IMPACT OF AIR TRANSPORTATION ON REGIONAL ECONOMIC AND SOCIAL CONNECTIVITY IN THE UNITED STATES

Ryan Tam*, R. John Hansman±
International Center for Air Transportation
Department of Aeronautics and Astronautics
Massachusetts Institute of Technology
Cambridge, Massachusetts, USA

ABSTRACT

This paper identifies some of the forces that influence the impact of air transportation on regional connectivity and economic productivity in the United States. In light of recent threats to the financial viability of the airline industry, a conceptual model has been developed to highlight the interdependence of the national economy and the air transportation system. These complex relationships are identified using regional economic and social indicators combined with airline traffic and financial data. The changes in supply and demand for air travel after the deregulation of the airline industry in 1978—as well as the challenges faced after the attacks of September 11, 2001—are used to frame this discussion.

INTRODUCTION

The rapid increase in the use of air transportation since deregulation in 1978, coupled with the unprecedented financial crisis in the airline industry after the September 11 terrorist attacks raises questions on how vulnerable the nation is to significant interruptions to its air transportation system. In an attempt to better understand its national importance, this paper examines some aspects of how the air transportation system has had an impact on the economic structure and social behavior in the United States.

To help identify these economic and social impacts, a conceptual model of these interdependencies was developed to structure the analysis of this paper. In light of this framework, two major changes in the air transportation system are evaluated. The first change was the deregulation of the airline industry in 1978. Fundamental changes in airline services occurred after the Civil Aeronautics Board eliminated restrictions on routes and fares. The second major change was the dramatic downturn in the US airline industry following the attacks of September 11, 2001. Although revenues had been declining at the major airlines well before the 9/11 attacks, the subsequent changes in travel behavior led to a reduction in national air transportation capacity by 10 to 20 percent in just a matter of weeks. This dramatic change has highlighted the key interdependencies between the economy and the airline industry.

CONCEPTUAL MODEL

Figure 1 shows a conceptual model of the relationship between the economy and the air transportation system. The model sets up the external relationship between the economy (shown in the upper left corner) and the air transportation system (shaded in gray on the lower right). The economy generates a *Travel Need* which creates the *Demand* for air transportation services. The *Supply* of air transportation services, in turn, provides an *Economic Enabling Effect* that creates access to people, markets, ideas and capital and thus enables the economy to function at a regional or national level. These relationships between *Supply, Demand, and the Economy* illustrate the basic macro functionality of the air transportation system.

The model further illustrates how the internal structure of the *Air Transportation System* (gray box) is based on the profitability of the airline industry. This internal feedback loop connects the demand for air travel to airline revenues and the supply of air transportation. *Airlines* control the *Supply* of air transportation by modifying *Prices, Networks, and Schedules*, which in

*Graduate Research Assistant, Student Member, AIAA (rtam@mit.edu)
±Professor, Fellow AIAA (rjhans@mit.edu)

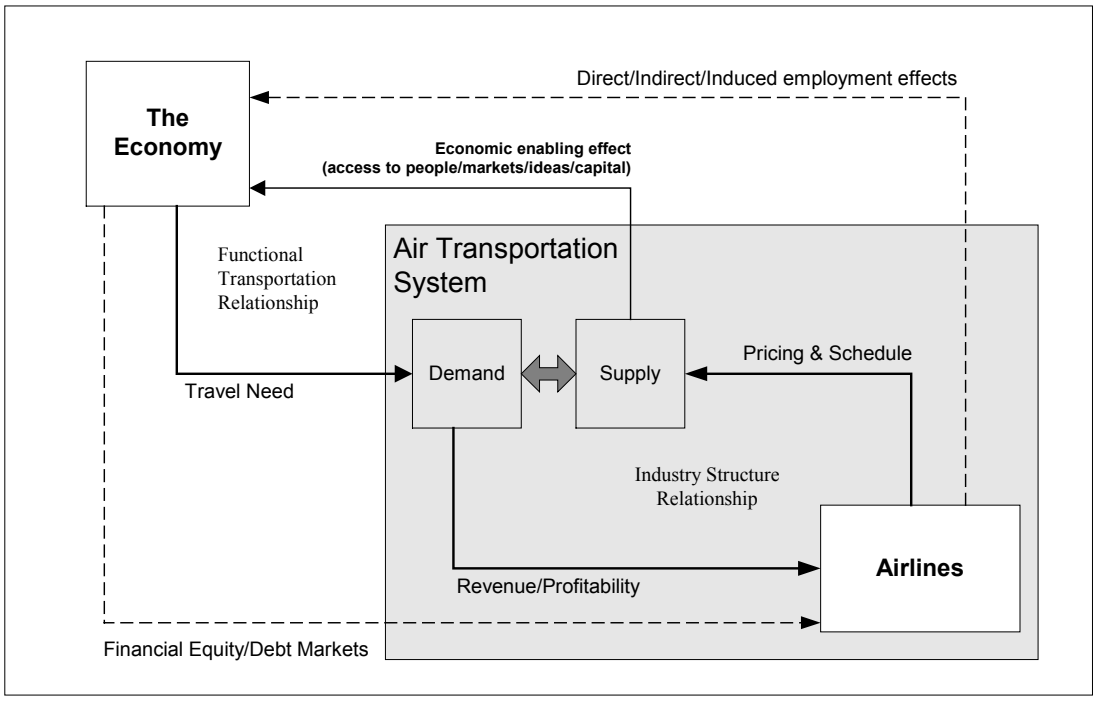

Figure 1: Relationship between the economy, air travel demand, and airline supply.

turn have a major impact on the *Demand* for air transportation services.

