Mixed Optimization: Diagnosis and Proposed Solution for Several Problems in the Airline Industry

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MIXED OPTIMIZATION: DIAGNOSIS AND PROPOSED SOLUTION FOR SEVERAL PROBLEMS IN THE AIRLINE INDUSTRY

JESSE HERCULES*

I. INTRODUCTION

THE PURPOSE of this paper is to describe several interrelated problems in the airline industry, explore economic and legal causes, and propose a solution using federal aviation, antitrust, and bankruptcy laws.

The airline industry has been plagued with bankruptcies. Since 1978, there have been 162 airline bankruptcies, and four recent airline bankruptcies are among the largest corporate bankruptcies ever. The United States Government Accountability Office reports that “[b]ankruptcy is endemic to the airline industry,” but that airlines have had “mixed results in reducing costs while under bankruptcy.”

Ticket prices tend to “frustrate consumers because they appear to be neither predictable nor rational.” Consumers face large differences in price based on “day of travel, time of day, and a variety of other factors, all of which are subject to frequent change.” Additionally, airline flights are often delayed—in

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1 U.S. GOV’T ACCOUNTABILITY OFFICE, COMMERCIAL AVIATION: BANKRUPTCY AND PENSION PROBLEMS ARE SYMPTOMS OF UNDERLYING STRUCTURAL ISSUES 3 (2005) [hereinafter GAO BANKRUPTCY].

2 Id. at 2.

3 Id.


5 Id.
2000, more than a quarter of airline flights arrived at least fifteen minutes late. Although a cyclical decline in air traffic has reduced delays, long-term traffic predictions suggest that congestion will soon return. Since it typically takes ten to twenty years to plan, get regulatory approvals, and construct a new runway at a major airport, our airports cannot easily add capacity to meet demand.

These problems are the result of a clash of two completely different business models within the airline industry: the linear model and the hub-and-spoke model. The linear model, exemplified by low-cost carriers like Southwest, has a large cost advantage. The hub-and-spoke model, exemplified by legacy airlines like United, gives an airline the ability to charge high prices when it dominates a hub. This clash of business models—one based on cost control and one based on pricing power—leads to problems of serial bankruptcy, irrational pricing, and needless congestion.

Several federal laws have shaped and contributed to the economic problems in the industry. The Civil Aeronautics Board ("CAB") price and route regulations prior to 1978, combined with the Taft-Hartley Act authorizing collective bargaining, burdened legacy carriers with high wages and benefits they

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8 Challenges Associated with Building New Runways: Hearing Before the Subcomm. on Aviation of the Comm. on Transportation and Infrastructure, 106th Cong. 13 (2000) (statement of John J. Duncan, Jr., Subcomm. Chairman) (Detroit began planning for two new runways in the mid-1980's. One was completed in 1993, but the other is not expected until the end of 2001. Cincinnati started work on a new runway in 1992, but it won't be completed until 2005. Orlando expects its fourth runway to be completed in 2003, 15 years after the FAA first approved it.).

9 GAO Profit, supra note 7, at 24 (explaining that in 2003, "'legacy airlines' unit costs were 67% higher" than low-cost carrier unit costs).

10 Office of the Assistant Sec'y for Aviation & Int'l Affairs, U.S. Dep't of Transp., Domestic Aviation Competition Series: Dominated Hub Fares 2 (2001) [hereinafter Hub Fares] ("In dominated hubs as a whole, 24.7 million passengers pay on average 41% more . . . ").

11 GAO Profit, supra note 7, at 4 ("Similar to other highly regulated industries, the airline industry was heavily unionized . . . ").
could no longer afford after deregulation. Legacy airlines turned to Chapter 11 of the Bankruptcy Code to level the playing field. In bankruptcy, the airlines can reject aircraft leases, terminate pensions, reject labor agreements, reject contracts already signed, and pay pennies on the dollar to unsecured creditors. However, legacy airlines still have not closed the cost gap because even in bankruptcy they have been unable to escape the high-cost hub-and-spoke business model. The major airlines have not found a way to fill their largest and most efficient aircraft except by using the inefficient hub system to generate connecting traffic.

The competition between linear and hub airlines follows a pattern: the linear airline adds routes through a legacy airline's "dominated hub" airport while the legacy airline attempts to defend its hub using predatory pricing. If the linear carriers are successful in gaining market share, the legacy airline loses pricing power and profitability at the hub. When a legacy airline loses enough pricing power at enough of its hubs, it files Chapter 11 bankruptcy and retrenches to its strongest remaining hubs. This competitive cycle benefits neither the legacy a-

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12 Id. at 27 ("Labor costs accounted for over 40 percent of the unit cost difference between legacy airlines and low cost airlines in 2003.").
13 GAO BANKRUPTCY, supra note 1, at 59 ("Bankruptcy has become a well-traveled path by which some legacy airlines are seeking to shed some of their costs and become more competitive.").
14 11 U.S.C. § 1110 (2006) (giving airlines a sixty day window to decide whether to reject aircraft leases and preventing creditors from repossessing aircraft during that time).
15 GAO BANKRUPTCY, supra note 1, at 10 ("With the approval of the bankruptcy courts . . . companies may also modify retiree benefits.").
17 See id. § 1123 (2006) (allowing bankruptcy plans to include rejection of executory contracts).
18 Id. (allowing bankruptcy plans to impair unsecured claims).
19 GAO PROFIT, supra note 7, at 24 ("Legacy airlines, as a group, have been unsuccessful in sufficiently reducing their costs to make them more competitive with low cost airlines.").
20 Id. at 26 (listing the low asset utilization caused by the hub-and-spoke model as a major cause of the cost gap).
22 HUB FAres, supra note 10, at 1 (explaining that passengers at a dominated hub pay 41% more on average than passengers flying in hub markets with low-fare competition).
23 U.S. DEP’T OF TRANSP., IMPACT OF AIR CARRIERS EMERGING FROM BANKRUPTCY ON HUB AIRPORTS, AIRPORT SYSTEMS AND U.S. CAPITAL MARKETS 12 (2003) [here-
lines nor the consumers who continue to pay higher prices at
dominated hubs. The hub-and-spoke system also creates peri-
ods of peak congestion and delays at airports, so the survival of
hubs is costly to travelers facing delays as well as to taxpayers
funding new runways and terminals.

