2$ ),  $\ln(Y_{irt})$  is a log-transformed value of capacity such as  $\ln(N\_seats_{rt})$  and  $\ln(N\_flights_{rt})$ ,  $W[k]_{rt}$  is the indicator that bankruptcy filing airlines are serving the route as detailed in section 5.1,  $Bshr_{rt}$  and  $D\_time_t$  are the same as before,  $Z_{rt}$  is the set of a constant, local economic conditions and other control variables  $LCCin$ ,  $SWin$ , and, lastly,  $u_{rt}$  is the combination of time-invariant route fixed effect ( $\delta_r$ ) and random shock to a route  $r$  at time  $t$  ( $\delta_{rt}$ ), i.e.  $u_{rt} = \delta_r + \delta_{rt}$ . In this model, a panel ID is a route.

## 6 Results

This section reports and discusses the estimation results. We examine whether bankrupt airlines under protection harms their competitors by triggering a price war with unfair cost advantage and contributing to overcapacity. The results do not support the accusation of potential harm of bankruptcy protection on rivals, especially LCCs, and the industry. The fare cut by bankrupt airlines is not so effective that pushes others to follow suit and the slack from bankrupt airlines' capacity cut is filled by other airlines eventually, leaving the total capacity level largely unaffected. In particular, we find that LCCs expand at the expense of bankrupt rivals. That is, the services that used to be provided by bankrupt airlines are now replaced by LCCs after they retreated. The route sample analysis shows how market competition plays out in the periods surrounding airline bankruptcies.

The airport sample analysis supplements the findings in the sense that it informs about how the fixed facilities and time slots at airport are redistributed between airlines in the periods surrounding bankruptcies. If bankrupt airlines reduce capacity but toughen competition at the same time, rivals may choose to use the newly available facilities from the reduction to increase services on other routes unaffected by bankruptcies. From the route sample analysis, we found that LCCs expand on the routes where bankrupt legacy airlines are serving while non-LCC rivals are reducing services. The airport sample analysis in section 6.3 shows that rivals expand while bankrupt airlines are shrinking. The expansion during the period is more prominent for LCCs. The results suggest that bankrupt airlines' capacity cutback gives new openings for their rivals on average but non-LCC competitors avoid bankrupt routes and use the newly available facilities/slots to expand services on other routes, possibly because LCCs' presence is growing and so is the competitive pressure on the bankrupt routes. That is, LCC expansion during rivals' bankruptcies, rather than the presence of bankrupt airlines on a route per se, may toughen the competition on the bankrupt routes.

In particular, we will investigate two empirical questions with the route sample. We then see how capacities are redistributed between airlines at airport. Our first question is whether bankrupt airlines hurt their rivals.

## 6.1 Does Bankrupt Airline Hurt Rivals?

We begin with fare and capacity change as price and quantity setting are the basic tools to operate and compete. In particular, we present the event study graphs in the periods surrounding airline bankruptcies.

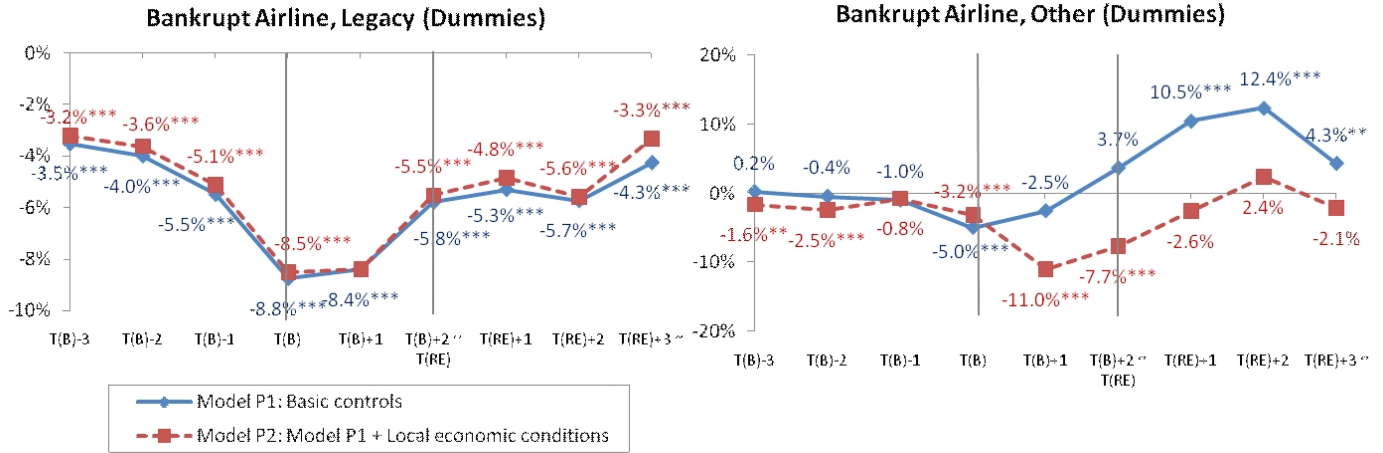


Figure 2: % Average Fare Change in the Periods Surrounding Bankruptcies, Bankrupt Airlines

Figure 2 reports the estimation results on average fare. Although average fare may be vulnerable to outliers, average fare is chosen over median fare since it better reflects the overall profitability. Model P1 includes *LCCIN*, *SWIN*, *Network*, *Net\_origin*, *Net\_dest*, *Direct*, *Round*, and *Codeshr* for controls. Model P2 adds local economic conditions, personal income, employment, and population. Another difference between the two models is that Model P2 do not cover non-MSAs and the quarters in 2008.  $T(B)$  is the quarter of bankruptcy filing,  $T(RE)$  is the quarter of reemergence from bankruptcy, that is, the last quarter in bankruptcy, and  $T(EX)$  is the quarter of exit by a bankrupt airline from a route. For bankrupt airlines, the fare change is measured by dummy variables indicating each period surrounding bankruptcy, which would capture an average change. The coefficient estimates are labeled and marked with \* if significant at 10%, \*\* if significant at 5%, and \*\*\* if significant at 1%.

The first graph shows the fare change for legacy carriers in bankruptcy. Fares decrease about 3-5% even prior to bankruptcy filing. Once a legacy airline files for bankruptcy, the average fare is even lower, over 8% in the first two quarters in bankruptcy and about 6% later, as compared to normal periods before they are at risk of bankruptcy. This fare cut is not negligible as compared to average quarterly fare change, which is about 3%. The bankrupt airlines' fare shows a modest upward trend after the early periods in bankruptcy, though it does not go up to the original level.

Other non-legacy bankrupt airlines (low-cost or regional airlines) show a sign of fare decrease prior to bankruptcy filing in Model P2 while their fares show little change in Model P1. The fare cut is significant in the quarter of bankruptcy. The estimation results based on the basic model, Model P1 show that the fare cut is even larger during bankruptcy but the cut does not persist in the post-bankruptcy periods.

Meanwhile, the results based on Model P2 (MSAs only, 1998Q1-2007Q4) are different that the fare cut dissipates quickly after the first quarter in bankruptcy and even increases in later periods. Also, the analysis with Model P2 do not cover the second bankruptcies (which ends up with liquidation) of Aloha and ATA Airlines and the bankruptcy of Frontier airline. Considering these bankrupt events compose a large portion of samples for other bankruptcies, the difference seems to be caused by the difference in bankruptcy events covered in the analysis. Eventually, the fare seems to go back to about the level in normal times in both cases.

In short, the bankrupt airlines' fare cut seems to be initiated by financial distress prior to actual bankrupt filing and the size of fare cut becomes larger in bankruptcy. Legacy airlines filing for bankruptcy tend to maintain low fare level even after reemergence while other bankruptcy filing airlines seem to return to original fare level eventually. Unlike the previous findings reported by Borenstein and Rose (1995), the fare cut does not dissipate after bankruptcy filing in legacy bankruptcies. Therefore, we cannot say that financial distress explains all the bankrupt airlines' fare cut. The deep discount upon bankruptcy filing indicates that bankruptcy filing itself has some effect on fare level: consumers discount bankrupt airlines, bankruptcy procedure pushes the airline to cut fare somehow, and/or their rivals cut fare to hurt the weakened airlines in bankruptcy and even chase them out of a market.

For the competitors to bankrupt airlines, we use the interaction between bankrupt airlines' presence (average market share in the past) and the bankruptcy indicator as detailed in section 5.1. The bankrupt airlines' usual market share is considered to allow different level of effects from different level of exposure to rivals' bankruptcy. The coefficient estimates are the change when bankrupt airlines' market share on a route is 100%. The average "bankrupt" share is about 20% on bankrupt routes but right-skewed. For instance, the estimated change in bankrupt airlines' rivals' fare when bankrupt airlines' share is 20% is the estimated coefficient multiplied by 0.2. Figure 3 reports the estimation result for the case of legacy bankruptcies and Figure 4 shows the results for that of other bankruptcies.

In case of legacy bankruptcies, non-LCC rivals seem to follow the bankrupt airlines' fare cut in pre-bankruptcy periods and the first two quarters of bankruptcies, as prices are strategic complements. The fare cut, though, is not as deep as that of bankrupt airlines, which is around 2.5% at most in case bankrupt share is 50%. As compared to the normal quarterly change, 3%, the fare drop does not seem economically significant unless bankrupt airlines are dominant with large market share, say over 60%. Moreover, non-LCC rivals' fare level seem to return to the normal level in the later stage of bankruptcy. Meanwhile, LCC rivals show a sign of fare decrease in pre-bankruptcy periods but the fare is still higher than usual. During bankruptcy, they do not match the bankrupt airlines' fare cut. They even raise fare marginally when legacy competitor is in bankruptcy. These results indicate that bankrupt airlines' fare cut is not as effective as often argued. In post-bankruptcy periods, both LCC and non-LCC rivals show a drop in fare, though not statistically significant, in the long term. As we will explore later, this may be because LCCs increased their presence during rivals' bankruptcy and so did the price competitive pressure.