Finally, the model also shows the traditional financial relationships between the economy and the airline industry (shown in dashed lines). The *Economy* influences the ability of the *Airlines* to secure capital *Equity* and finance *Debt*. Employment and spending by the airlines, in turn, have *Direct, Indirect, and Induced impacts* on the economy.

RELATIONSHIP BETWEEN THE ECONOMY AND THE AIR TRANSPORTATION SYSTEM

Most analyses on the economic impact of air transportation typically only address the direct financial effects from aviation employment and spending. The FAA has estimated that the US aviation industry accounts for some 11.6 million direct, indirect, and induced jobs and over $316 billion dollars in earnings.[1,2] These methods, however, may underestimate the true impact of air transportation by failing to take into account the *Enabling Effects* of air transportation and how high quality air connectivity affects access to markets, capital, ideas, and people.

To examine the relationship between the economy and the air transportation system, a review of economic and social trends in the US since deregulation was conducted. Increases in air travel, GDP growth, population geography, and travel behavior were analyzed.

Growth in air travel

In order to fully document the changes in the supply of air transportation, the growth in passenger traffic data, airline capacity and airline fleets were analyzed. The growth in domestic capacity was measured in terms of Available Seat Miles (ASMs), while Revenue Passenger Miles (RPMs) were used to measure traffic.[3]

Figure 2 shows that RPMs grew considerably faster after deregulation than in the period between 1954 and 1978. Between 1954 and 1978 US domestic RPMs grew at an average rate of 750 million RPMs per year. Between 1978 and 2000, RPMs grew at average rate of 1.8 billion RPMs per year. Reflecting this increase in demand, Figure 3 shows that the domestic scheduled ASMs increased from 300 billion in 1978 to over 700 billion by 2000. Figure 4 shows that the growth in capacity and traffic was achieved by a major increase in the size of airline fleets. The number of aircraft used in commercial airline service increased from 2,000 aircraft to over 7,000 aircraft between 1978 and 1995.

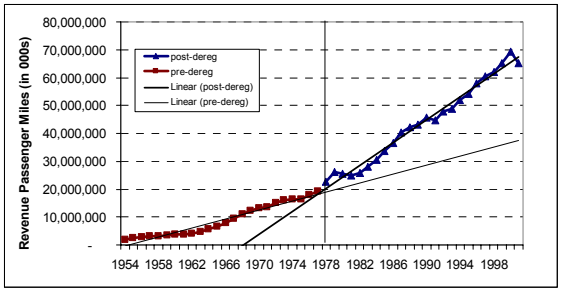

Figure 2: RPM Trends before and after deregulation. *Source: BEA and BTS OAI data.*

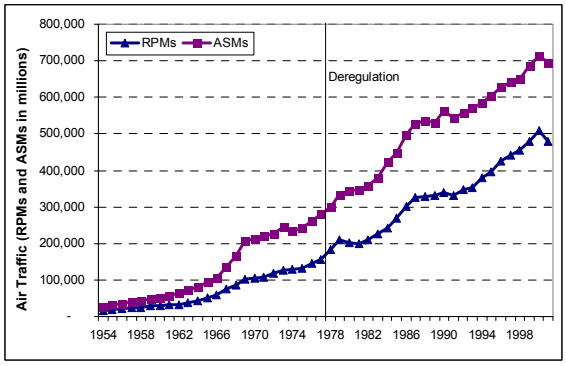

Figure 3: Growth in domestic travel, 1954-2001.[4] *Source: ATA data.*

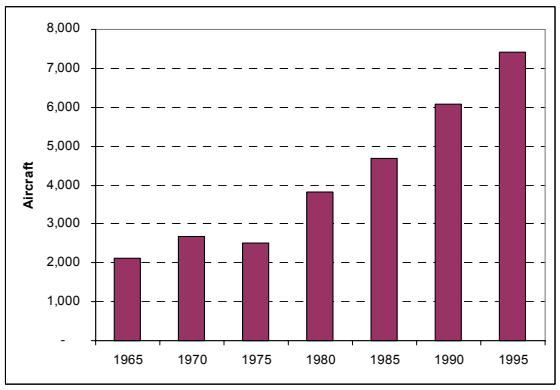

Figure 4: Growth of the US Commercial Airplane Fleet, 1965-1995. *Source: US BTS OAI data.*

Growth in Economic Activity

The relationship between air travel and economic growth was explored by analyzing increases in the US Gross Domestic Product (GDP) alongside the growth of domestic air travel. Constant 1996 dollars were used to measure the relative increase in GDP between 1954 and 2001, while air travel was measured using Revenue Passenger Miles (RPMs). Figure 5 shows that the growth of air traffic has historically tracked with the rise in GDP, and that rises in enplanements followed those for GDP.

The annual percentage change in RPMs and GDP was also analyzed in order to further investigate this relationship. Figure 6 confirms that there was a close correlation between annual economic growth and air travel after deregulation. Prior to deregulation, the annual change in RPMs also tracked the GDP—but not as closely.

The demand for air transportation services appears to be inherently related to economic activity. In general, a poorly performing economy will result in less circulation of goods and services and a reduction in personal income. The corresponding effect on air travel would involve some reduced demand for discretionary business and social trips such as vacations or visits to friends. Access to high quality air transportation is also thought to be a stimulant to economic growth through the *Enabling Effect* of access to markets, people, ideas, and capital. Since both the *Travel Need* and *Enabling Effect* are present in the interaction between the *Economy* and the *Air Transportation System* (Fig 1), it is difficult to de-couple these effects in most measures of system performance.