This paper proposes using federal aviation antitrust laws to
implement a new model of competition called mixed optimization.
Under mixed optimization, a consumer is able to buy air-
line transportation from different carriers on different legs of a
trip without a cost penalty. The consumer's bags would be in-
terchanged from one airline to another as needed. This combi-
nation of features would increase consumer choice and result in
more effective price competition. But this method would also
benefit the industry. By increasing the amount of potential con-
necting traffic at each airport, it offers legacy airlines a way to fill
large aircraft without the hub-and-spoke system. Linear carriers
will not be confined to high-density routes because many of
their customers will connect to legacy and regional airlines' 
flights. The peak traffic congestion associated with hubs will dis-
appear, reducing delays and capacity problems.

II. TWO BUSINESS MODELS FOR AIRLINES

There are two predominant business models today in the U.S.
airline industry. The legacy airlines and their regional code-
sharing partners adopted the hub-and-spoke model, which has
higher costs but allows them to charge higher prices when they
have dominant market share at a hub or a spoke. The low-cost
carriers adopted the linear model, which offers low costs due to
high asset utilization and labor productivity.

A. THE HUB-AND-SPOKE MODEL

The legacy airlines adopted the hub-and-spoke model in the
1980s, soon after deregulation. A route structure with a single
hub and many spokes would look like a bicycle wheel. The leg-
acy airlines each have several interconnected hubs within the
continental United States.\textsuperscript{25}

\begin{footnotesize}
\begin{itemize}
  \item inafter Hub Airports] ("Airports that are secondary hubs of financially weak air carriers . . . are generally more vulnerable than are primary hubs . . . during periods of retrenchment.").
  \item Mayer & Sinai, supra note 6, at 1195 ("[H]ub carriers often choose to cluster their flights at periodically spaced 'hubbing times' . . . at the cost of higher congestion.").
  \item Hub Airports, supra note 23, at 12.
\end{itemize}
\end{footnotesize}
There are three advantages to the hub-and-spoke model. First, the dominant airline at a hub (which is often also dominant at the spoke) has considerable market power and the ability to charge higher prices.\textsuperscript{26} The Department of Transportation ("DOT") has concluded that 24.7 million passengers at "dominated" hubs pay an average of 41% more than passengers at airports with price competition from low-cost competitors.\textsuperscript{27} The passengers at the "spokes" pay even more—DOT estimates that they pay 54% more than passengers at airports with price competition from low-cost competitors.\textsuperscript{28} The DOT study concludes that there is no quality of service justification for the higher fares.\textsuperscript{29}

Second, a continent-wide network of hubs and spokes allows a single airline to provide service from "anywhere to everywhere."\textsuperscript{30} In mathematical terms, "[j]ust one new round-trip flight from a hub where an airline already connects to $N$ cities will create $2N$ additional connecting routes" and thus "the number of potential connections grows exponentially . . . ."\textsuperscript{31} However, this advantage also creates a barrier to competition. By discounting connecting travel, raising prices for single-leg travel, and refusing to interchange bags, a network airline can prevent other airlines from effectively competing for any one leg of a connecting trip.

The third advantage of hubs is the ability to funnel passengers onto large aircraft for long-haul trips. Cost per seat-mile tends to decline as aircraft size increases.\textsuperscript{32} Cost per seat-mile also decreases as the (nonstop) length of the trip increases.\textsuperscript{33} Because a legacy airline can generate so much connecting traffic at a hub, it can fill a large aircraft like a Boeing 747-400 for long-
haul trips across the country (or across an ocean) at a low cost per seat-mile. However, this potential cost advantage is offset by the costs incurred in bringing connecting traffic into the hub.

The hub-and-spoke model also has three disadvantages. First, hubs cause artificial congestion. Like the roadways used by commuters, a hub airport has its own version of rush hour. As Mayer and Sinai explain, “hub carriers often choose to cluster their flights at periodically spaced ‘hubbing times’ to create the greatest variety of passenger destinations[,] but these convenient connections come at the cost of higher congestion.”\(^3\) As a result, they find that “hub airports will have more traffic and greater delays than non-hub airports of equivalent size and with equal local demand.”\(^35\)

Second, hubs cause low asset utilization. An airplane asset is ‘utilized’—making money—when it is flying, not when it is sitting on the ground. The congestion and delays caused by the hub model cause the legacy airlines to have significantly lower asset utilization than their linear model competitors.\(^36\) The aircraft all descend on the airport at the same time, and then sit and wait for the passengers and bags to transfer for the outbound trip. Since the “clock” is always running on aircraft loans or leases, the airline loses money when its planes are not in the air.

The third disadvantage is low labor productivity at hub airports.\(^37\) While the airplanes are all in the air, the labor force is under utilized. When the aircraft all arrive at the same time (and sit un-utilized), then the labor force can be productive in loading, fueling, towing, and de-icing the planes. It is only a slight exaggeration to say that either the airplanes are productive and the workforce is sitting around, or the workforce is productive and the airplanes are sitting around.

The hub-and-spoke model has been expanded through the use of code-sharing. In a code-sharing arrangement, two airlines each agree to let the other sell tickets for its flight and

\(^{34}\) Mayer & Sinai, supra note 6, at 1195.

\(^{35}\) Id. at 1197.

\(^{36}\) GAO PROFIT, supra note 7, at 28-29 (“[B]ecause legacy airlines generally operate a hub-and-spoke business model, they are not able to operate their aircraft for as many block hours per day as low cost airlines. . . . [T]hey continue to trail low cost airlines with respect to asset utilization trends.”).

\(^{37}\) Dempsey, supra note 21, at 692 (“Though hubbing increases costs by lowering . . . labor utilization . . . airlines have been attracted by their revenue enhancement potential.”).
agree on bag-exchange procedures.\textsuperscript{38} Therefore, a consumer can buy a ticket from one airline for a trip that uses two airlines’ route networks. The most common example is a consumer who buys a ticket from a “major” airline, but actually uses a separate regional airline for a leg from a small airport to a hub. A consumer who buys a ticket from United and rides in a small turbo-prop labeled “United Express” may be surprised to learn he is actually riding on a Great Lakes Airline flight.\textsuperscript{39} However, legacy carriers sometimes code-share with each other\textsuperscript{40} or with a foreign carrier, such as the Northwest/KLM code sharing agreement on flights from the United States to Europe.\textsuperscript{41}

Although code-sharing would seem to offer more choices to consumers, “[c]arriers with a code-sharing agreement at one of the airports on a route charge fares almost 8\% higher than carriers do on routes on which they do not code share.”\textsuperscript{42} Legacy airlines will refuse to code-share with low-cost carriers.\textsuperscript{43} Therefore, selective code-sharing can be a means for legacy airlines to concentrate market power and prevent low-cost airlines from competing for connecting traffic.