In an immediate liquidation of a large carrier will improve profitability for remaining airlines as often claimed, we are expected to see the sign of fare increase after a bankrupt airline withdraws all the services

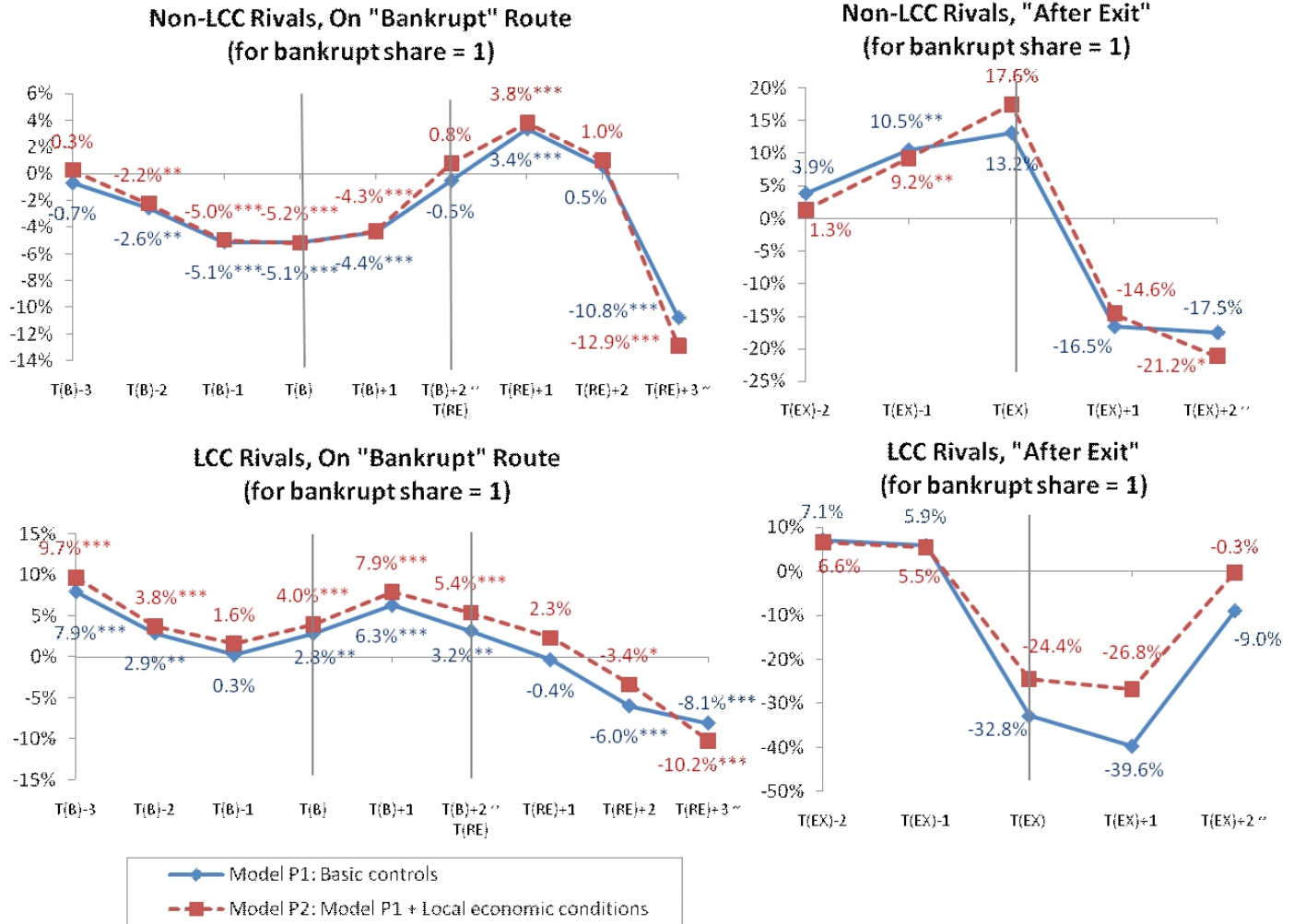


Figure 3: % Average Fare Change in the Periods Surrounding "Legacy" Bankruptcies, Rivals

from a route ("After Exit"). The results do not support this view. The changes in rivals' fare in the periods surrounding legacy airlines' bankruptcies are mostly insignificant in a statistical sense. If any, rivals' fares even decreased upon bankrupt airlines' exit. The fare of non-LCC rivals have increased until the quarter of bankrupt airline's exit ( $T(EX)$ ) but it dropped steeply after. The fare of LCC rivals, on the other hand, decreased right after a bankrupt carrier exits a route then returns to original level in the long term. As we will see in the capacity change analysis, this may be because LCCs have expanded after a bankrupt airlines are gone and competitive pressure has increased with it, as seen on the bankrupt routes. In addition, it is noteworthy that the Trans World Airlines (TW) is merged by American Airlines (AA) and hence its exit from a market may indicate the transfer of its assets to American Airlines. So, the merged airline may have tried to raise fare but the fare increase did not last long due to the increased competitive pressure from LCC growth on the route.

In sum, bankrupt legacy airlines engage in significant fare cut but their efficient rivals, LCCs are not

affected by the fare cut. Rather, their fares decreased in the post-bankruptcy periods. This result may indicate that competition has increased as LCCs expanded during legacy rivals' bankruptcies and legacy carriers have cut cost level and become a more efficient and stronger competitor.

In case of other (non-legacy) bankruptcies, competitors seem to set low fare levels in the pre-bankruptcy periods and the cut seems to start even before bankrupt airlines start to cut fare. This pattern suggests the possibility that not bankrupt airlines but their rivals may have put price competitive pressure, as an attempt to push the weakened airline under financial distress to bankruptcy and hopefully even to liquidation. During bankruptcy, the fare changes are negligible both for LCC and non-LCC rivals. In the post-bankruptcy periods, however, the rivals seem to keep their fares lower than usual in the long term. The fare of LCC rivals is significantly lower than normal right before a bankrupt airline exits a market but it rises after the exit. The fare of non-LCC rivals is lower than usual in all periods but the fare cut becomes smaller in later periods. Unlike the exit of legacy airlines in bankruptcy, that of non-legacy airlines (mostly LCCs) in bankruptcy seems to help others improve profitability, suggesting that fierce price competition, rather than overcapacity may be the source of low profitability. Overall, the results seem to indicate that non-legacy bankrupt airlines (either "LCC" or "Other" carriers) are losers in fierce competition and their disappearance from a route did raise profitability, though not large, for LCC rivals by lessening competition.

The estimated coefficients on other variables seem to make sense. First of all, in the fare equation Model P1, when LCCs are present on a route ( $LCCin = 1$ ), the average fare level is lower by 7.8% (-0.0782, SE=0.0053). If the low-cost airline is Southwest ( $SWin = 1$ ), the fare is even lower by 7.9% (-0.0786, SE=0.0076) so the total fare cut under the presence of Southwest is huge, about 15.7%. The number of routes a carrier is serving ( $Network$ ) is positively correlated with average fare level so the fare is higher by 6.9% with 1,000 routes (0.0687, SE=0.0299). The estimated coefficients on the number of routes flying out of the origin airport ( $Net\_origin$ ) and the number of those flying into the destination airport that a carrier is serving, ( $Net\_dest$ ) are not significantly different from zero at 10% but the signs are both positive (0.6570, SE=0.4537 for  $Net\_origin$ , and 0.4234, SE=0.4641 for  $Net\_dest$ ). The portion of direct flights ( $Direct$ ) and that of round trips ( $Round$ ) are both negatively related to average fare level: 2% lower with 10 percentage point more direct flights, 2.4% lower with 10 percentage point more round trip tickets (-0.2005, SE=0.0118 for  $Direct$ , and -0.2365, SE=0.0135 for  $Round$ ). When a ticket carrier and an operating carrier are different (i.e. code-sharing,  $Codeshr$ ), that is, an actual flight is operated by a different carrier from a carrier that sets fare and sells the ticket, the fare level is higher by 1.7% with 10 percentage point increase in the portion of tickets operated by code-sharing (0.1661, SE=0.0108). The results from Model P2 are not much different except that network variables ( $Network$ ,  $Net\_origin$ , and  $Net\_dest$ ) become not significantly different from zero at 10%. The log-transformed value of local conditions are all significant at 1%. Employment and personal income has positive impact and population has negative impact on average fare (0.7637, SE=0.0924 for  $\log(Emp\_origin)$ , 0.7540, SE=0.0904 for  $\log(Emp\_dest)$ , -0.1514, SE=0.0500 for  $\log(Inc\_origin)$ , -0.1466, SE=0.0481 for  $\log(Inc\_dest)$ , -0.4238, SE=0.0811 for  $\log(Pop\_origin)$ , -0.4342, SE=0.0802 for  $\log(Pop\_dest)$ ).

Now, let's look at the other side of competition: capacity setting. The results on average fare raises

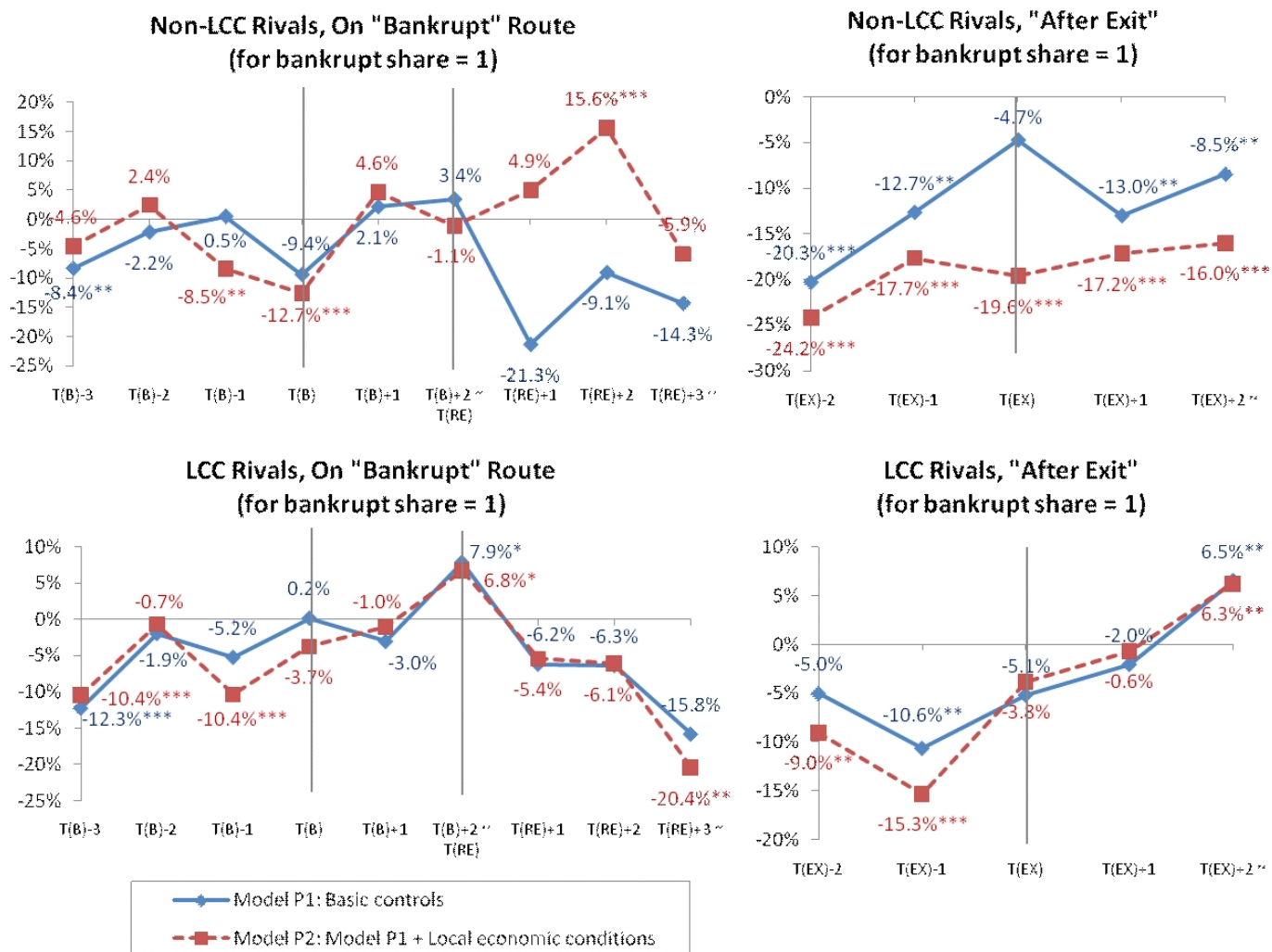


Figure 4: % Average Fare Change in the Periods Surrounding "Other" Bankruptcies, Rivals

other questions regarding capacity. First, are bankrupt airlines keeping capacity to make up the low fare with volume? Second, are non-bankrupt rivals reducing operations to support the fare level? Next figures, Figure 5-7, show bankrupt airlines' and their non-LCC and LCC rivals' average capacity level as compared to normal counterparts in each period surrounding bankruptcies, respectively.