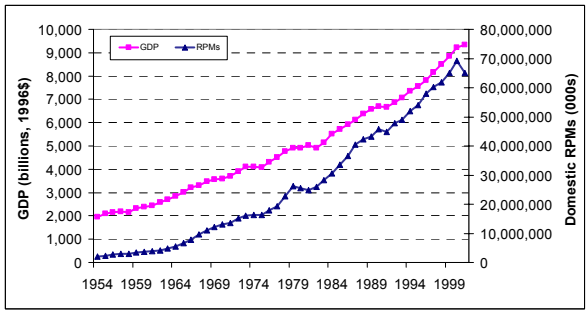

Figure 5: Growth in GDP and RPMs. *Source: US BEA and BTS data.*

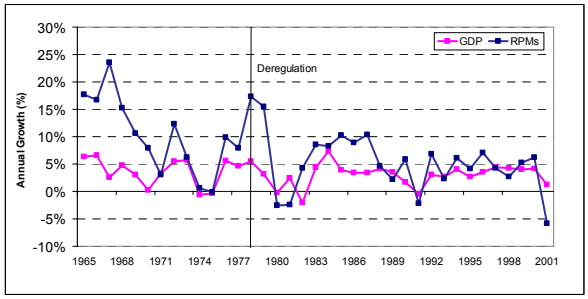

Figure 6: Annual percentage change in GDP and Domestic RPMs, 1965-2001. *Source: US BEA and BTS data.*

Changes in Regional Geography

To examine how air transportation may have affected regional population and economic growth, an analysis of regional economic and air traffic data was conducted. Economic census data on population growth and Per Capita Personal Income (PCIP) at the state level was combined with the Department of Transportation 10% air traveler coupon database. The number of airline trips per capita was also used to normalize the data for the size of each state.

Figure 7 illustrates the percentage change in air traffic over the percentage change in population between 1980 and 2000 (normalized to 1980 levels). Figure 9 shows a comparison of the change in per capita personal income over air traffic. Nationally,[5] there was a 24 percent growth in population and a 190 percent growth in PCIP between 1980 and 2000. In comparison, air travel by 136 percent on average.

In general, some of the faster-growing locations—by population and PCIP—in the West and Southeast were also associated with higher utilization of air travel. Although Nevada and Arizona had very high rates of population growth and air travel, they had some of the lowest increases in PCIP versus air travel. This is thought to be due to the rapid growth of the tourism industry and retirement relocations that stimulated air traffic demand but which generated relatively low-paying service jobs.

Massachusetts had the highest increase in PCIP between 1980 and 2000, but its air traffic only doubled over the same period. This reflects the limits of the Air Transportation Infrastructure. As Boston Logan International Airport (BOS) reached saturation, traffic increased at regional airports in Manchester, New Hampshire (MHT) and Providence, Rode Island (PVD). For example New Hampshire had low population and high PCIP growth, but an unusually high traffic increase of over 2,300 percent. When these states were grouped together to account for the regional the growth of air travel fell in line with the national average. Regional effects can also explain the other states with anomalously high air traffic growth—with Baltimore, Maryland (BWI) supporting the Washington DC-Northern Virginia region and Newark, New Jersey (EWR) supporting the New York city market.

While this analysis illustrates how the regional influence of air transportation infrastructure stretches across state borders, it also shows some evidence that the air transportation is related to the location of economic growth.

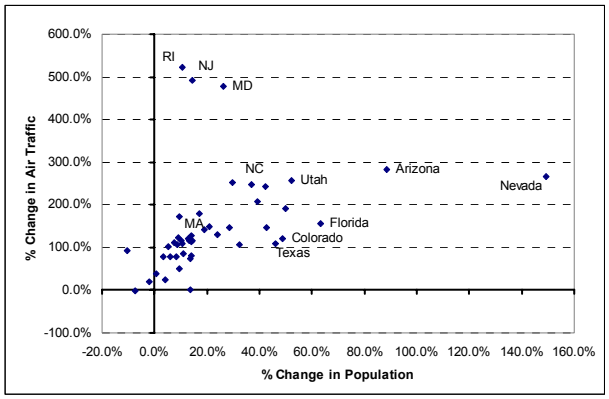

Figure 7: Change in state population vs. air traffic, 1980-2000. *Source: US BEA REIS and DOT 10% coupon data.*

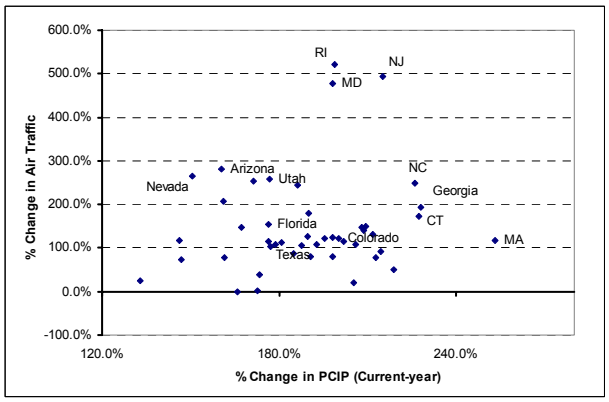

Figure 8: Change in per capita personal income vs. air traffic. *Source: US BEA REIS and DOT 10% coupon data.*

Changes in the characteristics of Air Travel

To more closely examine the changes in the use of air transportation, survey data on long-distance travel was examined. The data was collected from a periodic personal travel survey conducted by the US Department of Transportation.[6]

Figure 10 shows the rapid rise in the reported number of long distance (greater than 100 miles) trips by air. While overall long-distance air travel has gone up, the ratio of work to non-work trips has also changed. In 1972, less than 40 percent of trips were taken for non work-related purposes, but this had increased to 70 percent by 1990.

The increase in the number of non-work related trips indicates that the role of the air transportation system

has changed since deregulation. The enhanced connectivity and accessibility of the air transportation system appears to have enabled air transportation to be more fully integrated into the social fabric of the nation. The availability of cheaper airfares and frequent service made it easier for people to relocate for economic or other opportunities while still maintaining close relationships with family and friends.