\textbf{B. The Linear Model}

Southwest and the new low-cost airlines that have appeared since deregulation use a linear model instead of a hub-and-spoke model.\textsuperscript{44} The linear route structure often looks very

\textsuperscript{38} Id. at 695.
\textsuperscript{39} Id. at 758 (“Code-sharing is a way of defrauding consumers into believing they will be flying a megacarrier’s jets, when on most occasions they are funneled onto a smaller carrier’s turboprop aircraft at the hub, all in a deliberate attempt to steer feed traffic away from jet competitors.”).
\textsuperscript{40} Northwest Airlines Global Alliance Partners, http://www.nwa.com/corpinfo/allia/ (last visited Mar. 31, 2006) (showing that Northwest, Continental, and Delta are code-sharing on certain routes).
\textsuperscript{41} Id.
\textsuperscript{42} Dempsey, supra note 21, at 697 (quoting \textit{Airline Competition Enhancement Act of 1989: Hearing on S.1741 Before the Subcomm. on Aviation of the Comm. on Commerce, Science, and Transportation,} 101st Cong. 253 (1990) (statement of Kenneth M. Mead, Director, Government Accountability Office Transportation Division)).
\textsuperscript{43} Dempsey, supra note 21, at 756 (explaining that Frontier Airlines, a low-cost carrier, wanted to code-share with United in order to generate enough traffic to support jet service to smaller cities in the Great Plains area. United Senior Vice President Rakesh Gangwal refused, saying, “Frontier is a low-cost provider. United can never be a low-cost provider. Therefore, we think of you as the enemy.”).
\textsuperscript{44} GAO PROFIT, supra note 7, at 5 (“Low cost airlines entered the marketplace after deregulation and primarily operate point-to-point service from ‘focus cities’ using fewer types of aircraft.”).
much like a bus or train route structure—a straight line with stops along the way. In other cases, the linear structure takes the form of point to point service—an aircraft flies back and forth between city pairs.

The linear model is highly efficient from an asset and labor utilization perspective. Flights are more likely to arrive and depart on time, since they are scheduled to arrive at scattered times rather than all at once. Aircraft on the ground can be fueled, loaded, and sent back out quickly—they are not waiting for other flights with which to "hub." Labor productivity is higher since work is spread evenly throughout the day.

Passengers flying linear model airlines have fewer delays for the same reasons explained above. However, the scheduled layover for a linear model passenger will be longer because flights are scattered throughout the day instead of clustered. In mathematical terms, the median trip length (except for non-stops) will be longer, but the variance will be less.

Airlines using the linear model have tended to operate fewer models of aircraft, producing crew training and maintenance savings. Linear model airlines, for example Southwest and JetBlue, tend to operate mid-sized aircraft rather than aircraft at either end of the size spectrum. Linear model airlines do not

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45 Dempsey, supra note 21, at 692 ("[H]ubbing increases costs by lowering aircraft, gate, and labor utilization and increasing fuel consumption . . . .").
46 Mayer & Sinai, supra note 6, at 1195 ("Non-hub carriers . . . have no incentive to cluster flights at the same peak hubbing times and thus will incur fewer delays than the hub carrier.").
47 GAO PROFIT, supra note 7, at 29 ("Low cost airlines typically operate a point-to-point business model that allows them to limit the amount of time a plane must spend on the ground from the time it lands until it is ready to take off again.").
48 Id. at 27 ("Low cost airlines have been effective at keeping unit labor costs down by achieving higher labor productivity . . . .").
49 Mayer & Sinai, supra note 6, at 1197 (explaining that in "the extreme case . . . [an] airline minimizes congestion costs by scheduling a uniform number of arrivals and departures throughout the day. That strategy produces the longest connection times . . . .").
50 GAO PROFIT, supra note 7, at 28 ("[L]egacy airlines usually have more types of aircraft in their fleets, adding to maintenance costs and pilot training costs.").
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offer intercontinental ocean-crossing flights, and therefore have less need for large, long-range aircraft.

Linear model airlines tend to offer a simplified fare schedule. This is possible because their business model is based on low costs rather than on pricing strategy. Passengers who book within two weeks of travel, or who change their schedules, do not face large price penalties.

Linear model airlines typically have offered service on high-density routes. This allows them to expand without the need to offer a network of hub-and-spoke connections. For example, the way to attract the most passengers if an airline is only serving two cities is to pick two cities with a lot of passengers traveling between (not connecting through) the cities. This strategy makes sense because legacy airlines’ pricing and bag-interchange practices prevent the linear airlines from competing on just one leg of a connecting trip. But this strategy limits their expansion to high-density routes only.

C. Changing Between the Two Models

Given the disadvantages of the hub-and-spoke model, it is reasonable to ask why the legacy carriers—even in bankruptcy—have not simply converted to a linear model. The reason the legacy airlines are unable to adopt the linear model is because their aircraft fleet is not suited for linear operations. Legacy airlines have invested millions of dollars in large, efficient aircraft such as the Boeing 747-400 and Boeing 777. American Airlines, for example, has 296 airliners that are larger than the typical linear carrier aircraft. If a mid-size A320 or Boeing 737 is optimal for non-connecting linear flights, then who is filling the remaining 100 or more seats on a large aircraft? These seats are filled by passengers connecting through to other destinations. If a legacy airline switched to a linear model with its existing aircraft, it would lose money when its large aircraft flew half-

53 GAO Profit, supra note 7, at 6 (“Low cost airlines do not yet offer service outside Canada, Central America, and the Caribbean.”).
54 Id. (“These [low-cost] airlines offer a simplified fare structure . . . .”).
55 Id. (explaining that their simplified fare structure is “attractive . . . because they do not have restrictive ticketing rules that make it significantly more expensive to purchase tickets within 2 weeks of the flight or make changes to an existing itinerary.”).
56 Id. at 5-6.
empty. But if it somehow switched to an all mid-size fleet, the legacy airline would abandon its one area of efficiency and expertise—flying large airliners on long-haul and international routes.