Capacity is measured by the number of seats available. Though not reported, the results using scheduled departures (number of flights) as a measure are not much different. The capacity change is estimated by three empirical models with different RHS variables. Model C1 is the basic empirical model including year-quarter dummies and *LCCin* and *SWin* for controls. Model C2 includes carrier-specific linear time trends as an attempt to control for potential pre-existing growth pattern. We need attention in interpreting the results from Model C2 since the carrier-specific time trends may be capturing large portion of changes spurred by bankruptcies. One thing to see would be whether the difference between coefficient estimates from the two models is large. If the difference is small, it is likely to indicate that pre-

existing trends do not exist and the coefficients on carrier-specific time trends actually pick up bankruptcy effects. Lastly, we add local economic conditions in Model C3 as for robustness check. The estimated coefficients are labelled for Model C1 and C2. The statistical significance is market beside the estimates as in the fare graphs.

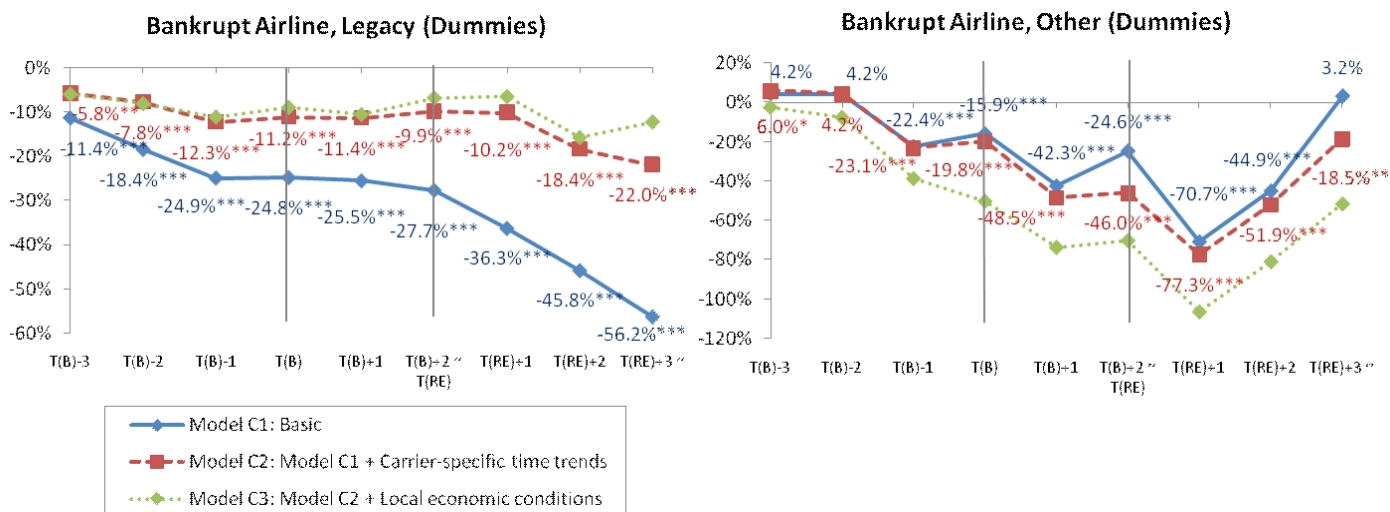


Figure 5: % Capacity Change in the Periods Surrounding Bankruptcies, Bankrupt Airlines

The estimation result suggests that bankruptcy filing airlines are shrinking their operations substantially as they near bankruptcy. This pattern goes beyond bankruptcy protection period for legacy carriers, continuing even in post-bankruptcy periods, so the capacity level is more than cut in half (in Model C1) in the long term. When other low-cost or regional airlines file for bankruptcy, on the other hand, their capacity cut is largest right after reemergence but it does not last afterwards. The difference in coefficients for the period three quarters prior to bankruptcy filing ( $T(B) - 3$ ) between Model C1 and Model C2 is negligible as compared to the differences in other periods, indicating that the carrier-specific time trends are picking up a large fraction of bankruptcy effects. So, the reasonable estimates will be between the two models, closer to Model C1.

During the same period, how are rivals setting capacity? Figure 6 presents capacity change for rivals in the periods surrounding legacy carriers' bankruptcies. Interestingly, the estimation result shows that LCCs tend to expand whereas non-LCCs rather shrink during rival's bankruptcy. In particular, non-LCC rivals' capacity show a steep decrease while a legacy carrier is in bankruptcy, by around 25-27% at largest if "bankrupt" share is 50%. The capacity seems to bounce back with rivals' reemergence but goes down again in the long term.

On the other hand, LCC rivals show capacity expansion during as a legacy carrier is going through bankruptcy. The capacity change for LCC rivals is insignificant three quarters prior to legacy bankruptcy filing but their capacity jump in the next quarter and an upward trend afterwards in the results from Model



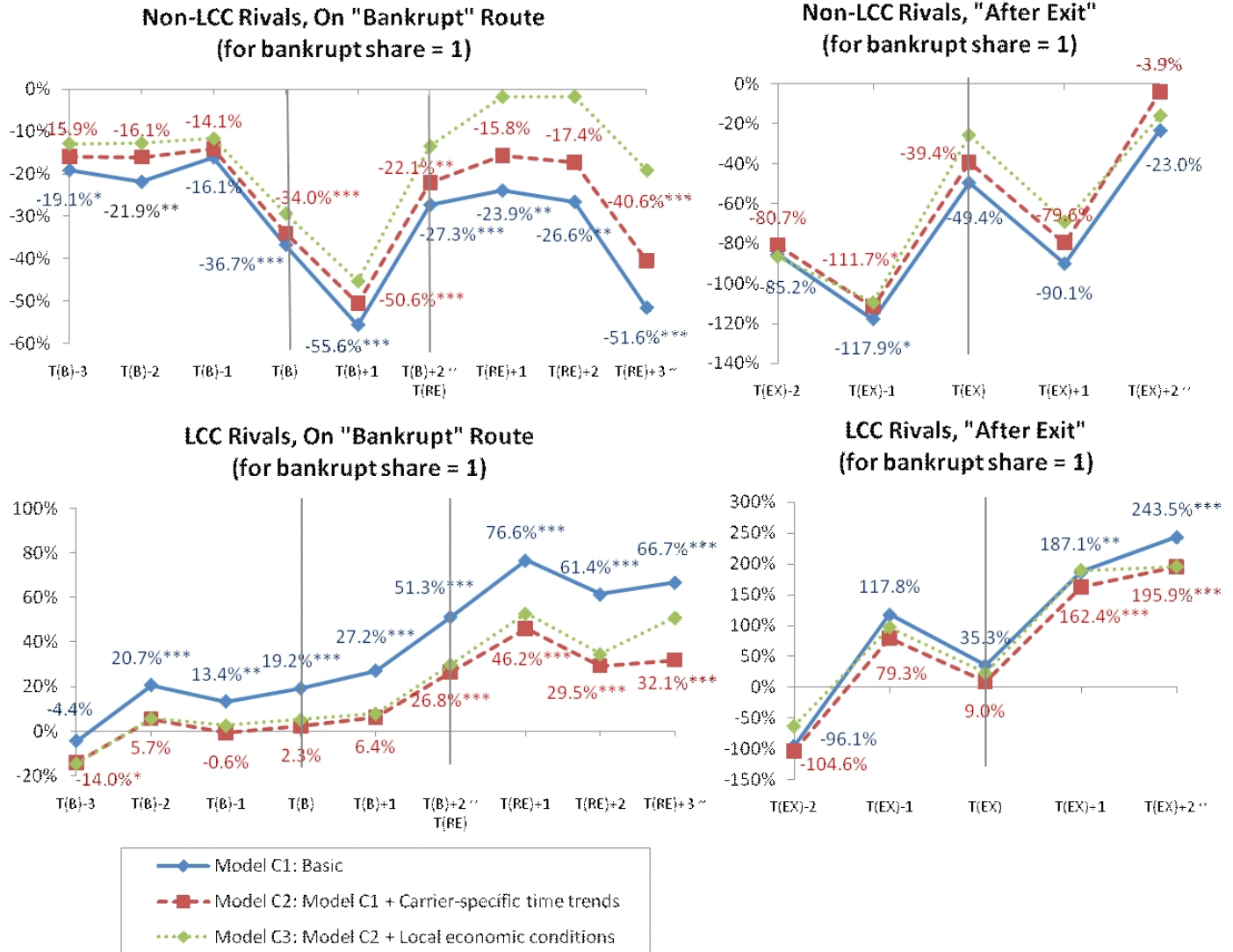


Figure 6: % Capacity Change in the Periods Surrounding "Legacy" Bankruptcies, Rivals

C1. After removing potential pre-existing capacity growth trend (Model C2), LCC rivals are expected to have 7% fewer seats three quarters prior to the bankruptcy filing and then have significantly more seats (about 13.4%) if "bankrupt" share is 50%. This result suggest that the LCC growth may have been rather slower on bankrupt routes than other unaffected routes before legacy carriers' bankruptcies then expedited as the legacy rivals near bankruptcy. Thus the LCC growth spurred by legacy rivals' bankruptcies would be close to the estimates from Model C1, which is over 25% at the last quarter of rivals' bankruptcy if "bankrupt" share is 50%. We can see that most of the LCC growth from pre-bankruptcy periods occurred during, rather than post- rivals' bankruptcy.

Bankrupt airlines' capacity cut can be interpreted as an effort to reduce total expenses quickly and regain proper liquidity level. This effort would not stop at reducing services. They also drop relatively unprofitable routes as means to reduce capacity and hence costs. The "After Exit" graph shows the

responses of remaining airlines to bankrupt airlines' exit from the market. Throughout the periods surrounding the exit, non-LCC rivals seem to maintain fewer seats than normal but present the sign of increase. In the long term, the capacity level does not seem different from the usual level. During the same period, LCC rivals increase capacity starting right before the bankrupt airline's exit, which leads to 100-120% more seats than usual in the long term if the bankrupt airline used to hold 50% market share on average for four quarters before a year prior to the exit. The fewer seats of non-LCC and LCC rivals in the period two quarters prior to the exit ( $T(EX) - 2$ ).