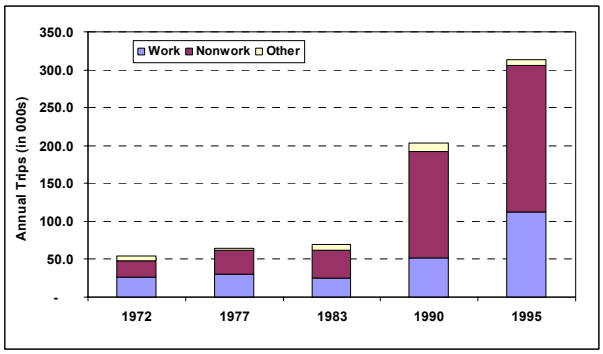

Figure 9: Growth in Long-distance trips by airplane, 1972-1995. *Source: US DOT NPTS.*

CHANGES IN THE AIRLINE INDUSTRY AFTER DEREGULATION

Two of the major changes in the airline industry after deregulation included the implementation of hub-and-spoke route networks and yield management systems. An analysis of these changes was conducted to investigate how airline business practices have influenced the social and economic trends seen previously.

Development of Hub-and-spoke Networks

To more closely look at the impacts of airline hubs, an analysis of the growth at one airport was conducted. During 2001, Atlanta's Hartsfield International Airport was the busiest airport in the world in terms of enplanements (75.8 million passengers), and the second busiest in terms of aircraft operations (890,000 movements). As shown in Figure 10, Atlanta is a large transfer hub for Delta Airlines and its regional affiliates. They operated 850 flights per day to 133 destinations in the contiguous United States on an average day during Summer 2000; flights to and from Atlanta accounted for 40 percent of the Delta's entire domestic operations.

To show the evolution of the hub and the growth of the highly connected hub-and-spoke bank structure, OAG flight schedule data for all carriers at Atlanta was analyzed at selected intervals between 1965 and 2000. Figure 11 illustrates the evolution of the banking structure using a histogram of scheduled flight arrivals in 15-minute increments throughout the day.

The plot for an average day in 1965 shows a concentration of scheduled flights around the mid-morning and late afternoon periods. In 1978, the development of the bank structure is already starting to be evident. The banking structure can be identified in the 1986 analysis by the high peaking of flights—between 25 and 40 flights per 15-minute period, although the presence of two major airline hubs (Delta and Eastern) shows the effect of competition at that time. The full nine-bank structure had been clearly developed by 2000.

The concentration of scheduled flight arrivals into narrow time windows is indicative of a high level of coordination to minimize scheduled travel time. Hub-and-spoke service patterns also enabled airlines to consolidate discrete levels of demand and offer more frequent services. These increases in connectivity presumably enabled people to better incorporate travel into their business and social activity patterns. It is thought to have influenced the changes in population distribution and other economic activities.

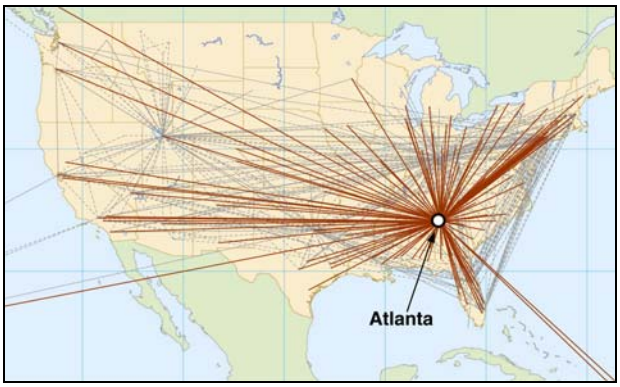

Figure 10. Delta's domestic route network in the Summer 2000, with the Atlanta hub indicated. *Source: OAG data.*

Yield Management

The impact of yield management practices was analyzed at the industry level by looking at historical data on airline revenue and traffic. Airline yields (the average price paid per mile) were examined using constant (1978) dollars in order to account for inflation.