Even from a public policy viewpoint, it is not clear that legacy carriers should switch to a linear model. Smaller communities in the United States are largely served by regional airlines. Regional airlines' passengers depend on the ability to connect through to their destinations after reaching the nearest large airport. Forcing the legacy airlines into a mid-sized fleet on a linear model would harm smaller communities by taking away the ability to connect easily to the rest of the country. A true solution to the airline industry's problems must leverage the expertise and aircraft fleet already in place at legacy, linear, and regional airlines.

III. HOW FEDERAL LAWS SHAPE COMPETITION

Several important federal laws and regulatory regimes have shaped and contributed to the economic problems now facing the airline industry. The legacy of fare and route regulation, the bankruptcy code, the antitrust laws, the labor laws, and the pension laws have acted and interacted to affect the airline industry.

The Civil Aeronautics Board (“CAB”) regulated the fares and route structure of the airline industry from its infancy until deregulation in 1978. The United States General Accounting Office (“GAO”) finds that the “‘legacy’ airlines carried over the [high] cost structures that had been protected by price regulation.” The legacy airlines all adopted the costly hub-and-spoke network model, whereas the new airlines “employ the less costly point-to-point service model.” The legacy carriers probably adopted the hub-and-spoke system because it offered a way to cover their high cost structures through high prices, which are less painful to an organization than cost-cutting. Their adoption of the hub-and-spoke model led them to invest in large aircraft suited for aggregating connecting traffic.

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58 GAO BANKRUPTCY, supra note 1, at 4.
59 Id.
60 Id. at 5 (“Each of the legacy airlines adopted a hub-and-spoke network model that can be more expensive to operate than a simple point-to-point service model.”).
61 Id.
Even if the major airlines had attempted to cut costs after deregulation, it would have been difficult due to the effects of two other federal laws. The Employee Retirement Income Security Act ("ERISA") prevents employers from reducing vested benefits,\(^6^2\) so the pensions negotiated during CAB regulation must be paid with money earned in the lower-price deregulated market. The Taft-Hartley Act and other federal labor laws\(^6^3\) authorize collective bargaining and strikes. Once a generous package of wages, benefits, and work rules has been established under collective bargaining, adjusting that package to changing market conditions is difficult due to the threat of a strike. Other unionized industries that enjoyed long periods of prosperity, such as the steel and automotive industries, are facing similar problems with locked-in pension obligations and the "ratchet effect" caused by generous wage, benefit, and work-rules packages in prosperous prior years.\(^6^4\)

The legacy airlines have looked to the federal bankruptcy laws as a way to counterbalance the cost impact of the period of regulation and the labor and pension laws.\(^6^5\) In Chapter 11 bankruptcy, legacy airlines can reject aircraft leases,\(^6^6\) terminate pensions,\(^6^7\) reject labor agreements,\(^6^8\) reject contracts already signed,\(^6^9\) and pay pennies on the dollar to unsecured creditors.\(^7^0\) In U.S. Airways’ 2003 bankruptcy, the airline unloaded $2.1 billion in unfunded pension obligations onto the Pension Benefit Guarantee Corporation, a federal corporation.\(^7^1\) In United Airlines’ 2004 bankruptcy, employees agreed to wage


\(^{6^5}\) GAO Bankruptcy, supra note 1, at 59 ("Bankruptcy has become a well-traveled path by which some legacy airlines are seeking to shed some of their costs and become more competitive.").

\(^{6^6}\) 11 U.S.C. § 1110 (2006) (gives airlines a sixty day window to decide whether to reject aircraft leases, and prevents creditors from repossessing aircraft during that time).

\(^{6^7}\) GAO Bankruptcy, supra note 1, at 10 ("With the approval of the bankruptcy courts . . . companies may also modify retiree benefits.").


\(^{6^9}\) See id. § 1123 (allows bankruptcy plans to include rejection of executory contracts).

\(^{7^0}\) Id. (allowing impairment of unsecured claims).

\(^{7^1}\) Lassiter, supra note 64, at 946.
cuts of $2.5 billion per year.\textsuperscript{72} Using just the threat of bankruptcy, in 2004 Delta negotiated a 32.5\% cut in pilot wages.\textsuperscript{73}

However, the GAO’s “analysis of major airline bankruptcies shows mixed results in reducing costs while under bankruptcy.”\textsuperscript{74} Airlines like U.S. Airways and TWA have been through more than one Chapter 11 bankruptcy in a short timespan,\textsuperscript{75} showing that the court approved reorganization plan did not work. Despite the bankruptcy of five of the seven legacy airlines since deregulation,\textsuperscript{76} “[l]egacy airlines, as a group, have been unsuccessful in reducing their costs to become more competitive with low cost airlines.”\textsuperscript{77} Notably, even in bankruptcy, the legacy airlines did not propose changing their basic hub-and-spoke business model.

The airline industry has also been affected by lax enforcement of the federal antitrust laws. The Department of Transportation (“DOT”) approved all twenty-one mergers submitted during the 1980s.\textsuperscript{78} The mergers allowed the industry to become even more “highly concentrated” at the fifty largest airports, according to the Justice Department’s mathematical Herfindahl-Hirschmann Index test.\textsuperscript{79} In addition to allowing mergers, the DOT has failed to challenge the more recent wave of code-sharing agreements that tend to raise prices\textsuperscript{80} and consolidate the market for international travel.\textsuperscript{81} Perhaps because

\textsuperscript{72} Id. at 948.


\textsuperscript{74} GAO BANKRUPTCY, supra note 1, at 2.

\textsuperscript{75} Id. at 17.

\textsuperscript{76} Continental, Delta, Northwest, United, and U.S. Airways have filed for Chapter 11 bankruptcy. Alaska and American have not.

\textsuperscript{77} GAO BANKRUPTCY, supra note 1, at 7.

\textsuperscript{78} Dempsey, supra note 21, at 701 (“The Department of Transportation has been widely criticized for approving each of the 21 mergers submitted to it in the 1980s.”).