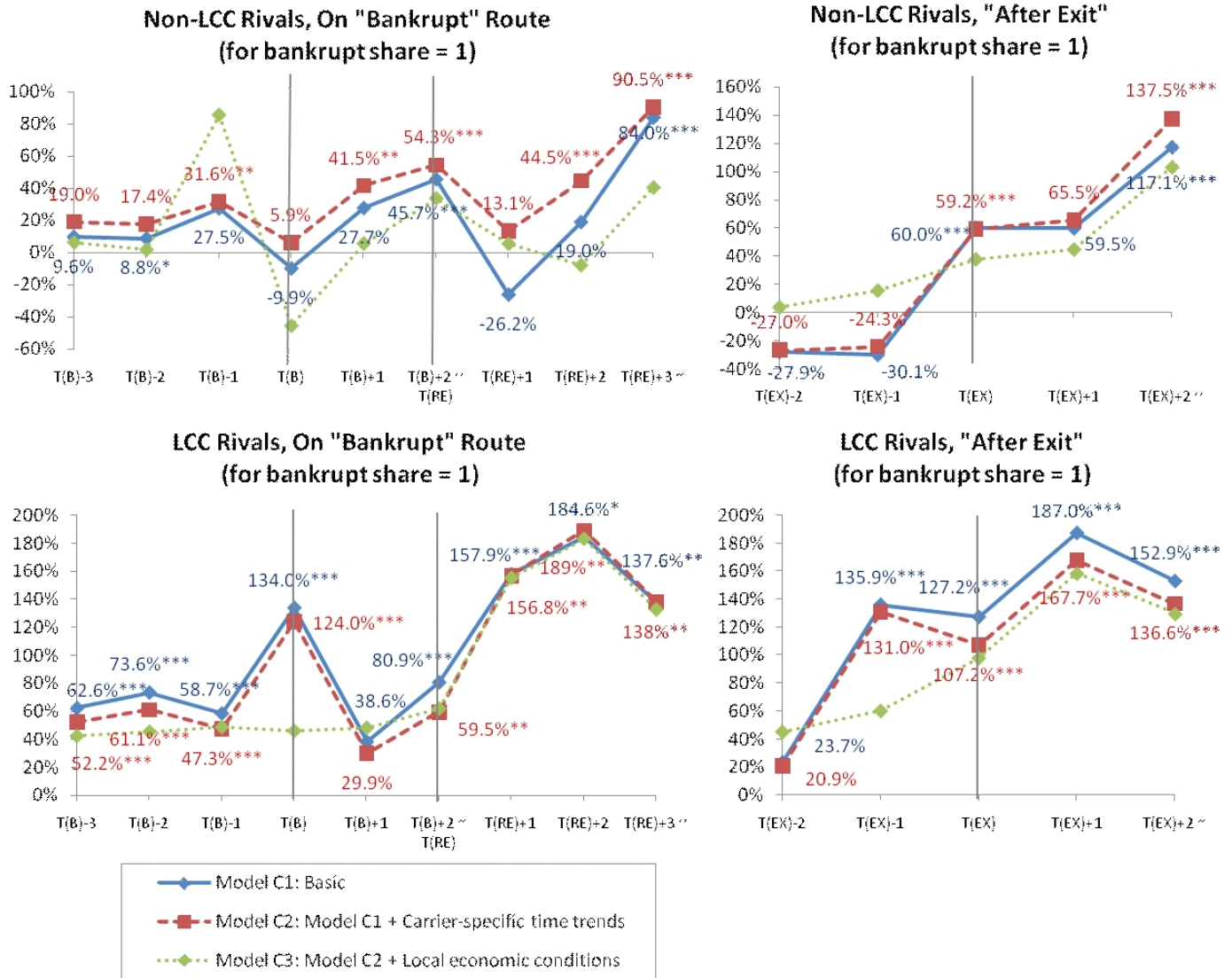


Figure 7: % Capacity Change in the Periods Surrounding "Other" Bankruptcies, Rivals

Figure 7 reports the capacity change for rivals in the periods surrounding other (non-legacy) bankruptcies. Unlike in legacy bankruptcies, the growth pattern is not much different between LCC and non-LCC rivals. Throughout the periods, both LCC and non-LCC show the sign of increase in capacity. The results

seem to be consistent with that the bankrupt airlines have been significant competitors although ended up with bankruptcy and their weaker presence gives all other rivals the opportunities to expand.

In the regression results from Model C1, the presence of low cost carrier ( $LCCin=1$ ) does not have a significant relationship with capacity level whereas Southwest is positively and significantly related to total capacity at 5% significant level (0.0175, SE=0.0210 for  $LCCin$ , and 0.0669, SE=0.0327 for  $SWin$ ). After adding carrier-specific time trends (Model C2), the estimated coefficients are higher and more significant (0.0277, SE=0.0223 for  $LCCin$ , and 0.0781, SE=0.0347 for  $SWin$ ). Including local economic conditions do not change the result do not change the result and the employment in destination airport city and personal income in origin airport city are positive and significant at 1% and 5%, respectively (0.6079, SE=0.3986 for  $\log(Emp\_origin)$ , 1.1855, SE=0.4214 for  $\log(Emp\_dest)$ , 0.5285, SE=0.2265 for  $\log(Inc\_origin)$ , 0.2689, SE=0.2432 for  $\log(Inc\_dest)$ , 0.0842, SE=0.3734 for  $\log(Pop\_origin)$ , and -0.2817, SE=0.3886 for  $\log(Pop\_dest)$ ).

Then, how are market and capacity shares would change in the periods surrounding bankruptcies? Figure 8-10 report the estimated change in the two measures of market presence in those periods. Market share is defined as a carrier’s share on a route in terms of passenger enplanements whereas capacity share is measured as a carrier’s share in terms of seats available. The results are consistent with the findings in the analysis on capacity changes that LCCs are actively expanding their presence while bankrupt airlines, especially legacy carriers, are shrinking.

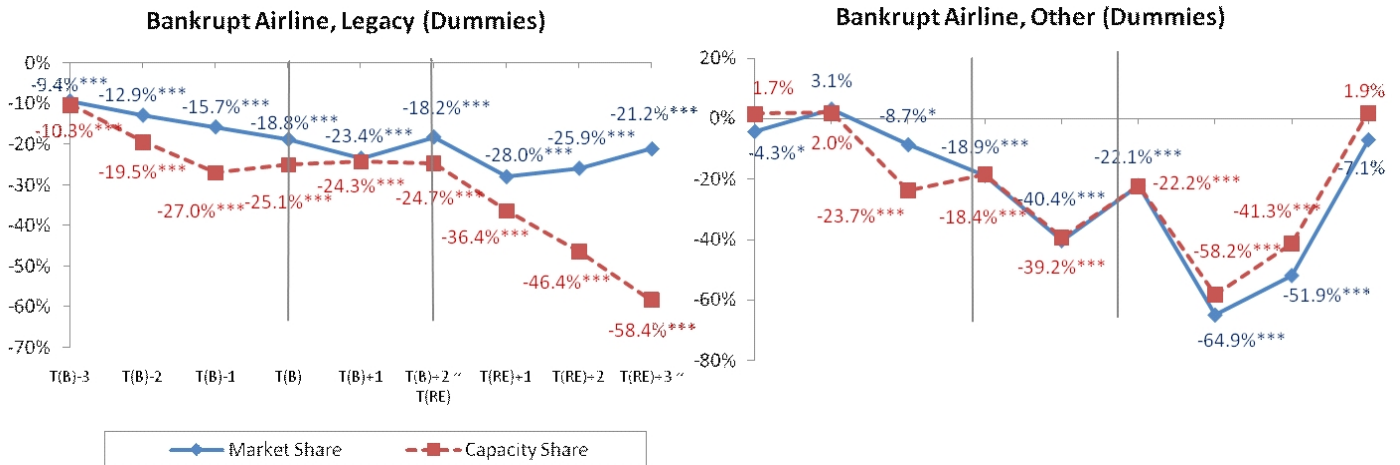


Figure 8: % Market Share/Capacity Share Change in the Periods Surrounding Bankruptcies, Bankrupt Airlines

Legacy carriers filing for bankruptcy show a significant decline in both market share and capacity share on a route as they near bankruptcy. We have seen that a large portion of capacity reduction by bankrupt airlines has occurred in pre-bankruptcy periods, which is consistent with the patterns of market and capacity share change. It is noteworthy that legacy carriers after reemergence from bankruptcy show a steady decline in capacity share unlike stable market share during the same periods. This indicates

that their capacity reduction in post-bankruptcy periods does not necessarily mean the bankrupt airlines reduce supplies. Rather, they seem to increase the of services operated by regional airline partners. Thus, the increase in capacity for non-LCC rivals in those periods may represent this pattern. For other bankruptcies, market and capacity shares move together and the movement over the course of bankruptcy is consistent with the capacity change presented before.