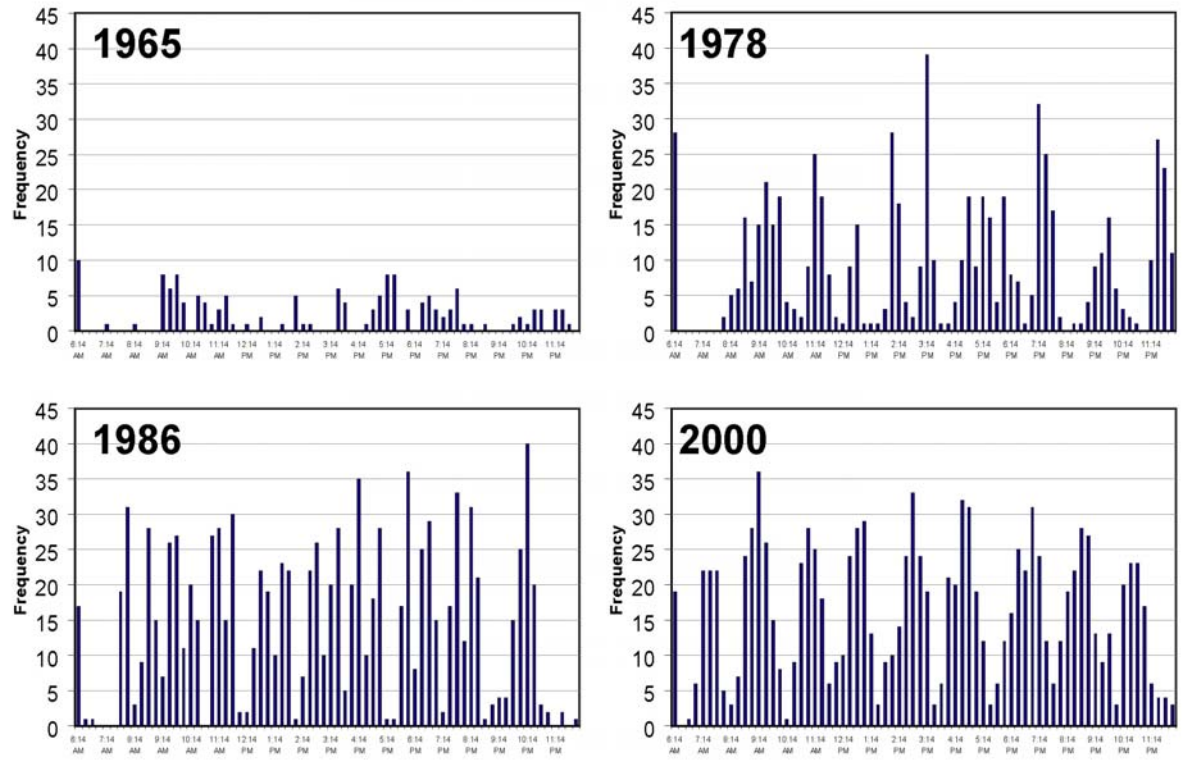

Figure 11: Evolution of hub-and-spoke service pattern at Atlanta, 1965-2000. Histogram shows scheduled nonstop arrivals for all airlines within 15-minute periods on an average summer weekday. *Source: Official Airline Guide data.*

Figure 12 shows that the average yield has been continually declining since the 1960s, although this decline slowed in the 1990s. At the same time, Figure 13 shows that the average system load factors increased from about 60 percent in 1978 up to 72 percent in 2000. This indicates that on average, airplanes had more seats filled and were thus generating more revenue per flight.

Yield management has been largely responsible for the increasing load factors by enabling airlines to use a spectrum of fares to stimulate travel demand. By enabling airlines to sell-off excess seat inventory while maintaining the revenue from passengers willing to pay higher fares, yield management systems contributed to airline profitability. However, in the late 1990's, yield management practices became more aggressive—driven in part by the strong economy and investor expectations. The spread between highest and lowest fares has increased to unprecedented levels in recent years, however, and these historically high load factors have contributed to operational and consumer satisfaction problems.

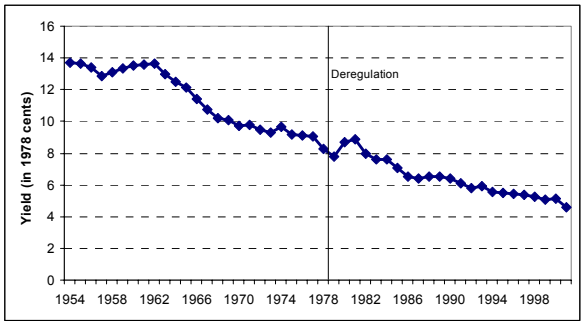

Figure 12: Decline in average industry yields (constant 1978 dollars). *Source: ATA data.*

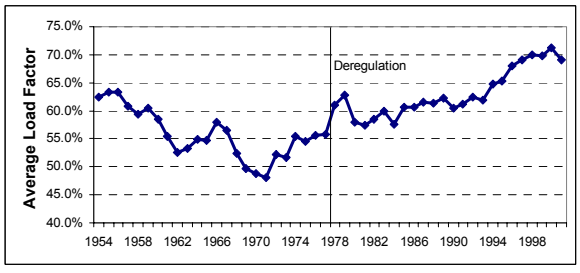

Figure 13: Average domestic load factors. *Source: ATA data.*

INDUSTRY CHALLENGES SINCE 9/11

The softening of demand both prior to and after 9/11, coupled with the economic and operational shocks that occurred in the wake of the terrorist attacks, have created unprecedented challenges for the domestic and international airline industry. These will be discussed briefly in this section.

Airline Profitability

As discussed above, the demand for air transportation is strongly correlated with the overall economic situation. As a consequence, the profitability of the industry has historically been cyclic. This can be seen in Figure 15, which depicts the US Airline Industry net profits/losses (in current-year dollars). Since deregulation in 1978, the industry has exhibited an exponentially growing oscillatory profit/loss behavior.

In the four quarters following the 9/11 attacks, the three largest US carriers collectively lost over $5.3 billion dollars.[7] Figure 16 shows the reported quarterly statements for three major US airlines (America, Delta, United) as well as Southwest Airlines. For the major airlines, losses began in the third and fourth quarters of 2000, and this reflected the softening economy. The losses for the major carriers increased significantly after the 9/11 attacks even after the $5 billion dollars in cash infusions from the Air Transportation Stabilization Board that were intended to cover the costs of the national system shutdown. In marked contrast, Southwest Airlines was one of the only major carriers to remain profitable following the events of 9/11.

While US carriers have experienced losses during periods of recessions, the magnitude of the current losses for the major carriers (excluding Southwest) is clearly unprecedented. The coupling of the normal cyclic behavior with the post 9/11 shock has put the industry in a period of extreme loss. The current loss rate is about $8 billion dollars per year.