\textsuperscript{79} Id. at 693 (explaining that an HHI above 1800 is deemed highly concentrated. The weighted average concentration at the fifty largest airports rose from 2,217 in 1977 to 3,870 by 1998).

\textsuperscript{80} Id. at 697 (quoting Airline Competition Enhancement Act of 1989: Hearing on S.1741 Before the Subcomm. on Aviation of the S. Comm. on Commerce, Science, and Transportation, 101st Cong., 253 (1990) (statement of Kenneth M. Mead, Director, Government Accountability Office Transportation Division)) (“Carriers with a code-sharing agreement at one of the airports on a route charge fares almost 8\% higher than carriers do on routes on which they do not code share.”).

\textsuperscript{81} Dempsey, supra note 21, at 701 (“The DOT has also given major airlines antitrust immunity to form global code-sharing cartels, further concentrating the
of many complaints, the Justice Department has made attempts to enforce the laws against predatory pricing. However, legacy airlines have been able to preserve many dominated hubs at which twenty-four million consumers still pay about 41% more on average than at airports with low-cost competition.

The current legal model offers no real solutions for legacy airlines. Long ago, they adopted the hub-and-spoke model in an attempt to cover the costs imposed on them by CAB regulation. They cannot switch to a low-cost linear business model (even in bankruptcy) because their fleet of large aircraft would fly half-empty without hub-driven connecting traffic. Bankruptcy is at best a partial fix, allowing them to reduce certain legacy costs such as wages and pensions. Mergers offer them a way to gain market share and raise prices. However, legacy carriers will eventually lose that market share to low-cost linear airlines unless they adopt an illegal strategy of predatory pricing.

IV. THE CURRENT COMPETITIVE MODEL

The current economic problems facing the airline industry are the result of a clash between the linear model and the hub-and-spoke model. The linear model is based on low cost, but the hub model is based on pricing power. When businesses using these two models compete (and go through bankruptcy cycles), a pattern emerges that defines the current airline industry.

A. IF THERE WERE NO LINEAR MODEL AIRLINES

The financial problems of legacy carriers are not caused by competition between themselves. When they compete only with each other, the legacy airlines are able to charge high enough prices to cover their costs. A DOT study compared three markets where legacy carriers competed only with each other versus three similar markets where there was competition from linear

market for connecting traffic and depriving independent airlines the opportunity to compete for it.”).

82 Id. at 690 (explaining that between 1996 and 2000, thirty-two complaints of predatory behavior were filed).

83 Id. at 699 (giving an example: the Justice Department filed suit against American Airlines based on predatory pricing at its Dallas/Fort Worth hub, which was intended to drive low-cost rivals out of the market and preserve American’s ability to charge high prices at DFW over the long term).

84 HUB FARES, supra note 10, at 2.
model airlines. One-way fares were 213% higher when there was no competition from linear model carriers. The GAO estimates that legacy carriers’ operating costs are only 67% higher per seat-mile than the linear model carriers. Although this is a rough comparison, it shows that legacy carriers are able to command high enough prices to cover their costs when they do not have to compete with linear model carriers.

B. Hub Invasion and Defense

Linear model airlines are growing by invading the legacy carriers’ markets. “In 1998, low cost airlines operated in 31.5 percent of the markets served by legacy airlines, and provided a low-cost alternative to 72.5 percent of passengers. By 2003 . . . they operated in 45.5 percent of the markets . . . and provided a low cost alternative to 84.6 percent of passengers . . . .” Linear model airlines grew from a 23% share of total passenger traffic to 33% during the same period. Legacy airlines have lost $24.3 billion since 2000, while the linear model airlines have posted $1.3 billion in profit.

Sometimes, the linear model airline can establish a new route without provoking a price and capacity war with the incumbent legacy airline. This is most likely to happen when the linear airline has a very strong balance sheet, like Southwest Airlines. “Most major network carriers have learned that Southwest is too strong to beat, and do not enter into competitive battles with it.”

Linear airline JetBlue built a $128 million war chest before its first flight. As a result, “it has not been subjected to the predatory conduct described herein, for it is, quite simply, too financially strong to kill.”

However, the usual pattern of competition between linear model and hub model airlines is a predatory pricing war. Pro-

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85 Id. at 9.
86 Id.
87 GAO Profit, supra note 7, at 24 (“[B]y 2003, legacy airlines’ unit costs were 67 percent higher [than low-cost carriers on 1,000 mile stage lengths].”).
88 Id. at 43-44.
89 Id. at 44.
90 Id. at 94.
91 Dempsey, supra note 21, at 719 (quoting Robert Rowen of Reno Air: “If it’s a long-term player with a strong balance sheet like Southwest, they react moderately compared to a Kiwi or Reno Air.”).
92 Id.
93 Id. at 690 n.4 (citing Lorraine Woellert, Take Airline Reform Off Standby, Bus. Wk., Jan. 24, 2000, at 50).
fessor Paul Stephen Dempsey, in the Journal of Air Law and Commerce, described it as follows:

1. Major airline establishes dominance at airport serving major city.
2. Dominance allows major airline to price well above competitive levels.
3. When a new entrant attempts to enter a major airline’s hub, dominant airline responds with below-cost pricing, capacity dumping, and/or a number of other predatory practices until the new entrant is driven out.
4. Once the new entrant is driven out of the market, dominant airline raises prices to levels sometimes higher than those prevailing before the new entrant attempted entry.94

The Department of Justice ("DOJ") also concluded that legacy airlines use predatory practices to defend hubs. The DOJ prosecuted American Airlines for the following 1996 predatory behavior:

[W]hen an LCC [low cost carrier] entered a DFW [Dallas/Ft. Worth International Airport] route and it appeared that the LCC would be economically viable if American simply followed a profit-maximizing business strategy, American would instead saturate the route with enough additional capacity at low fares to keep the entrant from operating profitably.95

The DOJ concluded that the purpose and effect of this strategy was to drive out the low-cost rival so that American could raise fares again.96

This predatory behavior is the best explanation for ticket prices that tend to "frustrate consumers because they appear to be neither predictable nor rational."97 Since airlines’ costs are relatively stable, wildly fluctuating prices are probably caused by predatory pricing rather than normal price-setting based on cost.