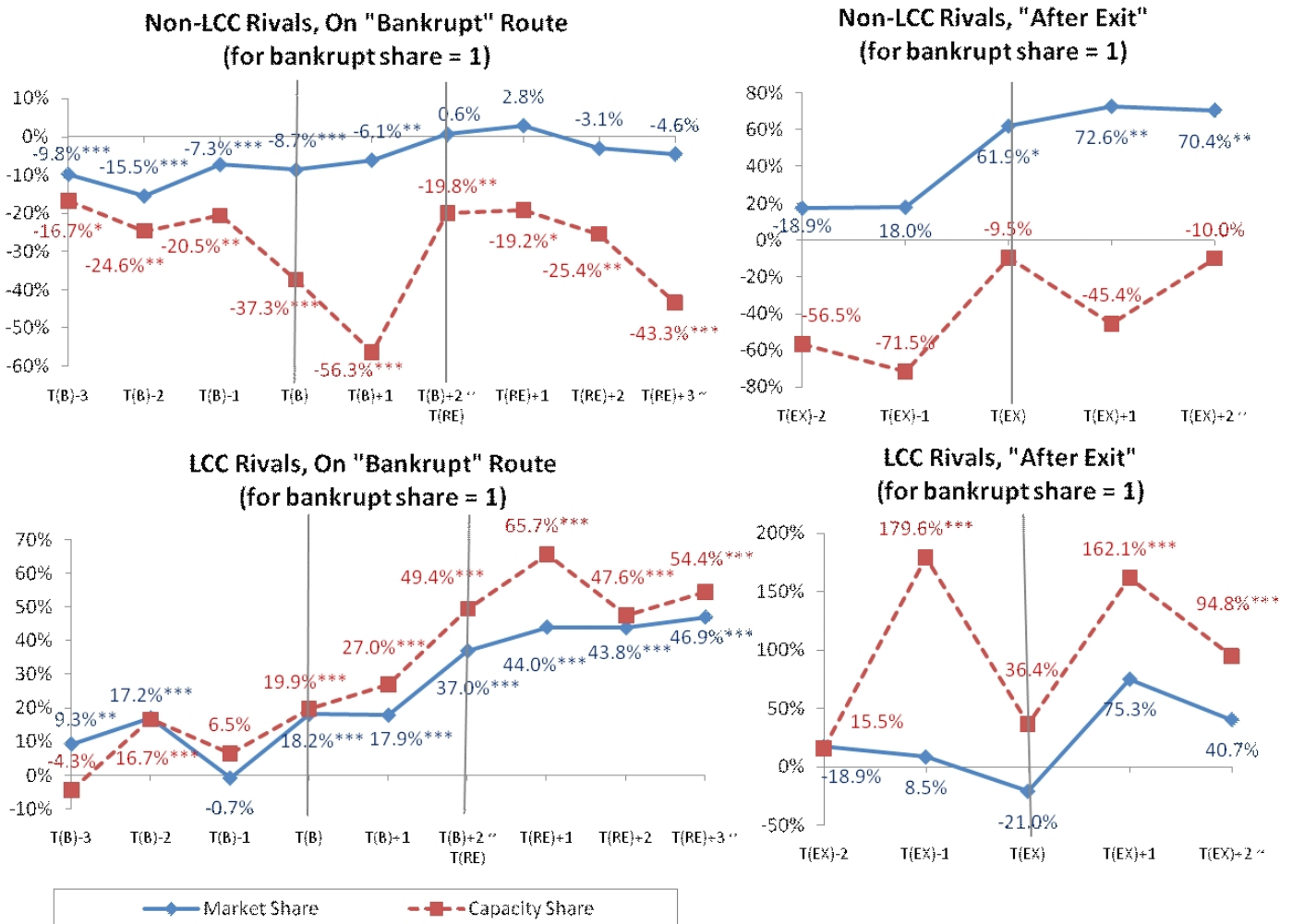


Figure 9: % Market Share/Capacity Share Change in the Periods Surrounding "Legacy" Bankruptcies, Rivals

The loss in market and capacity shares of bankrupt airlines is significant. Then, who are the bankrupt airlines losing their market and capacity shares to? Figure 9 shows the changes in shares for LCC and non-LCC rivals. Non-LCC rivals tend to have the same or lower market and capacity shares in the periods of interest as compared to normal times whereas LCC rivals have won both market and capacity shares throughout the periods. Meanwhile, non-LCC rivals' market share, not capacity share, jumps upon bankruptcy airlines' exit. Part of the jump is caused by a merger of TWA by American Airlines. The capacity and market shares of LCC rivals tend to be higher in pre- and post- exit of bankrupt airlines

than normal.

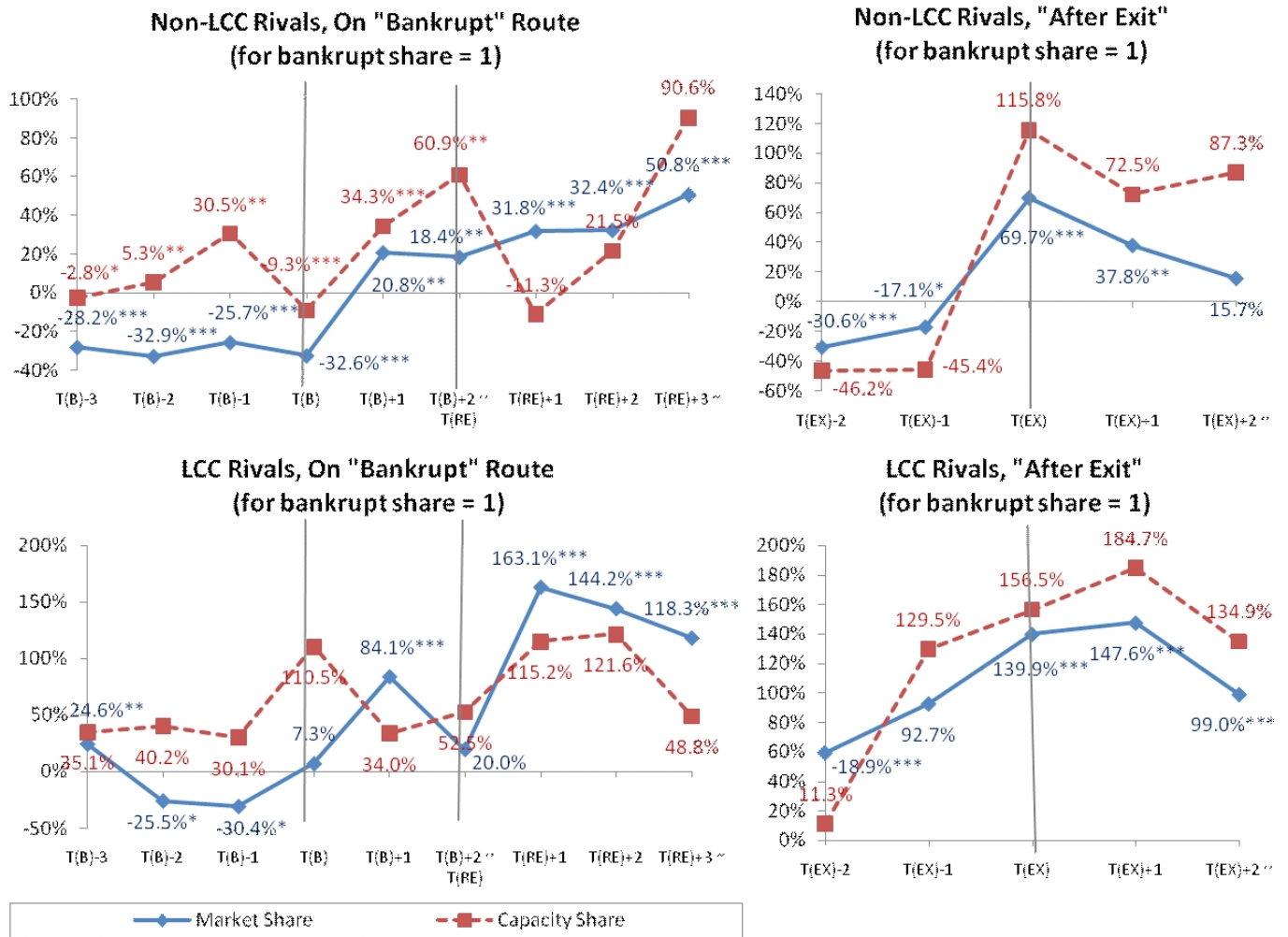


Figure 10: % Market Share/Capacity Share Change in the Periods Surrounding "Other" Bankruptcies, Rivals

If we look at low cost airlines in particular, they are actually increasing their presence in the bankrupt route. Once a bankrupt airline exits from a route, other airlines, especially low cost carriers, seem to win market share at least in later periods. So low cost airlines take an opportunity to expand and increase their market share at the expense of bankrupt airlines and other non-bankrupt airlines.

Figure 10 is for the case of the other bankruptcies. In this case, both non-LCC and LCC rivals show the tendency of increase in market and capacity shares as in the analysis of capacity change.

So far we have seen carrier-level changes in fare, capacity, and market/capacity shares in the periods surrounding bankruptcy. The main findings are that bankrupt airlines cut fare as well as capacity in those periods and, during the same periods, LCC rivals do not match the fare cut and expand capacity and market presence. In addition, these patterns are even more prominent when a bankrupt airline is a

legacy carrier and its market share used to be higher on a route in the near past. Therefore, bankrupt airlines' fare cut is not as effective enough to hurt their competitors as often claimed. Moreover, bankrupt airlines do reduce capacity in the course of bankruptcy and their disappearance from a market does not seem to help others to increase profitability in legacy bankruptcies.

The rivals' fare cut in the post-bankruptcy periods rather suggest that, though bankrupt carriers may have triggered fare cut in the beginning, it could be their capacity cut that increases price competition by allowing LCCs to expand. The LCC expansion raises price competitive pressure for not only legacy carriers but also LCCs themselves as average competitors are getting stronger. In sum, bankrupt airlines operating under protection per se do not seem to harm rivals' profitability. Instead, the increasing exposure to LCCs can be more significant. In particular, efficient airlines with low cost structure are reaping the benefits from bankrupt airlines' capacity cut and expand, leading to even fiercer competition. In other words, the industry transition in favor of more efficient and stronger players may have been facilitated by bankruptcy filings and capacity cut that followed. The LCCs profit today as bankrupt rivals are shrinking but the competition seems to get tougher as they are competing against stronger counterparts. Now, we will move on to the route level analysis to see how the total capacity level on the routes changes during the periods affected by bankruptcy.

## 6.2 Does Total Capacity Change?

We have seen that bankrupt airlines tend to reduce capacity over the course of bankruptcy. If outright liquidation is to eliminate costly excess capacity kept by bankrupt airlines and improve profitability for other airlines, we should be able to find the sign of decrease in total capacity level as bankrupt airlines cut capacity or exit from a market. However, the tendency of capacity increase by LCC rivals not-in-bankruptcy while bankrupt airlines' capacity cut suggests that this may not be true. That is, even when bankrupt airlines are reducing capacity, LCCs may take this as an opportunity to add their capacity, leaving the total capacity level intact. The estimated total capacity change in the periods surrounding bankruptcy is presented in Figure 11.

The total route capacity change is estimated in using three different models. Model R1 is the basic specification with time-specific dummy variables and Model R2 includes the presence of LCC and Southwest (*LCCIN* and *SWIN*) for controls. Local economic conditions are added in Model R3 so the model covers only MSAs, 1998Q1 through 2007Q4. As detailed in section 5.1, the bankrupt-route indicators (whether there is a bankrupt airline serving the route) are multiplied by the average market share of the bankrupt airlines in normal times to take account of potential heterogeneities of effects depending on the different degrees of exposure to bankruptcies.

In legacy bankruptcies, the number of available seats on a route increases right before bankrupt filing and then drops until the end quarter of bankruptcy in the results from Model R1 and Model R2. Although the capacity is decreased over the course of bankruptcy, given that the average bankrupt share is about 20%, the estimated decline is less than 1%. Even when bankrupt share is 50%, it is only about 2%. which is no larger than average quarterly change in the capacity in the sample routes,



4.8%. The standard deviation of quarterly capacity adjustment is about 1.9%. In fact, Borenstein and Rose (2003) reported that capacity change for two quarters before and after bankruptcy filing is no larger than quarterly usual capacity adjustment. The result confirms their findings. The decrease in the capacity is statistically significant but economically insignificant. Besides, aggregate demand shock such as September 11 (2002Q3) led to over 10% route capacity reduction on average in the sample so it has a much larger impact on capacity level. Moreover, after reemergence, the route capacity level seems to recover afterwards.

Besides, considering that LCCs expanded during rivals' bankruptcies, the increase in the pre-bankruptcy period can be due to the transfer of capacity of LCCs from other routes, as it would be hard to increase capacity immediately and so LCCs may raise capacity on a bankrupt route by redistributing the given capacity from other routes to bankrupt routes in the short term.