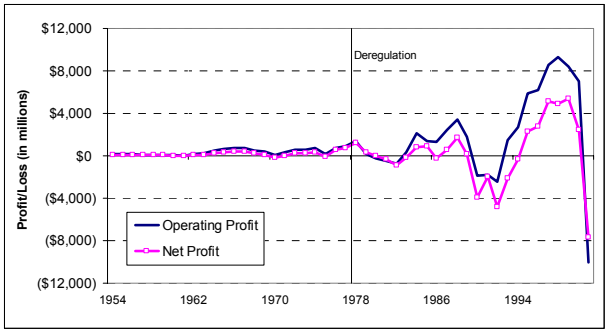

Figure 15: Annual Profit and loss of Domestic US Carriers. *Source: ATA data.*

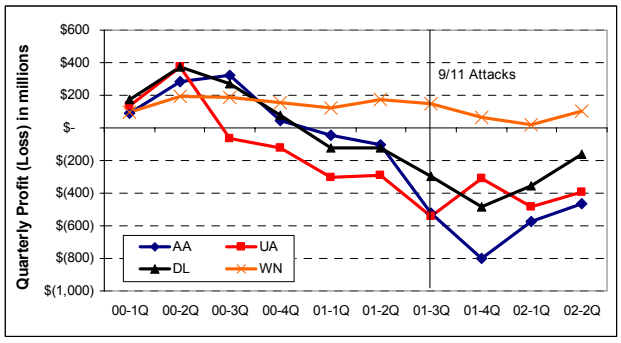

Figure 16: Recent profits of the three largest US carriers and Southwest. *Source: ATA data.*

Post 9/11 Recovery

The cash infusion and industry loans being provided as part of the 2001 Aviation and Transportation Security Act were designed to recover some of the costs and loss of revenue associated with the shutdown of national airspace after 9/11. Figure 17 shows a notional representation of possible recovery trajectories that could apply to individual airlines or the industry as a whole.

Figure 17 shows the unit revenue in Revenue per Available Seat Mile (RASM) and unit costs in Cost per Available Seat Mile (CASM) over time. Prior to 9/11, RASMs were trending down due to softening demand and yields, while CASMs were trending upwards due to increased labor costs, increased fuel costs, debt burden and other operational costs. During the period between 9/11 and 9/13, no revenues were received due to shutdown of US airspace. When operations resumed, the CASMs were higher due to a number of factors, including increased security and insurance costs. RASMs were down significantly due to shaken public confidence in air travel.

Figure 17 illustrate three potential recovery trajectories following 9/11. In the *Quick Recovery* trajectory, the

RASMs recover quickly and the carrier returns to profitability. Southwest Airlines appears to have followed the *Quick Recovery* trajectory. The remainder of the major US air carriers appears to either be on the *Slow Recovery* or *Insolvency* trajectories, as their RASMs have not recovered to match their increased CASMs.

Figure 18 illustrates that while the domestic ASMs initially dropped about 15 percent after 9/11, the system-wide capacity in August 2002 was still about 7.5 percent below the previous year. Figure 19 shows that the passenger RPM traffic is also down about 7.3 percent. Figure 20 shows that average load factors during 2002 have been restored to previous levels. It appears that revenue management systems and capacity reductions have been successful at restoring load factors to pre-9/11 levels. The continuing losses in the airline industry, however, show that the nature of the revenues has clearly changed.

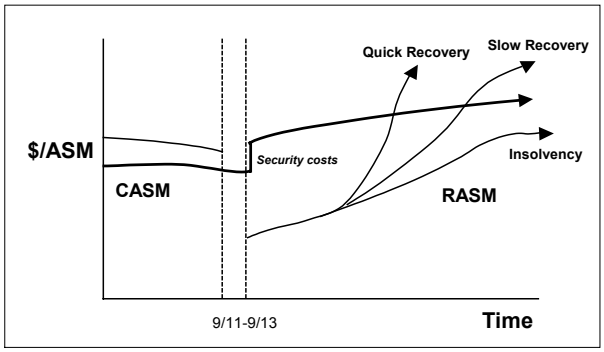

Figure 17: Potential industry recovery trajectories after 9/11.

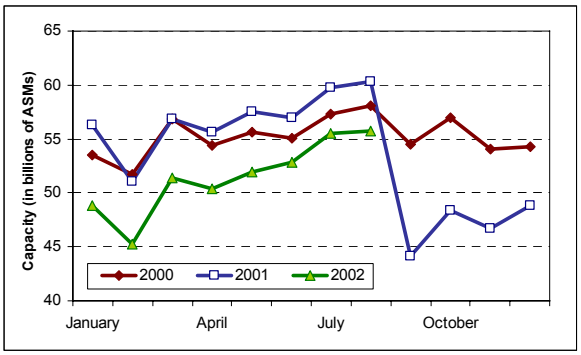

Figure 18: Domestic capacity, 2000-2002. *Source: ATA data.*

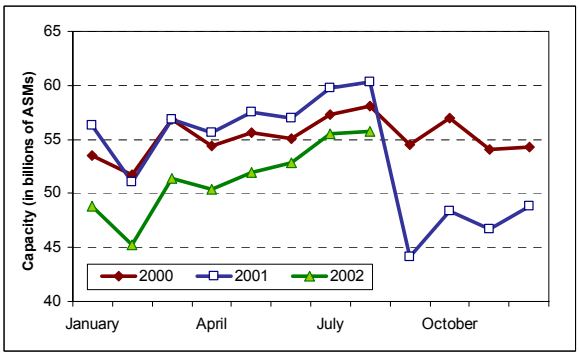

Figure 19: Domestic traffic, 2000-2002. *Source: ATA data.*

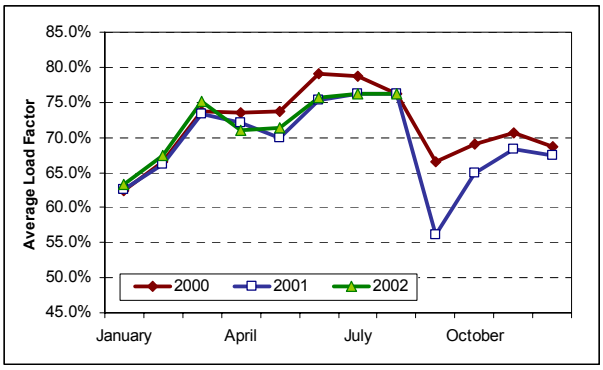

Figure 20: Domestic average load factors, 2000-2002. *Source: Airline financial reports.*

Investor Confidence

The investment capital markets have recognized that the major US network airlines are on the *Slow Recovery* or *Insolvency* trajectories, while the low cost carriers such as Southwest and JetBlue are on the *Quick Recovery* trajectories. This is reflected in Figure 21, which shows that Southwest Airlines market capitalization was greater than the rest of the industry combined and that JetBlue had a valuation 10 times greater than that of United Airlines.