C. LEGACY AIRLINES USE BANKRUPTCY TO RETRENCH

If the low-cost entrant withstands the predatory conduct, the legacy airline permanently loses pricing power in that market.98

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94 Dempsey, supra note 21, at 736.
95 Id. at 699-700.
96 Id. at 700.
97 Rollman, supra note 4, at 392.
98 HUB FARES, supra note 10, at 9 ("We have repeatedly demonstrated the large reduction in prices that typically follows entry by a low-fare carrier in markets with a history of high average fares . . .").
However, the legacy airlines will have some dominated hubs and monopoly routes on which they can still charge a high price. When this “mix” of low-price and high-price fares fails to cover the legacy carrier’s overall cost structure, the carrier must file a Chapter 11 bankruptcy to reduce costs.

The DOT describes the legacy carriers’ prospective cost reduction process as follows: “[L]arge network air carriers will (1) retrench to primary hubs, (2) downsize secondary hubs, (3) convert secondary hub service from an overwhelming reliance on large jet aircraft to a fleet comprised primarily of regional jet aircraft, or (4) eliminate some network hubs.” The DOT study gives three typical examples of airlines downsizing or eliminating secondary hubs related to bankruptcy: U.S. Airways at Pittsburgh, United Airlines at San Francisco, and American Airlines (TWA bankruptcy) at St. Louis. Dominated “primary” hubs such as United’s Chicago hub and American’s Dallas/Fort Worth hub are less vulnerable to downsizing.

GAO data shows that the legacy carriers are achieving their cost reductions primarily through capacity reduction (becoming smaller) rather than unit cost reduction (becoming more efficient). This is further evidence that the legacy airlines are shrinking in size but unable to change their underlying cost structure. The reason legacy carriers will downsize or abandon secondary hubs is because they have lost the dominant market share needed to charge high prices there. They will use bankruptcy to retrench to their primary hubs, where they still dominate and can still charge high enough prices to cover their high costs. Unable to convert to a low-cost linear airline model today, the legacy carriers are using bankruptcy to postpone the need for change. However, they will have to return to bankruptcy—perhaps more than once—as they continue to downsize and retrench.

D. CONSUMERS AND TAXPAYERS LOSE

The current competitive model in the airline industry is harmful to consumers and taxpayers. Consumers at dominated

100 Id. at 7-8.
101 Id. at 12.
102 GAO Profit, supra note 7, at 3 (explaining that legacy airlines reduced expenses 14.5% between 2001 and 2003, but this was accompanied by a 12.6% reduction in seat capacity. “Despite the cost-cutting efforts of legacy airlines over the last couple of years, legacy airlines’ unit costs have not been reduced . . . ”).
hubs pay significantly higher fares with no increase in service quality. Wildly fluctuating prices elsewhere, due to predatory price wars between legacy and linear airlines, are a burden to consumers who must spend more time price-shopping and plan their travel dates based on artificial price changes. Consumers at hub airports face frequent delays and artificial congestion caused by hubbing. This artificial congestion creates a need for more runways and terminals that cost taxpayers. Perhaps most importantly, new runways now take ten to twenty years to plan and construct, so we may be unable to add enough capacity to overcome projected congestion under the hub system.

V. PROPOSED COMPETITIVE MODEL OF MIXED OPTIMIZATION

This section proposes a new model of competition which will eliminate the economic and public policy problems caused by the current competitive model. The new model is discussed along with means to implement it using either a new statute or existing federal regulatory and antitrust laws.

A. DEFINING MIXED OPTIMIZATION

Mixed optimization essentially involves two changes to the current system. The first change is to prohibit airlines from making the ticket price on one flight dependent on whether a

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103 HUB FARES, supra note 10, at 3 (“The four rationales commonly used to explain away high fares in hub markets—passenger mix, operational cost, quality of service, and the Southwest Effect—only apply if price competition is not present. It is the lack of price competition, not the rationales listed, that explain high prices at hub markets.”).
104 Rollman, supra note 4, at 392.
105 Mayer & Sinai, supra note 6, at 1197 (“hub airports will have more traffic and greater delays than non-hub airports of equivalent size and with equal local demand.”).
107 Challenges Associated with Building New Runways: Hearing Before the Subcomm. on Aviation of the Comm. on Transportation and Infrastructure, 106th Cong. 13 (2000) (statement of John J. Duncan, Jr., Subcomm. Chairman) (“In the last decade, aircraft departures increased by about 30 percent, airline passengers increased by 40 percent, and air cargo increased by an astounding 90 percent. Yet during that time [the 1990s], . . . the Department of Transportation says that only five new runways were added at large airports.”).
customer purchases a seat on a connecting flight. Airlines today charge much more for tickets purchased separately than for the same route purchased as a connecting flight. For example, the author recently priced a trip from Memphis to Salt Lake City. Buying the complete trip from American Airlines through its Dallas hub cost $431. But buying tickets on the same flights separately cost $391 and $353, for a total of $744. Under mixed optimization, the cost would have been identical for both quotes.

The second change required under mixed optimization is to require airlines to interchange bags with every other airline. It is clearly feasible for competing airlines to interchange bags for connecting passengers, since they already do this today for their code-sharing partners. This change will require detailed regulatory implementation. However, the airline industry is already highly regulated and used to working closely with United States Department of Transportation regulators. In addition, the agency will be able to model its regulations on successful private code-sharing agreements to ensure fairness and feasibility.

From a consumer point of view, mixed optimization will look a lot like the current system of code-sharing. A consumer will buy a single ticket for a route between his origin and destination, but the route may include two or more airlines during different legs of the trip. The consumer will check baggage on his first flight and pick it up from the carousel at his destination without the need to retrieve and re-check bags at intermediate stops. So, from the consumer’s perspective, it will look as if all carriers simply agreed to do code-sharing with each other.

B. Technology Enables Mixed Optimization

Advances in technology since deregulation in 1978 make mixed optimization feasible. In particular, consumers today can connect directly to computerized reservation systems and bags can be tracked using wireless inventory systems.

1. Computerized Reservation Searching

The current hub-and-spoke system makes searching easy by restricting choices. For example, there are only a few practical choices for a flight from Memphis to Salt Lake City. You can fly United through Denver, American through Dallas/Fort Worth,
or Northwest through Minneapolis. There is little reason to investi-
gate mixed itineraries, such as flying Northwest to Phoenix and
then completing the trip on Delta, since they are almost cer-
tain to be more expensive. The practical searching al-
gorithm is to request a quote from each carrier that serves both
cities and accept whatever routing and connections they happen
to offer. A consumer with a pencil, paper, and a telephone can
effectively use this algorithm by calling each of the airlines
directly.