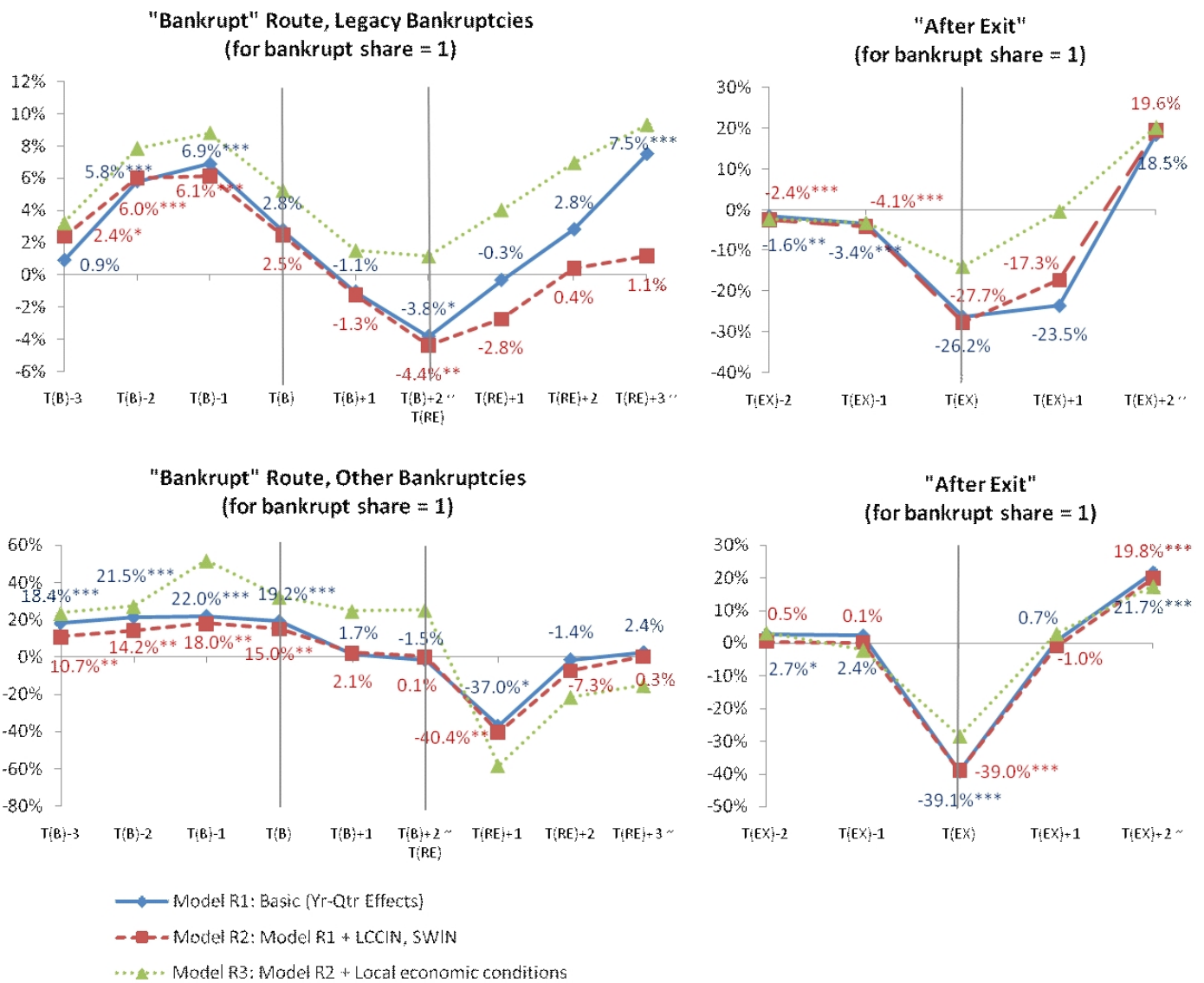


Figure 11: % Total Route Capacity Change in the Periods Surrounding Bankruptcies

In other bankruptcies, the total route capacity seems to even increase with larger "bankrupt" share. The capacity drops steeply right after reemergence but it returns to the normal level in the long term. When a bankrupt airline exits from the market, the total route capacity drops substantially with higher market share of bankrupt airlines both in legacy and other bankruptcies. However, the capacity level seems to rebound to the normal level eventually.

Aside from the bankruptcy effects, the presence of LCC and/or Southwest on a route has a significant and positive relationship with the total route capacity level. In particular, the capacity is about 10% higher when LCC is in and the presence of Southwest is related to additional 15% higher capacity level, meaning 25% capacity increase in total when Southwest is in (0.1016, SE=0.0133 for *LCCin*, 0.1549, SE=0.0242 for *SWin*).

Moreover, the scheduled departures show little change as compared to available seats. In fact, the number of scheduled flights even tends to increase. This result indicates that large aircrafts are being replaced by smaller ones on bankrupt routes during the period. As a side discussion, this suggests that a large carrier would not internalize the congestion problem they cause because their reduction in schedules would be filled by other airlines, leaving the total congestion level unaffected.

In sum, there is a sign of capacity decrease in the periods surrounding bankruptcies, which may indicate that bankrupt airlines add capacity that would otherwise been eliminated. The size of the decrease, however, is neither economically meaningful nor persistent on a bankrupt route. Moreover, even when bankrupt airline actually cease operation on a route, the total route capacity does not show a sign of decrease. That is, overcapacity problem does not seem to get worse as a result of bankruptcy protection. These results are non consistent with the argument that bankrupt airlines are keeping the capacity that would otherwise been liquidated.

Although the total capacity does not change meaningfully, the composition of capacity has been changed because bankrupt airlines reduce capacity and other airlines fill the gap and thus the industry is improving in productive efficiency. We have seen the replacement of bankrupt airlines' capacity by their rivals. For consumers' perspective, who provides flight services may not be important as long as there is some airlines that would. The composition of capacity, however, could matter in terms of allocative efficiency. If bankrupt airlines are relatively inefficient and they are forced to cut back on capacity, then relatively efficient airlines may take the openings as an opportunity to expand. This is what we have found in the previous section. This replacement will lead to lower average cost level and higher efficiency industrywide. Next section will use the airport sample to check the finding from the route sample.

### **6.3 Redistribution of Capacity between Airlines at Airport**

This is a supplementary section that confirms the findings in the previous sections and illustrates how capacities are redistributed between airlines during bankruptcies, given fixed facilities and slots of airport. The route sample analysis shows how market competition plays out in the periods surrounding airline bankruptcies. The airport sample analysis, on the other hand, rather focuses on the supply side that



essential physical resources are limited that could have limited efficient firms from growth. In this case, bankrupt airlines' capacity cutback would provide new openings for other airlines to use. The growth of efficient airlines at an airport spurred by bankruptcy of rivals that have been operating at the airport will indicate the existence of entry barrier due to fixed facilities and slots (at least for short term).

For the airport sample, basically the same statistical models will be used except we replace route with airport and dependent variables will be capacity (in terms of available seats). Though not reported here, the analyses using other measures of market presence such as scheduled flights, market share, and capacity share lead to similar conclusions. Figures 12-14 are the event study graphs from estimation results. Model AC1-Model AC3 are comparable to Model C1-Model C3 employed in carrier-level capacity change on bankrupt routes.

As in the route sample analysis, the estimation results with the airport sample show the pattern of LCCs' replacement of bankrupt airlines capacity in the periods surrounding bankruptcies. Although non-LCC rivals to bankrupt airlines are now also expanding, the growth is more prominent for LCCs. The result indicates that the presence of bankrupt airlines on a route may be associated with deteriorated profitability of serving the route for non-LCC rivals. This would be at least in part because LCCs are growing out of shrinking airlines in bankruptcy. That is, not only bankrupt airlines' aggressive pricing but also LCC expansion on a route will toughen the competition on bankrupt route. So, non-LCC rivals may have chosen to pick up some slack at the airport where bankrupt airlines have retreated and use the resources to expand in other markets.

The growth of LCCs spurred by rivals' bankruptcies leads to our next question: how large is the bankruptcy effect on LCC rivals' expansion? Next section attempts to quantify the effect.

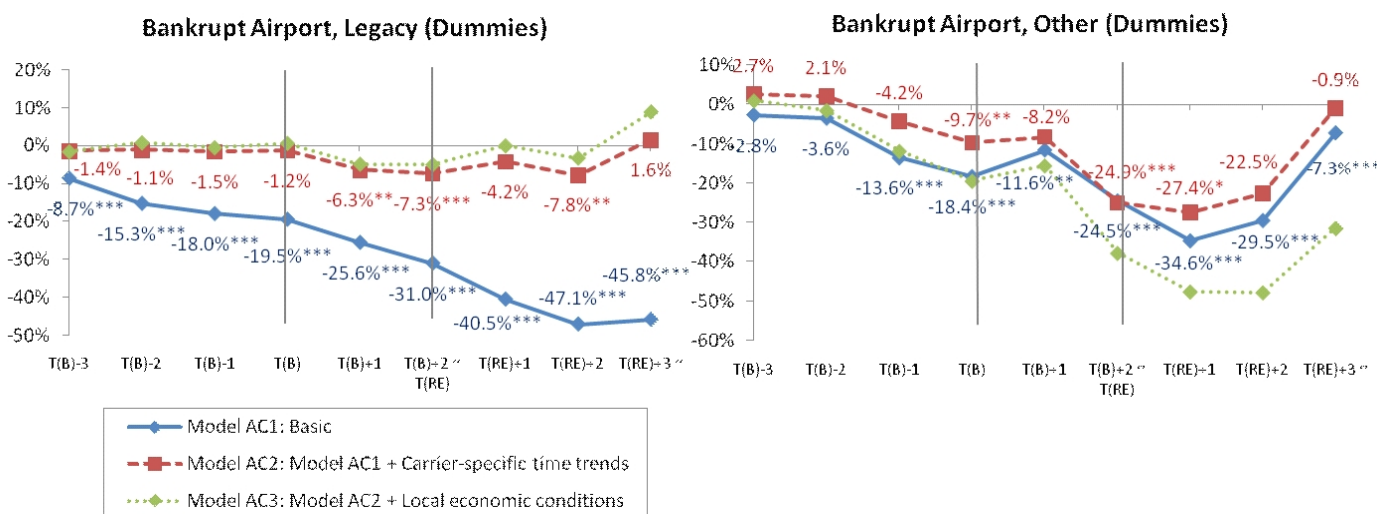


Figure 12: % Capacity Change at Airport in the Periods Surrounding Bankruptcies, Bankrupt Airlines