Figure 22 shows the resulting imbalance in relative market share and market capitalization. Southwest has over 50% of the market capitalization but only abut 10% of the market share. Conversely American, United, and Delta have among the largest traffic shares, but some of the lowest market capitalization. This indicates that a significant share of the national air transportation lift capacity is at severe financial risk.

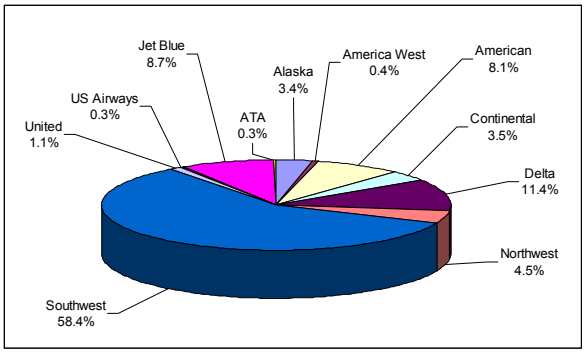

Figure 21: Market capitalization of the US major airlines plus JetBlue and ATA on September 4, 2002. *Source: Yahoo! Finance data.*

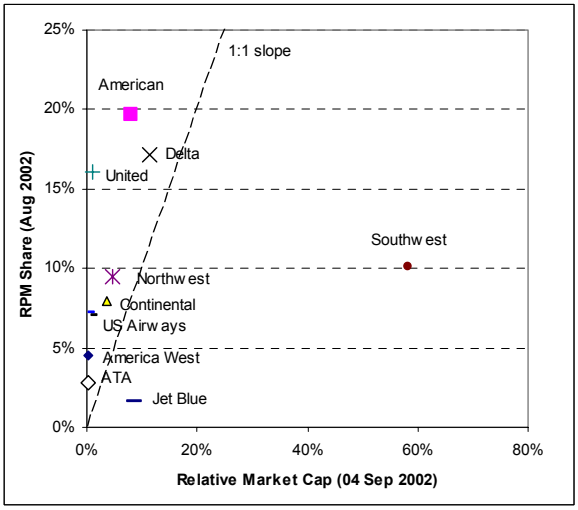

Figure 22: Market Share vs. Market Cap. *Source: Yahoo! Finance data and airline news releases.*

KEY QUESTIONS FOR THE AIRLINE INDUSTRY

As discussed above, the US economy and social structure has evolved to depend on a high quality air transportation system with a high-density network and a spectrum of fares that makes air travel accessible to a broad market. The slow recovery of much of the industry after 9/11 has raised a number of key questions for the industry and the nation.

Industry Structure

How the overall structure of the US airline industry will evolve is a key question. While low cost carriers are doing well, they generally operate limited route networks and rely less on market segmentation than the major network carriers with large hub and spoke networks. If some of the financially stressed major carriers fail, one major question is how this would affect the overall industry structure and business models.

Changes in the Revenue Paradigm

While air traffic after 9/11 has largely been restored, the downshift in revenues still threatens the industry as a whole. Traditional market segmentation assumptions are failing; the existence of low-fare competition on the most profitable markets and the dominance of low-yield, non work-related travel appears to make it extremely difficult to increase revenues to more sustainable levels. Pressure from the low-cost, limited network carriers is forcing the major network carriers away from pricing strategies that reflect the value of the network. If the strong networks that support the national economy and quality of lift are to remain intact, a new revenue paradigm is clearly necessary.

Reductions in Operating Costs

The expanding presence of low-cost carriers continues to exert pressure on the major network carriers to reduce their operating costs. More fuel-efficient airplanes, optimized scheduling, reduced ticket distribution costs, and other technological improvements have improved airline productivity since deregulation. Labor remains one area that distinguishes the low-cost carries with the US majors, yet it typically only accounts for 33% to 40% of the total operating costs.

One strategy is to preserve existing hub networks, but to make them more efficient by transforming traditional hubs with rolling bank schedules and replacing larger aircraft with regional jets. Rolling bank systems enable greater aircraft and gate utilization. Figure 23 shows the shift that American Airlines has made at Dallas-Ft. Worth from a highly peaked banking structure to a rolling bank. American Airlines estimates that it will gain the equivalent of 17 new aircraft through scheduling efficiencies in this structure and also gains in labor and gate costs.[8] However, these operational efficiencies come at the cost of increased passenger travel times and may reduce the effective connectivity in some city-pair markets. It is also worth noting that the rolling banks are less susceptible to major interruptions due to weather or ATC delays, and could result in additional operational cost savings.

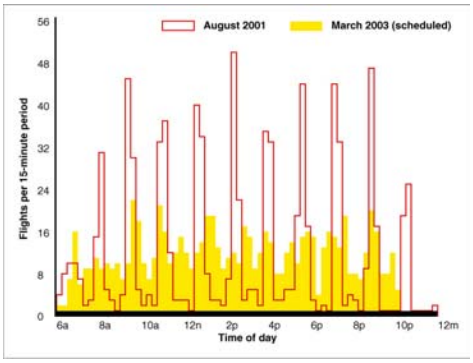

Figure 23: American Airlines conversion to a rolling bank schedule at Dallas-Ft. Worth. *Source: American Airlines electronic timetable data.*

Impact on Small Markets

One of the major questions in the potential restructuring of the airline industry is the impact on small markets. If the major network carriers cannot price in a manner to reflect the value of the high-density networks, then the level of service to small markets will drop significantly.