Mixed optimization offers more and better choices to the con-
sumer, but the sheer number of choices could make searching
more difficult. To be sure of getting the best price (or the best
compromise between cost and travel time), a consumer would
need to check every combination of flights that starts out in the
origin city and ends in the destination city. Assuming a passen-
ger has three potential flights from each of three airlines con-
necting through each of the fifty largest airports, there are 450
possible itineraries. This number grows exponentially as more
stops or more choices at each stop are added. There is no way
for a consumer, armed only with a pencil and a telephone, to
compare this bewildering array of options.

Only a computerized search system can find the best needle
in this haystack of potential choices. But this is no longer a
problem. Computerized systems have been available to travel
agencies for more than fifteen years, and for almost ten years
consumers have been able to connect directly to powerful in-
ternet search and reservation systems like Travelocity and Ex-
pedia. So the consumer with only a pencil and a telephone can
have a travel agency do the computerized search, while an in-
ternet-savvy consumer can perform the computerized searching
himself.

Of course, the website providers and travel agencies would
have to reprogram their database structures and search logic af-
after mixed optimization. There would be many more connec-
tions available, but only one price per flight leg offered at any
given time. Since pricing becomes less complex while connec-
tions become more complex, it appears that the overall com-
plexity of the programming should be roughly the same as
today. The programmers could also reduce complexity by elimi-
nating choices that are obviously impractical. A practical search
algorithm for domestic flights might eliminate routes that
double the distance traveled and routes involving more than two
connections. A practical search algorithm might also eliminate
flights with connection waiting times over five hours and total travel times over twelve hours. These or similar limitations on search scope will reduce programming complexity and computer hardware cost with very little loss of practical choice to the consumer.

In the previous Memphis to Salt Lake City example, a consumer would still consider the United flights connecting through Denver, but also all other potential connections through Denver. Denver is an ideal connection since it adds less than 1% to the mileage compared to traveling nonstop. Mixed connections through Kansas City (4% increase in mileage), St. Louis (12% increase), and Dallas/Fort Worth (13% increase) should be considered. Connections through New York City (206% increase) or Honolulu (568% increase) are probably not worth investigating, even for a computer.

After eliminating clearly impractical choices, travel agencies and websites will present the best choices to consumers by using a detailed profile for each consumer. For example, the profile could list the relative importance of reducing travel time, reducing cost, reducing the number of stops, increasing amenities, and decreasing delays. The available flights would be sorted so that the most preferable itineraries appear at the top. The consumer who is looking for a first-class seat on a nonstop flight should not have to look through a long list of two-stop routes on low-cost carriers that only offer coach.

2. Wireless Tracking of Luggage

The second technological advancement that enables mixed optimization is wireless tracking of luggage. Mixed optimization depends on airlines' cooperation with each other to exchange bags in a quick and reliable manner. If airlines could offer excellent bag-interchange on their own connections and terrible bag-interchange on connections to other carriers, they could discourage consumers from scheduling routes that included multiple airlines. However, today it is feasible to combine wireless inventory tracking with airline-specific operational rules to create a fair and enforceable system of bag interchange.

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109 Calculated by the author using great-circle routing on AOPA's Real Time Flight Planner software.

110 Id.

111 Id.
Wireless inventory tracking systems, commonly known as Radio Frequency Identification ("RFID") systems, have sensors mounted in the ceiling above a store or warehouse.\textsuperscript{112} They send and receive signals from inexpensive RFID "barcodes" attached to items of inventory.\textsuperscript{113} For example, a computerized inventory system can count the items of inventory in stock and track their movement and location within a warehouse.\textsuperscript{114} Airports and airlines are beginning to use this system today.\textsuperscript{115}

Under mixed optimization, each airport would create a large bag interchange area. This area would be subdivided into zones for each airline. When a consumer connects from one airline to another, bag handlers for the "inbound" flight will move the bag to the outbound airline's zone within the interchange area. Then, workers from the outbound airline will pick up the bag and load it on the appropriate outbound flight.

The new bag interchange system creates two new failure modes. First, the inbound airline could be late in moving the bag to the interchange area. Second, the inbound airline could take the bag to the wrong outbound carrier's interchange zone. (Two other failure modes already exist today: the outbound carrier could be late in loading the bag onto the outbound flight, and the outbound carrier could load the bag onto the wrong flight.) An appropriate set of deadlines and penalties, based on RFID data, can ensure that bags reach their customers at least as well as today.\textsuperscript{116}

\textsuperscript{113} Id.
\textsuperscript{114} Id.
\textsuperscript{115} IBM BUSINESS CONSULTING SERVICES, THE UNTOLD RFID STORY 4 (2004), http://www.ibm.com/industries/wireless/doc/content/bin/Product_Innovation_in_Electronics.pdf (Las Vegas McCarran Airport will soon require all bags to be tracked using RFID).
\textsuperscript{116} The RFID system can determine who is at fault when a consumer doesn't get his or her bag at the destination. By polling the RFID tags each minute, the wireless inventory system can create a record of the time each bag entered an airline's interchange zone. This information shows whether the inbound airline brought the bag to the right outbound carrier's interchange zone on time. If so, any of the other failure modes are the fault of the outbound carrier.

Knowing who is at fault does not solve the problem of returning lost or misrouted bags to the customer. The correct approach is to make the destination airline responsible for getting the bag to the customer. The customer should have only one point of contact for resolving complaints—it is not feasible for customers to deal with two or three airlines who each insist that the lost bag is the other airline's problem. It is much more feasible to ask the baggage personnel
Mixed optimization will produce profound and permanent change in the airline industry. It will give the legacy airlines a practical alternative to the hub-and-spoke system, ending the problems hubs are causing for consumers and for the industry. Under mixed optimization, airlines will specialize according to their existing areas of expertise and fleet mix.