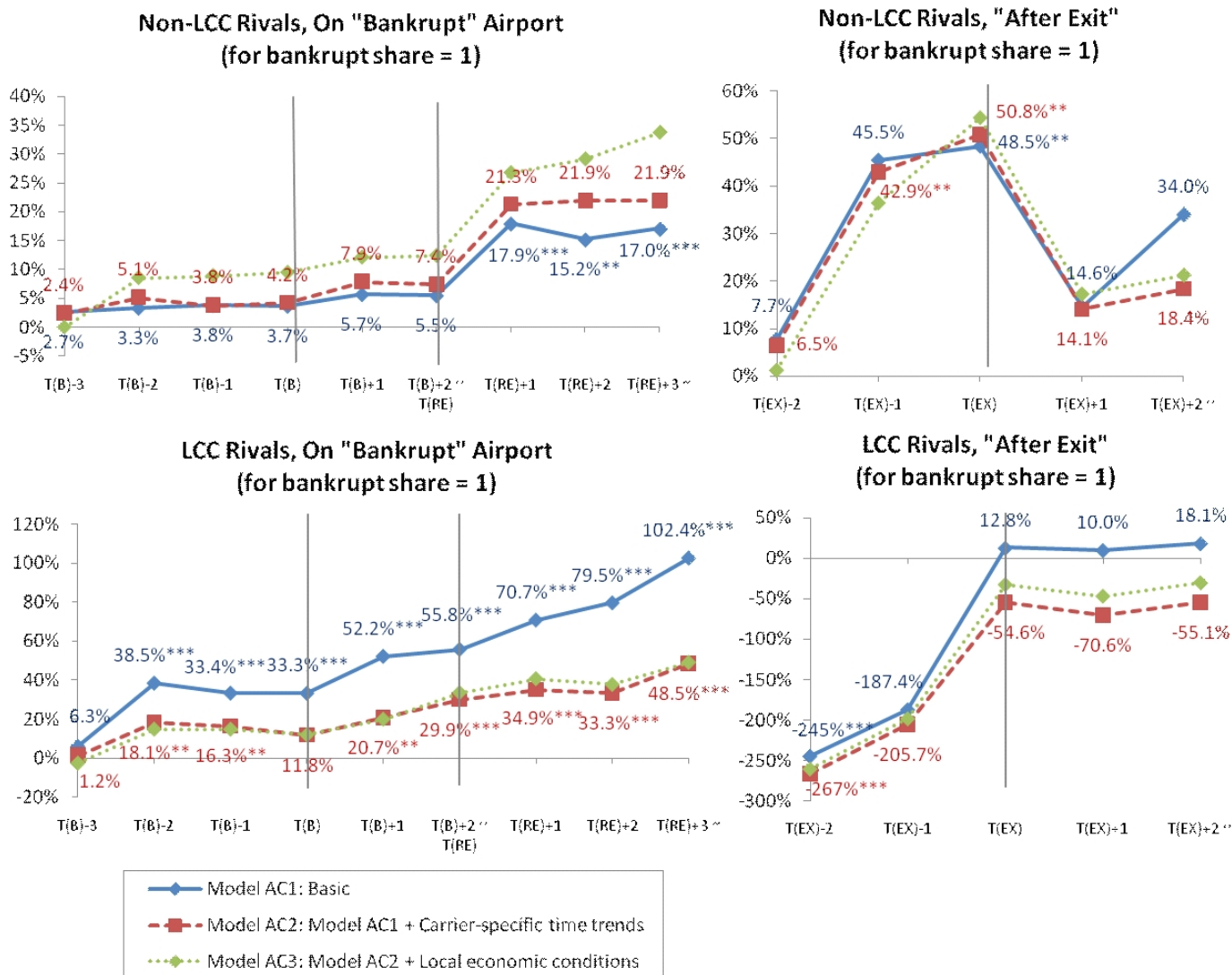


Figure 13: % Capacity Change at Airport in the Periods Surrounding "Legacy" Bankruptcies, Rivals

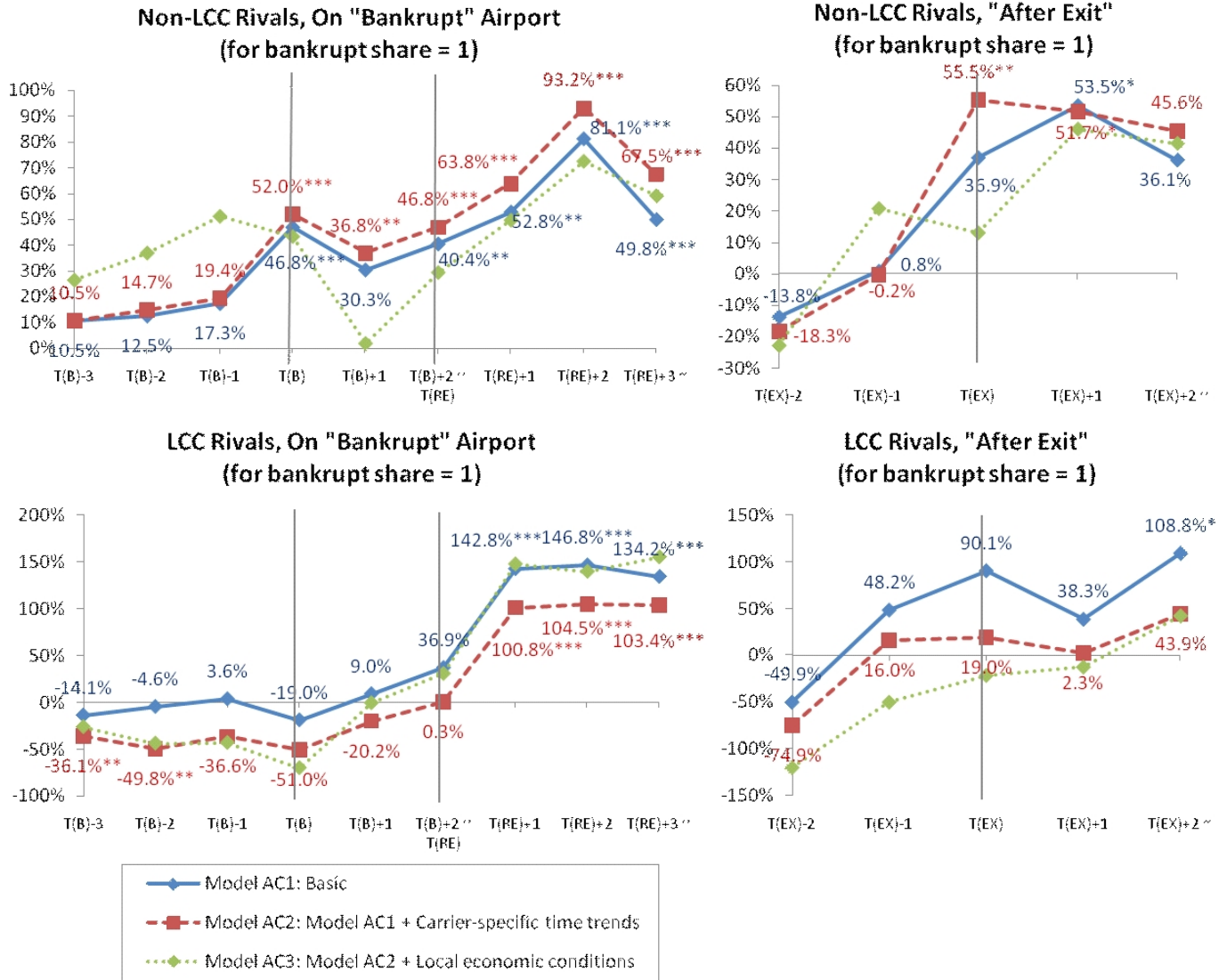


Figure 14: % Capacity Change at Airport in the Periods Surrounding "Other" Bankruptcies, Rivals

## 7 Calculating the Fraction of LCC Growth from Rivals' Bankruptcies

Given the long history of the airline industry since deregulation in 1978, LCCs, even with substantial cost advantage over legacy carriers, have not expanded as rapidly and extensively as expected (see Figure 15). Also, most of the growth has occurred only after 1990 (LCCs' passenger share is less than 5% in 1990). This raises a question: what does it take for efficient airlines to take markets from less efficient incumbents?

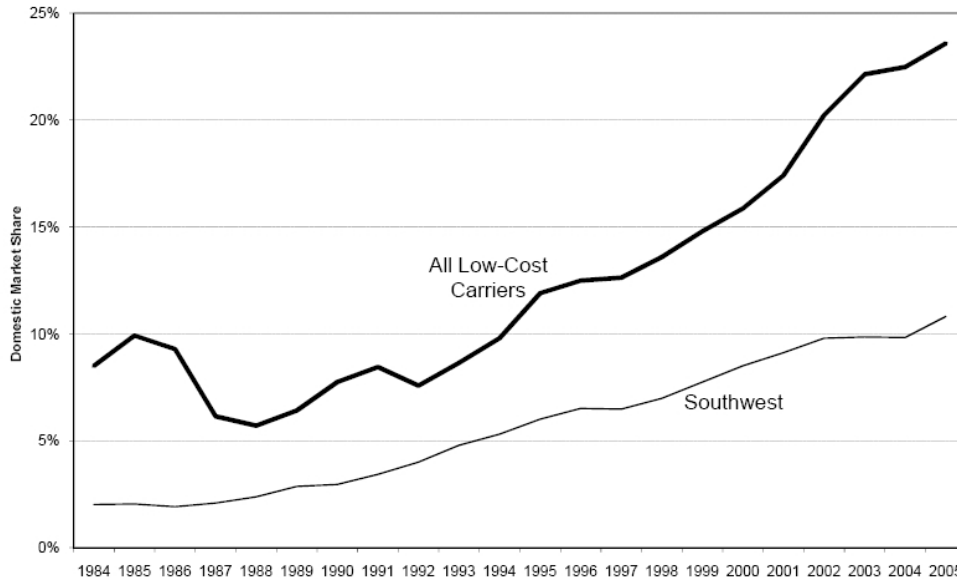


Figure 15: Domestic Market Share of Southwest and LCC, 1984-2005 (Source: Borenstein and Rose (2007) "How Airline Markets Work. . . Or Do They" Figure 7)

Incumbent legacy airlines can be very adverse to reducing capacity for various reasons. For one, capacity reduction is not reversible so it may be hard to get terminals or other airport facilities back once they lose them to other airlines. Or, since they have extra aircraft anyway, they can add capacity at very low marginal costs. These reasons may be holding back the incumbent airlines from reducing capacity in normal times when they do not need any dramatic change immediately. In addition, the facilities and time slots are fixed at least in the short term in the airline industry. Even if LCCs can provide comparable services to legacy airlines, it may be hard for them to get the access to the fixed assets necessary to operate as long as incumbents are not giving them up. The discrete capacity reduction by incumbents then will provide an immediate expansion opportunities for efficient airlines whose growth has been limited.

9/11, for example, was the event that led incumbent airlines to cut capacity significantly and discretely. LCCs also retreated capacity in the aftermath of 9/11. However, LCCs soon expanded by picking up the slack from large network airlines' capacity cutback. Although bankruptcy is not as exogenous as 9/11 shock, the risk of being liquidated may urge the airlines to cut back on capacity as substantially and discretely as 9/11. The empirical results with the route sample indicated that LCCs filled the vacuum from bankrupt airlines' retreat, suggesting that rivals' bankruptcy can be a factor that spurs LCC expansion.

Figure 16 shows the quarterly route capacity change by carrier group, as compared to the first quarter of 1998, at quarterly 1000 most travelled airports. It is clear that legacy airlines are reducing capacity on average and LCCs are increasing capacity. The correlation of the quarterly changes between legacy airlines and LCCs is about -0.8. The highly negative correlation between legacy and low cost airlines shows the possibility that at least part of legacy airlines' capacity is being replaced by low cost airlines.