Airline networks were generally preserved immediately after 9/11, although some cities received reduced frequencies or down-gauged equipment to regional jets. When system-wide capacity was cut by 20 percent after 9/11, many hub and spoke network carriers simply eliminated the last bank of flights in lieu of cutting service to cities. Some airlines did discontinue service at smaller airports with little contribution to total network revenue, although these communities generally have retained access to air service at nearby airports.

As carriers begin to enter Chapter 11, it is likely that service to small markets will be lost or that a significant premium will be necessary to retain service. What is also unprecedented, however, is that a significant fraction of the national air transportation lift capacity is at risk. The business failure of a large network carrier, for example, could result in a reduction in the national air transportation capacity of up to 20 percent. With airline average load factors already at historically high levels, the system would have little capacity to pick up the slack. While such a capacity reduction may be absorbable at the national level, it could have severe impacts at the local level. There are many cities that are only served by one or two carriers, and the transportation capacity in these markets could be particularly vulnerable to service cutbacks.

Government Intervention

One of the major questions which faces the industry is the proper role of the government. Because the Air Transportation System is a fundamental component of the national transportation infrastructure, the government cannot allow the industry to fail at a systemic level. However, the appropriate role for the government is unclear. In addition, it does not appear that the loan guarantees provided by the Air Transportation Stabilization Board have been effective at stabilizing the industry and may have actually had an adverse effect by keeping yields down in some markets.

While a free market approach would eventually reach equilibrium in the face of multiple carrier failures or cutbacks, there would be major service disruptions due to operational difficulties in shifting aircraft and labor resources between carriers. In addition, the market will tend to concentrate resources on the most profitable markets and reduce or eliminate service to weak markets. This is likely to cause political pressure for government action.

CONCLUSION

This paper has identified some of the key relationships between the economy and the air transportation system while focusing on the close interrelationship between the airline industry and the supply/demand of air transportation. The dramatic increase in the use and characteristics of air travel since deregulation suggests that the nation has evolved to have a strong dependence on the air transportation system for regional economic and social connectivity.

The US airline industry is facing a period of unprecedented stress due to the softening of demand and the operational impacts of 9/11. Most major US carriers have been unprofitable over the past year with little expectation of profitability in the near future. These stresses are forcing a major restructuring of the industry, and the end state is unclear. Much of the US air transportation lift capacity is at risk. The magnitude and strategic ramifications of major changes in the Air Transportation System to the national economy and social quality of life would indicate that some government intervention is likely to occur.

ACKNOWLEDGEMENTS

The authors would like to thank Nida Rizwan Farid, Aleksandra L. Mozdzanowska, Ian Garrick-Bethell, and

Suzanne San Guliano for their help with data plots and analysis. The authors are also grateful to the Alfred P. Sloan Foundation for the sponsorship of this project under the MIT Global Airline Industry Project (http://web.mit.edu/airlines).

REFERENCES

Air Transport Association. *Annual Passenger Prices (Yield), US Scheduled Airlines*. Washington: ATA, September 4, 2002. Available on-line from: http://www.airlines.org/

Air Transport Association. *Annual Traffic and Capacity: US Scheduled Airlines*. Washington: ATA, September 4, 2002.

Air Transport Association. *Monthly Passenger Traffic Report – Scheduled Service Only*. Washington: ATA, September 13, 20002.

AMR Corporation. *American Airlines Electronic Timetable.* Forth Worth, Texas: American Airlines, 2001-2002.

Official Airline Guides. Secaucus, NJ: Reed Travel Group, 1965-2002.

US Bureau of Economic Analysis, *Regional Economic Information System:1969-2000*. Washington, DC: US GPO, 2002.

US Census Bureau. *1972 Census of Transportation.* Washington: GPO, 1974.

US Census Bureau. *1977 Census of Transportation: National Travel Survey.* Washington: GPO, 1979.

US Department of Transportation Bureau of Transportation Statistics, *Historical Air Traffic Statistics, Annual 1954-2001*. Washington: BTS, 2002. Database on-line. Available from: http://www.bts.gov/oai/indicators/top.html

US Department of Transportation Bureau of Transportation Statistics. *National Transportation Statistics 2001*. Washington: US GPO, July 2002. Database on-line. Available from: http://www.bts.gov/publications/nts/index.html

US Department of Transportation, Federal Highway Administration. *Nationwide Personal Travel Survey: 1977-1995.* Washington: GPO.

NOTES

[1] J. Robins Tucker. "Economic Impact of Civil Aviation on the US Economy 2002: Interim Results." Powerpoint. Federal Aviation Administration. Air Traffic Control Association Conference. July 9, 2002.

[2] Direct impacts are those from the airlines and other primary business in the air transportation system. Indirect impacts are those from businesses such as hotels or car rental services that are associated with air travel. Induced impacts come from the subsequent rounds of spending from the households employed directly or indirectly by the aviation industry.

[3] The impact of non-revenue travel such that related to frequent flyer programs was not studied.

[4] Only ATA US member airlines are included (Aloha, Alaska, America West, American, American Trans Air, Continental, Continental Micronesia, Delta, Hawaiian, JetBlue, Midwest Express, Northwest, Southwest, United, and US Airways).

[5] These analyses excluded Alaska and Hawaii due to their reliance on air travel. Delaware and Idaho were excluded due to a lack of good data.

[6] It should be noted that in 1983, the sample size of the survey was drastically reduced and may have affected the results for that year.

[7] Tucker, 2002.

[8] AMR Corporation, *American Unveils Next Set of Fundamental Business Changes,* Press Release. August 13, 2002. http://www.amrcorp.com/news/