The most immediate industry change will be a breakup of the relationship between regional airlines and legacy carriers. For example, Great Lakes regional airline transports passengers from around the Great Plains region into United’s Denver hub. On arrival, these passengers connect to their destinations on United flights only—it would be cost prohibitive to recheck baggage and connect on a different airline. However, under mixed optimization, the Great Lakes passengers will connect to outbound flights on many different airlines. It seems unlikely that United will continue paying Great Lakes on a per-flight contract basis when United derives no special benefit from the Great Lakes flights. Similarly, the other legacy carriers will end their contracts with their partner regional airlines.

The regional airlines will grow under mixed optimization, despite the loss of their contracts with the legacy carriers. Regional airlines’ passengers will have many more connecting flights and final destinations to choose from, since they will be able to connect to any airline upon reaching the large airports. This will lead to higher passenger loads on the regional airline flights. The regional airlines have a competitive advantage and considerable experience in bringing passengers from smaller communities to large airports using smaller aircraft; they will simply become more successful in this niche.

The legacy airlines will specialize in flying large aircraft on long-haul and international routes. Because large aircraft on long routes have the lowest costs per seat-mile, the legacy airlines will become cost-competitive on these routes if they dismantle their expensive hub-and-spoke networks. Under mixed optimization, they will no longer need the hub-and-spoke net-
work to generate enough traffic to fill these large aircraft—they can draw connecting traffic from all airlines serving the large airports. So, under mixed optimization the legacy carriers will abandon the hub-and-spoke system and start to undercut today’s “low cost” airlines on routes that support large-aircraft service.

The legacy carriers will also use their long-range aircraft to offer nonstop flights that the low cost airlines (flying medium-range aircraft) cannot duplicate. Legacy carriers will charge a premium for these flights, since consumers are willing to pay more for a nonstop flight than a comparable one-stop flight. The legacy carriers also have decades of experience in providing long-range international service. There is no indication that the low-cost carriers intend to challenge them in these markets. So the legacy airlines’ expertise in operating and maintaining large, long-range aircraft and flying international routes will provide them with a profitable specialization.

The cost-efficient linear model airlines flying midsize aircraft will specialize in providing capacity wherever prices are high. In the past, linear airlines focused on high-density routes. That strategy makes sense if passengers cannot connect to a different carrier’s flights. However, passengers under mixed optimization will be able to connect on a legacy or regional carrier without a cost penalty. So, under mixed optimization, the linear model airlines can apply their operational excellence to any route.

For linear model airlines, high prices on a route are a signal that they should begin low-cost service along that route without considering whether the passengers are connecting or nonstop. (Of course, as capacity increases price will decrease.) Therefore, today’s linear model airlines and their midsize aircraft will fill in the gaps in capacity, ensuring that no airline has excessive market power or pricing power along any route.

The mixed optimization model offers opportunities for each type of airline—legacy, linear, and regional—based on their current expertise and fleet mix. By eliminating an unnecessary constraint (the inability to switch airlines enroute), more opportunity is available to all. The artificial congestion, delays, and high prices of the hub system (as well as the cycle of bankruptcy and retrenchment to primary hubs) will disappear.

The only negative impact to consumers from the mixed optimization system will be an increase in scheduled layover length. With airplanes arriving and departing at more evenly spaced times throughout the day, scheduled layovers will be longer than under the hub system. However, unscheduled de-
lays will be reduced. The author believes most consumers will accept this tradeoff. But airlines will offer nonstop flights to accommodate the consumers willing to pay for the time savings. In either case, the bait-and-switch of hub connections that are short in schedule but long in practice will end.

D. Legal Implementation of Mixed Optimization

There are two basic methods for the federal government to implement mixed optimization in the airline industry. The most clear-cut and powerful method is for Congress to amend the Airline Deregulation Act directly. The first alteration would prohibit airlines from making the ticket price on one flight dependent on whether a customer purchases a seat on a connecting flight. The second alteration would authorize the Secretary of Transportation to promulgate and enforce rules for mandatory bag interchange between airlines. Both of these alterations fall under Congress's authority to regulate interstate and foreign commerce. Since they are far less intrusive than the prior CAB fare-and-route regulation, they should withstand any constitutional challenge in court.

The alternative method depends on the Secretary of Transportation's power to regulate unfair methods of competition under Section 41712 of the Federal Aviation Act.117 Under the Airline Deregulation Act of 1978 (as well as several of its predecessors), the airlines are not subject to Federal Trade Commission regulation of unfair methods of competition.118 Instead, Congress provided a separate avenue of DOT enforcement.

The first relevant provision reads, "On the initiative of the Secretary of Transportation . . . and if the Secretary considers it is in the public interest, the Secretary may investigate and decide whether an air carrier . . . is engaged in an unfair or deceptive practice or an unfair method of competition in air transportation."119 The second relevant provision reads, "If the Secretary, after notice and an opportunity for a hearing, finds that an air carrier . . . is engaged in an unfair or deceptive prac-

118 Dempsey, supra note 21, at 791 (“Every other industry in our economy is subject to the oversight of the Federal Trade Commission. Airlines are not. Nor are airlines subject to the deceptive practices regulation of the states, under the broad construction of the preemption provisions of the Airline Deregulation Act of 1978.”).
tice or unfair method of competition, the Secretary shall order the air carrier . . . to stop the practice or method."\textsuperscript{120}

If the Secretary of Transportation implements mixed optimization in order to prevent unfair competition for connecting traffic, the *Chevron* standard will apply to his decision. Under *Chevron*:

If Congress has explicitly left a gap for the agency to fill, there is an express delegation of authority to the agency to elucidate a specific provision of the statute by regulation. Such legislative regulations are given controlling weight unless they are arbitrary, capricious, or manifestly contrary to the statute.\textsuperscript{121}

Because of the standard of *Chevron* deference, any legal challenge to mixed optimization would face an uphill battle. However, it is not clear what interest groups would have a vested interest in opposing mixed optimization. Admittedly, all three categories of airlines (legacy, regional, and linear) would face dramatic changes as a result of mixed optimization. But the changes appear to offer the legacy airlines a way to escape their downward spiral while also offering linear and regional airlines a broader arena to expand and compete.

In the final analysis, mixed optimization offers benefits to consumers, taxpayers, and airlines. It can be thought of as a technology-enabled extension of the original airline deregulation, creating competition on every segment of every trip. It can be implemented either by Congress or by the DOT; either implementation should withstand legal challenge.

\textsuperscript{120} *Id.*