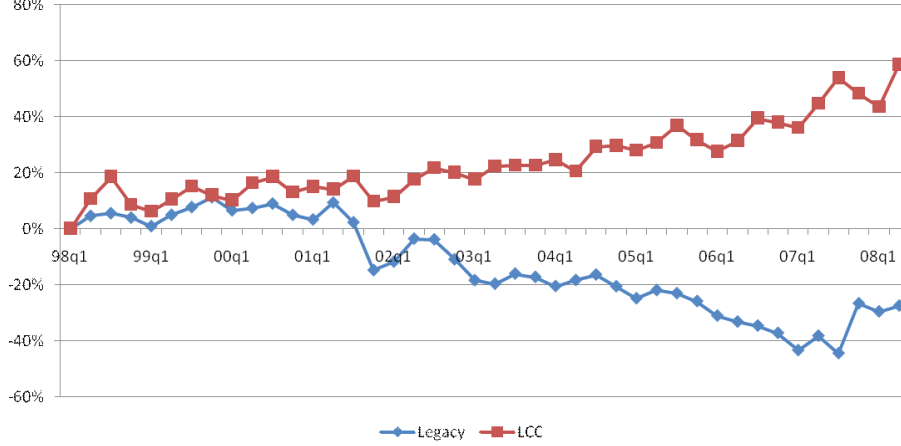


Figure 16: % Route Capacity Change by Carrier Group at Quarterly 1000 Most Travelled Routes (base: 1998Q1)

Some argue that the price competitive pressure from low cost carrier pushes legacy carriers to file for bankruptcy. In that sense, LCC expansion itself would have affected legacy airlines' bankruptcies. The pre-existing trend of LCC expansion, if any, is controlled by adding carrier-specific time trends. Even after removing the trend, LCCs show the pattern of replacing bankrupt airlines' capacity. That is, whatever the reason for the bankruptcy is, bankruptcy seemed to prompt LCC rivals' expansion even further as LCCs took the openings from bankrupt airlines' capacity cut for recovery as an opportunity to expand. Then how large is this effect? That is, how large is the fraction of LCC growth from rivals' bankruptcies?

Here we would like to quantify the bankruptcy effect that spur LCC expansion. How much fraction of LCC growth is explained by LCC's expansion while a bankrupt rival is cutting back on capacity by reducing supplies of seats in an airport or even dropping relatively unprofitable airports. Based on the estimation results from Model C1-Model C3, we can calculate the fraction as we take the following steps.

First, we focus on direct bankruptcy effect so the changes in pre- and post- bankruptcy periods will not be included to quantify the fraction of LCC growth spurred by rivals' bankruptcies. That is, the direct bankruptcy effect includes the change in the periods in rival's bankruptcy or after bankrupt rival's exit ( $K_{during} \equiv \{T_B, T_B + 1, T_B + 2 \sim T_{RE}, T_{EX}, T_{EX} + 1, T_{EX} + 2 \sim\}$ ). We begin with calculating counterfactual capacity level of each LCC absent rivals' bankruptcies. We use the estimates from regression on capacity change with the main route sample. In particular, the estimated estimates on LCCs during rivals' bankruptcies will be used (Figures 6 and 7). For each combination of a LCC, route, and time period, the counterfactual capacity level of the LCC absent rivals' bankruptcies at that time ( $\widetilde{Capacity}_{i,r,t}$ ) can be calculated from:

$$\widetilde{Capacity}_{i,r,t} = \frac{1}{1 + \sum_{k \in K1 \cup K2} (\widehat{\Delta\%}_{k,r,t}^{lg} + \widehat{\Delta\%}_{k,r,t}^{oth})} \cdot Capacity_{i,r,t}$$

where  $\widehat{\Delta\%}_{k,r,t}^{lg} \equiv \widehat{\gamma}_k^{lcc} Bshr[k]_{rt}^{lg}$ ,  $\widehat{\Delta\%}_{k,r,t}^{oth} \equiv \widehat{\lambda}_k^{lcc} Bshr[k]_{rt}^{oth}$ ,  $Capacity_{i,r,t}$  is the actual capacity of LCC  $i$  on a route  $r$  at time  $t$ , and  $K1, K2$  are the same as defined earlier. The direct and indirect bankruptcy

effect until time  $t$  is then easily calculated by taking the difference between actual and counterfactual capacity level:

$$Capacity_{i,r,t} - \widetilde{Capacity}_{i,r,t} = \frac{\sum_{k \in K1 \cup K2} (\widehat{\Delta\%}_{0,k,r,t}^{lg} + \widehat{\Delta\%}_{0,k,r,t}^{oth})}{1 + \sum_{k \in K1 \cup K2} (\widehat{\Delta\%}_{0,k,r,t}^{lg} + \widehat{\Delta\%}_{0,k,r,t}^{oth})} \cdot Capacity_{i,r,t}$$

Calculating direct bankruptcy effect, however, takes a few more steps. The direct bankruptcy effect of inducing LCC expansion on each route will come either from that bankrupt airline stays in but reduces capacity or from that bankrupt airlines exit the route. Thus, we need to identify the final period of each bankruptcy  $b$  on a route  $r$  ( $\equiv \bar{T}(b, r)$ ).

$$\bar{T}(b, r) = \text{Max}\{t \text{ s.t. } k(t) \in K_{during}\}$$

where  $k(t)$  is the function that maps from calendar date to event periods from pre-bankruptcy to post-bankruptcy. If bankruptcy ended during the data period, as is almost always the case, the final period will fall into either  $[T_B + 2 \sim T_{RE}]$  or  $[T_{EX} + 2 \sim]$ . Then the bankruptcy effect accumulated from pre-bankruptcy periods ( $\equiv B_{lg}$  for legacy bankruptcies and  $B_{oth}$  for other bankruptcies) can be calculated from summing the individual LCC growth induced until the end of rival's bankruptcy on a route over all LCCs ( $i$ ), routes ( $r$ ), and bankruptcies ( $b$ ):

$$B_{lg} = \sum_b \sum_r \sum_i \widehat{\Delta\%}_{0,k(\bar{T}),r,\bar{T}}^{lg} \cdot \widetilde{Capacity}_{i,r,\bar{T}}$$

$$B_{oth} \equiv \sum_b \sum_r \sum_i \widehat{\Delta\%}_{0,k(\bar{T}),r,\bar{T}}^{oth} \cdot \widetilde{Capacity}_{i,r,\bar{T}}$$

where  $\bar{T} = \bar{T}(b, r)$  and  $k(\bar{T})$  is the event period at  $t = \bar{T}$  (which is either  $[T_B + 2 \sim T_{RE}]$  or  $[T_{EX} + 2 \sim]$  in most cases). Next step is the remove the change in pre-bankruptcy periods to capture the LCC growth occurred during rivals' bankruptcies:

$$\Delta Capacity_{lg} = B_{lg} - \sum_b \sum_r \sum_i \widehat{\Delta\%}_{0,k(T_B(b)-1),r,T_B(b)-1}^{lg} \cdot \widetilde{Capacity}_{i,r,T_B(b)-1}$$

$$\Delta Capacity_{oth} = B_{oth} - \sum_b \sum_r \sum_i \widehat{\Delta\%}_{0,k(T_B(b)-1),r,T_B(b)-1}^{oth} \cdot \widetilde{Capacity}_{i,r,T_B(b)-1}$$

where  $T_B(b)$  is the quarter of filing for bankruptcy  $b$  (so  $T_B(b) - 1$  is the last period prior to actual bankruptcy filing of bankruptcy event  $b$ ). Finally, the fraction of LCC growth during the data time periods explained by rivals' bankruptcies then can be calculated by dividing the estimated bankruptcy effects by the actual LCC growth during the same period:

$$\begin{aligned}
Fraction^{lg} &= \frac{\Delta Capacity_{lg}}{\sum_{t=1998Q1}^{2007Q4} \sum_r \sum_i (Capacity_{i,r,t} - Capacity_{i,r,t-1})} \\
Fraction^{lg} &= \frac{\Delta Capacity_{oth}}{\sum_{t=1998Q1}^{2007Q4} \sum_r \sum_i (Capacity_{i,r,t} - Capacity_{i,r,t-1})}
\end{aligned}$$

Sum of the two fractions is the direct bankruptcy effect from all rival bankruptcies. Table 6 shows the estimated bankruptcy effects. The estimated fraction of LCC growth explained by responses to rivals' bankruptcy ranged from 13 to 18% depending on which model to use. If we disentangle the effect into legacy bankruptcies and other bankruptcies, most of the LCC growth during rivals' bankruptcies are from legacy bankruptcies. In particular, the fraction explained by legacy rivals' bankruptcies is ranged from 15.5 to 16.9%. We can see that the fraction is significant.

Table 6. Fraction of LCC Growth from Rivals' Bankruptcy

Bankruptcies	Model C1	Model C2	Model C3
Legacy	16.88%	16.38%	15.50%
Other	1.18%	2.82%	-2.37%
Total	18.06%	19.19%	13.14%

Model C1 : Basic (Yr-Qtr specific time effects, *LCCin*, *SWin*)  
Model C2 : Model C1+ Carrier-specific time trends  
Model C3 : Model C2 + Local economic conditions

## 8 Conclusion

The paper investigates two separate but related questions on airline bankruptcies and industry change. First, we ask whether bankrupt airlines harm rivals by engaging in aggressive pricing and contributing to overcapacity problem. We found little evidence that bankruptcy protection harms the efficient rivals and the industry since bankrupt airlines underprice other competing against them and they are holding on to capacity that would otherwise have been liquidated. Bankrupt airlines cut fares but also cut capacity, non-bankrupt rivals cut fares a little but expand capacity, and low cost airlines among non-bankrupt rivals do not cut fare and increase capacity. So efficient airlines with lower cost are not negatively affected by bankrupt airlines' pricing and increase their presence. They replace the bankrupt airlines' inefficient capacity and possibly improve industry efficiency. So bankruptcy protection does not harm the industry in the sense that bankrupt airlines do not harm industry profitability and financial health of efficient rivals. However, if the bankrupt airlines were liquidated immediately and low cost carriers can expand at low cost, then the efficient carriers' growth might have been bigger. Thus the answer to the question if bankrupt protection harms the industry would be yes and no. It is "no" in the sense that bankrupt

protection does not worsen the situation but it is "yes" in the sense that efficient airlines could have expanded even more and the industry could have been better off without bankrupt airlines. Thus, the answer would depend on the capability of bankrupt airlines to cut costs down to the level comparable to LCCs.

The second question is raised from the answer to the first question. The main lesson from the first question is that LCCs are growing at the expense of rivals' bankruptcies, especially those of legacy carriers. This pattern indicates the existence of entry barriers that have limited LCC growth. The immediate and substantial capacity reduction that bankrupt airlines are taking will present new opportunities for efficient airlines to expand. Section 7 quantified the fraction of LCC growth spurred by rivals' bankruptcies. The estimated fraction ranged from 13 to 18% and moreover most of the growth occurred during legacy rivals' bankruptcies.

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